AXIS MEGA DISTRIBUTION CENTRE

OPERATION & MAINTENANCE MANUAL

ELECTRICAL AND ELV SERVICES

REVISION 1.1

DEVELOPER:
RHB TRUSTEES BERHAD
(AS TRUSTEE FOR AXIS REIT)
LEVEL 11, TOWER ONE,
RHB CENTRE, JALAN TUN RAZAK,
50400 KUALA LUMPUR.

ARCHITECT:
KOOI KEAT ARCHITECT
NO.19, TAMAN BUKIT DUMBER,
11600 PENANG.

CIVIL & STRUCTURAL ENGINEER:
WK & PARTNERS CONSULT SDN BHD
NO.C-8-1, PUTRA WALK, JALAN PP 25,
TAMAN PINGGIRAN PUTRA,
43300 SERI KEMBANGAN, SELANGOR.

MECHANICAL & ELECTRICAL ENGINEER:
HAN YANG CONSULTANCY SDN BHD
12-B, MEDAN ANGSANA 2,
11500 BANDAR BARU AYER ITAM,
PULAU PINANG.

FIRE FIGHTING ENGINEER:
FIG CONSULTANCY SDN BHD
UNIT 12-4, 4TH FLOOR,
JALAN 3/114, KUCHAI BUSINESS CENTER,
OFF JALAN KUCHAI LAMA,
58200 KUALA LUMPUR.

QUANTITY SURVEYOR:
PERUNDING KOS CSS
NO.47 & 49-4-1 & 2, JALAN 1/62D,
BANDAR MENJALARA,
52200 KUALA LUMPUR.

MAIN CONTRACTOR:
AME CONSTRUCTION SDN BHD
NO.18, JALAN ANGKASA MAS 6,
KAWASAN PERINDUSTRIAN TEBRAU 2,
81100 JOHOR BAHRU, JOHOR.

ELECTRICAL CONTRACTOR:
KEJURUTERAAN BROAD-WAY SDN BHD
29, JALAN JINTAN,
TAMAN SUPREME, CHERAS
56100, KUALA LUMPUR.

GENERAL SAFETY PRECAUTIONS

- Never wear metal jewellery such as rings or watches when working on the electrical equipment.
- Use only appropriate tools and test equipment when performing maintenance work.
- Use appropriate personal protective equipment.
- Report any near misses or dangerous occurrences to the immediate supervisor.
- Stop and remove power supply from the equipment prior to perform the maintenance.
- Warning signs at the electrical sources must be prominently displayed throughout the maintenance period.
- Dislocation of fire extinguishers not allowed.
- Smoking is strictly prohibited in the Control Room.
- Only certified and authorised person are allow to perform the risky tasks.

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1.0 GENERAL OVERVIEW

1.1 INTRODUCTION

This manual describes all the Low Voltage (LV) and Extra Low Voltage (ELV) Services Operating and Maintenance requirements relating to AXIS MEGA DISTRIBUTION CENTER (AMDC).

The ELV system and components used in AMDC had past the pre-test before the system started up. Followed by, Testing and Commissioning (T&C) stages before handing over the services to ensure the provided system and components are safe and fulfill the requirements. All the test report had been compiled in this O&M.

For safety reason, there are some precaution steps needed to follow before, during and after the maintenance and operation.

1.2 OBJECTIVE

This Operating and Maintenance Manual has been prepared to provide guidance and recommendations to assist:

a) Users of the building
b) Managers of the building and services
c) Employees, (both directly employed staff and contractors), who carry out maintenance, repair or new works within the building.

in the understanding, running and maintenance of the services installed.

1.3 CONTENTS

To obtain the most benefit from this manual, it must be read in conjunction with all related documents located in the other related Sections of this manual as well as Health and Safety File.

In addition to the documentation directly related to the systems covered by this manual, other inter-related documentation may need to be consulted to obtain a more comprehensive understanding of not only the service or plant in question but also it is possible effect on other services and areas. These documents will be included within the suite of documents forming the Health and Safety File and include building structure and fabric information and electrical services.

It is essential that all aspects of Health and Safety, relating to the task, are understood prior to carrying out maintenance works.

The manual has been produced in sections with each section of the manual detailing the different aspects of the operation and maintenance requirements. These sections are as follows:

Chapter 1: General Overview
Chapter 2: List of equipment installed with spare part numbers
Chapter 3: Catalogue & Operation Manual
Chapter 4: Warranty Certificate & Authorities letter
Chapter 5: Test report/user acceptance test
Chapter 6: As Built Drawing

2.0 LIST OF EQUIPMENT INSTALLED WITH SPARE PART NUMBERS

2.1 GENERAL ELECTRICAL SERVICES COMPONENTS

ITEMS	MODEL	BRAND
GI PIPE	-	SOUTHERN PIPE
PVC CONDUIT	WIREMAN	MEGAPOWER
METAL TRUNKING / TRAY / LADDER	-	UNITED U-LI
UNDERFLOOR TRUNKING		UNITED U-LI
CABLE	PVC, XLPE/PVC, XLPE/SWA/PVC	MEGA CABLE
LSOH CABLE	MICA/LSHF/LSFH	OLYMPIC CABLE
METAL CLAD SWITCHES AND SOCKET OUTLET	CLIPSAL	SCHNEIDER
PVC SWITCHES AND SOCKET OUTLET	BELANKO	LEGRAND
FIREMAN SWITCH		MK
ISOLATOR	KAVACHA WHT 35	SCHNEIDER
KELUAR SIGN	SURFACE MOUNT	JUMBOHAN
EMERGENCY LIGHT	TWIN LIGHT/ RECESSED TYPE	JUMBOHAN

2.2 HIGH TENSION

ITEMS	MODEL	BRAND
HT CABLE	3C XLPE/SCT/PVC ALU.	OLYMPIC CABLE
VCB	SCHNEIDER	SCHNEIDER
RMU	RM6	SCHNEIDER
TRANSFORMER	1250KVA ONAN	MTM

2.3 SWITCHBOARD COMPONENET

ITEMS	MODEL	BRAND
COMBINED OVERCURRENT AND EARTH-FAULT RELAY	SPAJ 140 C	ABB
LED INDICATOR	LED	AMICO
SELECTOR SWITCH	AC1/ AC3	ANDRASS
FUSE HOLDER	FH-10C	ANDRASS
SURGE ARRESTOR	ESP 415 M2	FURSE
CAPACITOR		FRAKO
CONTACTOR	SC SERIES	FUJI
FUSE SWITCH	TYPE FN	LARSEN & TOUBRO
METER		LEGRAND/ MH
HARMONIC FILTER CIRCUIT REACTOR		LETRIMATIK
PSUH BUTTON, SELECTOR	DIN SERIES	MACK
CURRENT TRANSFORMER		MH
EARTH FAULT RELAY	MK201A	MIKRO
EARTH LEAKAGE RELAY	MK301A	MIKRO
POWER FACTOR REGULATOR	PFR140	MIKRO
SURGE PROTECTION DEVICE	MMP C + CN SERIES	FURSE
MONITORING RELAY	MX200	MIKRO
TIME SWITCH		NEM
DIGITAL POWER METER	PM1200	SCHNEIDER
AUTO TRANSFER SWITCH	ATYS 3	SOCOMEC
ISOLATOR	SIRCO	SOCOMEC
AIR CIRCUIT BREAKER	AR220S	TERASAKI
MINIATURE CIRCUIT BREAKER	TECS DIN MODULAR	TERASAKI
MOULDED CASE CIRCUIT BREAKER	TEMPOWER 2	TERASAKI

2.4 GENSET

ITEMS	MODEL	BRAND
DIESEL ENGINE	6DWD-430	DAEWOO
ALTERNATOR	ECO 40-1S/4	MECC ALTE

2.5 LIGHT FITTING

ITEMS	MODEL	BRAND
200W HIGHBAY	HBL200G2	DAVIS
100W HIGHBAY	HBL100G2	DAVIS
200W FLOOD LIGHT	VOLUX-FL200-LED	VOLUX
100W FLOOD LIGHT	LED Flood Light EcoMax II-100W	OPPLE
100W COMPOUND LIGHT	SBLED-10B	VOLUX
30W SURFACE DOWNLIGHT	DLMF-8-30W	DAVIS
TOILET DOWNLIGHT	DA235	DAVIS
WEATHER PRROF BARE CHANNEL	WPLT440	DAVIS
BARE CHANNEL	ACS435TBD	DAVIS
WIREGUARD BARE CHANNEL	PBD435DLS4K	DAVIS
2’ X 2’ OFFICE LIGHTING	PLW240	DAVIS
2’ X 4’ OFFICE LIGHTING	PL440	DAVIS
COMPOUND LIGHT POLE	FLANGE TYPE 6m / 8m	LYSAGHT

2.6 PA SERVICES

ITEMS	MODEL	BRAND
Emergency Paging Panel	EP1200A	AMPERES
PRE-AMPLIFIER MIXER	MX2222	AMPERES
POWER AMPLIFIERS	PA2480	AMPERES
CHANGEOVER & MONITORING	AX3800	AMPERES
AMPLIFIER MONITOR PANEL	AM4120	AMPERES
24 DC AUTOMATIC BATTERY CHARGER	BC9740	AMPERES
SPEAKER VOLUME CONTROLLERS	VC7000	AMPERES
CEILING SPEAKER	CS515	AMPERES
SURFACE MOUNT SPEAKER	DV410	AMPERES
HORN SPEAKER	HS815	AMPERES
ANALOGUE PAGING MIC	PM1060	AMPERES
SEQUENTIAL POWER SWITCHER	SQ9715	AMPERES
SELECTOR & DATA DECODER	ZS5122	AMPERES
CD/MP3/AM-FM TUNER		SHERWOOD

3.0 CATALOGUE & OPERATION MANUAL

Southern Pipe



ISO 9002

ISO 9002

ISO 9002

FULFILLING THE NEEDS OF A DEMANDING ECONOMY



Head Office (Butterworth Plant)

Southern Pipe Industry (M) Sdn. Bhd. is currently one of the biggest steel pipe manufacturers in Malaysia. Its sales revenue ascended to more than RM 200 million while annual production capacity exceeded 200,000 mt. At present, Southern Pipe Industry (M) Sdn. Bhd. has expanded into two steel pipe factories. The main plant is located in Butterworth, Seberang Prai Utara, Penang, while the other plant is located in Nibong Tebal, Seberang Prai Selatan, Penang. Manufacturing activities are carried out at both these two plants. Strategically located near the Butterworth Port to facilitate exports throughout South East Asia, Hong Kong, Taiwan, Japan, Australia, Europe and the United States of America, we aim to be a leading exporter in the ASEAN region.

PRODUCTS

PRODUCT	CLASSIFICATION	STANDARD SPECIFICATION		APPLICATION
Circular Hollow Section	Carbon Steel Tubes For Ordinary Uses, Water Piping and Structural Purposes	BS 1387 SS 17 (Pg. 12)	Light Medium Heavy	City & Industrial Water, Irrigation & Agriculture Water, Oil and Gas Supply, Sprinkler & Fire Fighting Piping, Ship Piping, Sewage & Drainage Piping, Civil Engineering, Steel Towers, Furniture, etc.
		ASTM A 53 (Pg. 14)	Grade A	
		JIS G 3452 (Pg. 16)	SGP	
	Carbon Steel Tubes For Water and Sewage Purposes	BS 534/MWA (Pg. 17)		City & Industrial Water, Irrigation & Agriculture Water, Sewage & Drainage Piping, etc.
	Carbon Steel Tubes For Machine Structural Purposes	JIS G 3445 (Pg. 18)	STKM 11 A	Bicycles, Vehicles, Machineries, etc.
	Carbon Steel Tubes For General Structural Purposes and Scaffolding	JIS G 3444 (Pg. 20)	STK 290 STK 400 STK 490 STK 500 STK 540	Civil Engineering, Architecture, Steel Towers, Scaffoldings, Piles, Struts and other structures.
	Carbon Steel Tubes For Scaffolding	BS 1139 (Pg. 22)		Falsework and Working Scaffolds
	Carbon Steel Tubes For Structural Purposes (AA Pipes)	SPIM B 100 (Pg. 23)		Ordinary Uses, Light Support, etc.
Square and Rectangular Hollow Section	Carbon Steel Tubes For General Structural Purposes	ASTM A 500 (Pg. 24)	Grade A	Buildings, Bridges, Bicycles, Vehicles, Machineries, Lamp Posts, Hand Rails, Furniture Pipes, Escalators, Elevators, Containers Structures & all other supports, etc.
			Grade B	
Light Gauge Lipped Channel	Light Gauge Lipped Channel	SPIM C 100 (Pg. 28)		Special Profiles for Building Structural Purposes, Civil Engineering, Building Construction, etc.
Cold Rolled Products (Circular, Square & Rectangular)	Cold Rolled Products	SPIM B 103 SPIM A 100 (Pg. 30)		Furniture, Construction, Engineering, Electrical Appliances, etc.
Window Pipes	Window Pipes	SPIM B 102 (Pg. 32)		Window Piping

We provide Slitting, Tubing & Hot-Dip Galvanizing Services. We also customize tubing products.

NOTE: All the tables shown are for reference only.

Carbon Steel Circular Hollow Section

For Ordinary Uses, Water Piping And Structural Purposes
BS 1387 : 1985
SS 17 : 1996

CLASS	NOMINAL SIZE		OUTSIDE DIAMETER				WALL THICKNESS		MASS OF BLACK TUBE						NUMBER OF THREADS PER INCH	BUNDLING
			MAXIMUM		MINIMUM				PLAIN ENDS			THREADS & COUPLING				
	in	mm	in	mm	in	mm	in	mm	kg/m	kg/ft	lb/ft	kg/m	kg/ft	lb/ft		Pieces
LIGHT	1/2	15	0.843	21.4	0.827	21.0	0.079	2.0	0.947	0.289	0.636	0.956	0.291	0.642	14	91
	3/4	20	1.059	26.9	1.039	26.4	0.091	2.3	1.38	0.421	0.927	1.39	0.424	0.934	14	91
	1	25	1.331	33.8	1.307	33.2	0.102	2.6	1.98	0.603	1.331	2.00	0.610	1.344	11	91
	1 1/4	32	1.673	42.5	1.650	41.9	0.102	2.6	2.54	0.774	1.707	2.57	0.783	1.727	11	44
	1 1/2	40	1.906	48.4	1.882	47.8	0.114	2.9	3.23	0.984	2.171	3.27	0.997	2.198	11	44
	2	50	2.370	60.2	2.346	59.6	0.114	2.9	4.08	1.244	2.742	4.15	1.265	2.789	11	44
	2 1/2	65	2.992	76.0	2.961	75.2	0.126	3.2	5.71	1.740	3.837	5.83	1.777	3.918	11	19
	3	80	3.492	88.7	3.461	87.9	0.126	3.2	6.72	2.048	4.516	6.89	2.100	4.630	11	19
	4	100	4.484	113.9	4.449	113.0	0.142	3.6	9.75	2.972	6.552	10.0	3.048	6.721	11	10
MEDIUM	1/2	15	0.854	21.7	0.831	21.1	0.102	2.6	1.21	0.369	0.813	1.22	0.372	0.820	14	91
	3/4	20	1.071	27.2	1.047	26.6	0.102	2.6	1.56	0.475	1.048	1.57	0.479	1.055	14	91
	1	25	1.346	34.2	1.315	33.4	0.126	3.2	2.41	0.735	1.620	2.43	0.741	1.633	11	91
	1 1/4	32	1.689	42.9	1.657	42.1	0.126	3.2	3.10	0.945	2.083	3.13	0.954	2.104	11	44
	1 1/2	40	1.921	48.8	1.890	48.0	0.126	3.2	3.57	1.088	2.399	3.61	1.100	2.426	11	44
	2	50	2.394	60.8	2.354	59.8	0.142	3.6	5.03	1.533	3.380	5.10	1.554	3.427	11	44
	2 1/2	65	3.016	76.6	2.969	75.4	0.142	3.6	6.43	1.963	4.328	6.55	1.996	4.402	11	19
	3	80	3.524	89.5	3.469	88.1	0.157	4.0	8.37	2.551	5.625	8.54	2.603	5.739	11	19
	4	100	4.524	114.9	4.461	113.3	0.177	4.5	12.2	3.718	8.199	12.5	3.810	8.401	11	10
	5	125	5.535	140.6	5.461	138.7	0.197	5.0	16.6	5.095	11.156	17.1	5.212	11.492	11	5
	6	150	6.539	166.1	6.461	164.1	0.197	5.0	19.7	6.004	13.239	20.3	6.187	13.643	11	10
HEAVY	1/2	15	0.854	21.7	0.831	21.1	0.126	3.2	1.44	0.439	0.968	1.45	0.442	0.974	14	91
	3/4	20	1.071	27.2	1.047	26.6	0.126	3.2	1.87	0.570	1.257	1.88	0.573	1.263	14	91
	1	25	1.346	34.2	1.315	33.4	0.157	4.0	2.94	0.896	1.976	2.96	0.902	1.989	11	91
	1 1/4	32	1.689	42.9	1.657	42.1	0.157	4.0	3.80	1.158	2.554	3.83	1.167	2.574	11	44
	1 1/2	40	1.921	48.8	1.890	48.0	0.157	4.0	4.38	1.335	2.944	4.42	1.347	2.970	11	44
	2	50	2.394	60.8	2.354	59.8	0.177	4.5	6.19	1.887	4.160	6.26	1.908	4.207	11	44
	2 1/2	65	3.016	76.6	2.969	75.4	0.177	4.5	7.93	2.417	5.329	8.05	2.454	5.410	11	19
	3	80	3.524	89.5	3.469	88.1	0.197	5.0	10.3	3.139	6.922	10.5	3.200	7.057	11	19
	4	100	4.524	114.9	4.461	113.3	0.213	5.4	14.5	4.419	9.745	14.8	4.511	9.946	11	10
	5	125	5.535	140.6	5.461	138.7	0.213	5.4	17.9	5.456	12.030	18.4	5.608	12.366	11	5
	6	150	6.539	166.1	6.461	164.1	0.213	5.4	21.3	6.492	14.315	21.9	6.675	14.718	11	10

Carbon Steel Circular Hollow Section

For Ordinary Uses, Water Piping And Structural Purposes
BS 1387 : 1985
SS 17 : 1996

SUPPLY CONDITIONS:

Length
: Standard Length is 6 meter
: Cut-to-length is available upon request

Identification Marking
: Light tubes are marked by brown color band
: Medium tubes are marked by blue color band
: Heavy tubes are marked by red color band

Surface Finish Options
: Black Finish
: Galvanized Finish

End Finish Options
: Plain End
: Thread Cut with Coupler

TECHNICAL SPECIFICATIONS :

Leak Tightness Test
: Each tube shall be tested for leak tightness - Hydraulic/Hydrostatic test at a pressure of 50 bar (720 psi) or Eddy Current test.

Mechanical Properties:

MECHANICAL PROPERTIES		
TENSILE STRENGTH R_m	YIELD STRENGTH R_e	ELONGATION ON GAUGE LENGTH $L_o = 5.65\sqrt{S_o}$ A
N/mm^2	N/mm^2	%
320 to 460	195 (min)	20 (min)

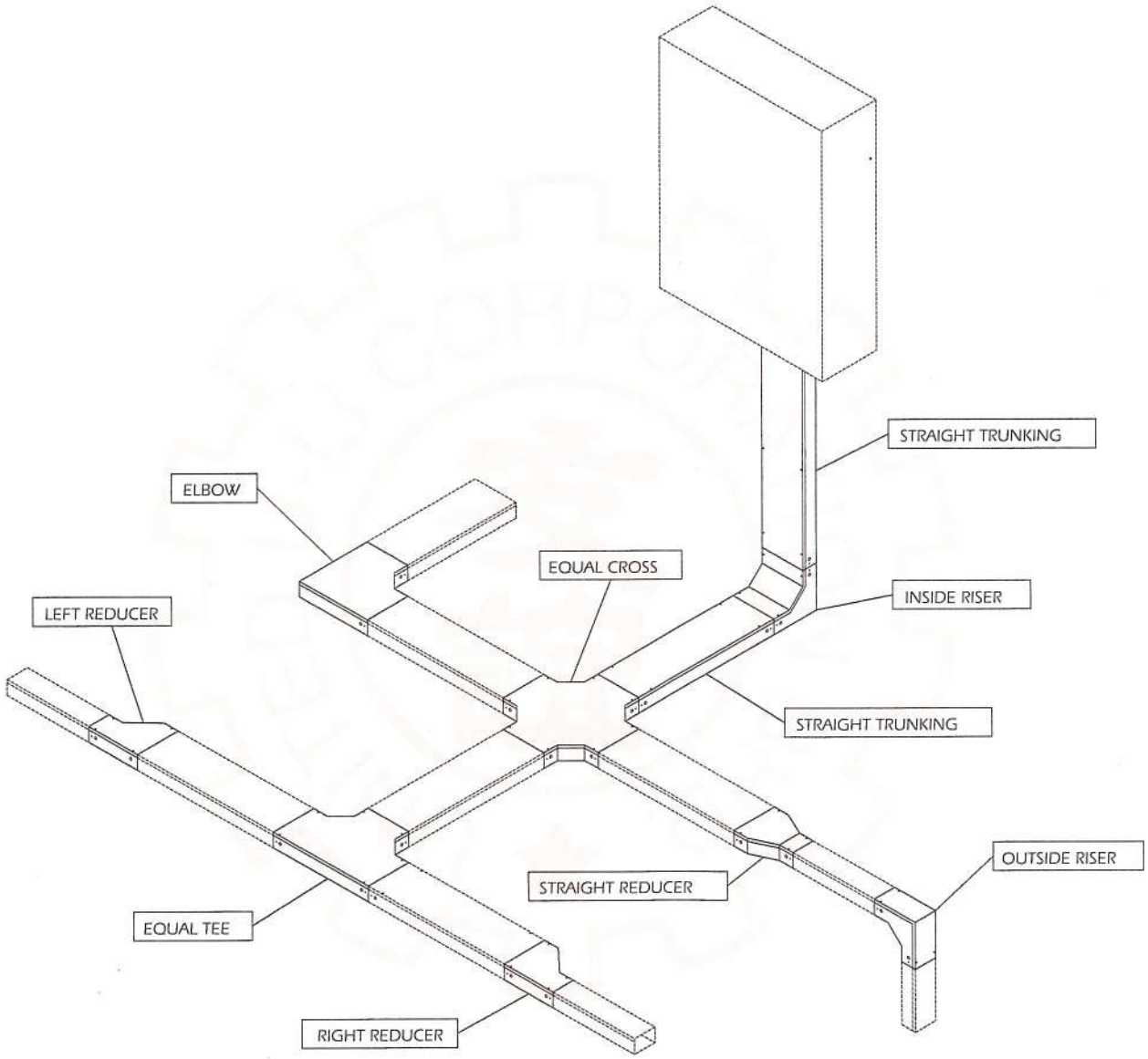
Chemical Composition:

CHEMICAL COMPOSITION (Ladle) %			
C max	Mn max	P max	S max
0.20	1.20	0.045	0.045

Tolerances:

PERMISSIBLE VARIATION		
Wall Thickness	:	- 8 %, + not specified (Light Tubes) - 10 %, + not specified (Medium & Heavy Tubes)
Weight	:	The mean consignment weight for quantities of 150m (500ft) and over of one size : ± 4% of the standard weight.
	:	The mean consignment weight for any single tube : +10%, -8% of the standard weight.
Length	:	- 0mm, + 30mm

U-LI™ range of Steel Surface Cable Trunking, Cable Ducting and Accessories

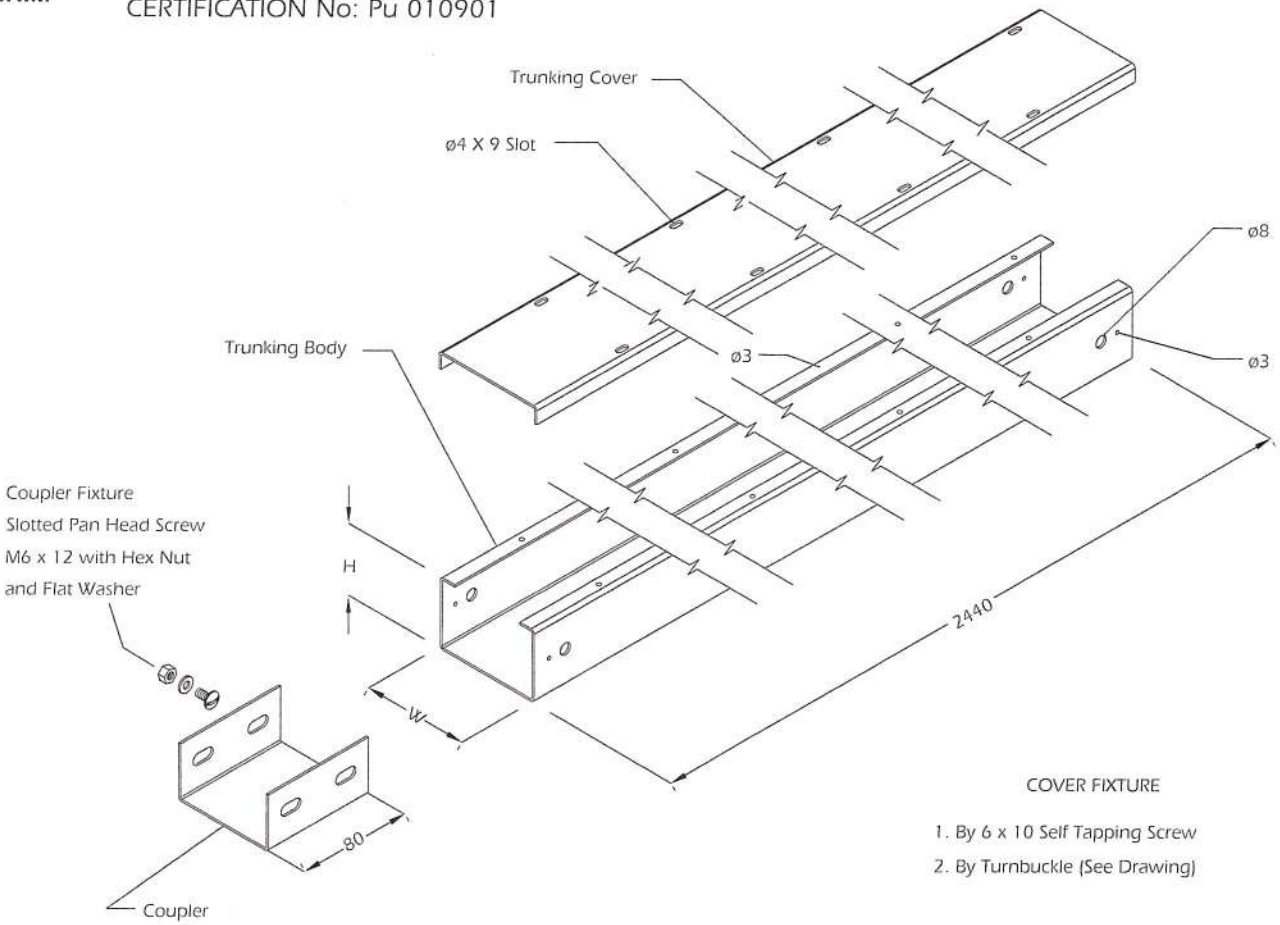


Steel Surface Cable Trunking-Straight

SIRIM

Type: UL/TG/ST

United U-LI Steel Surface Cable Trunking and Accessories are Certified to SS 249:1981 (Part BS 4678) by SIRIM QAS International Sdn Bhd
CERTIFICATION No: Pu 010901



COVER FIXTURE

1. By 6 x 10 Self Tapping Screw
2. By Turnbuckle (See Drawing)

TYPE 1	SPECIFICATION	CLASSIFICATION	PROTECTION	MATERIAL COATING	FINISH (BOTH SIDES)
Manufactured to SS 249 : 1981	SS 249:1981	Class 1	Medium	Electro Galvanised to BS 1706/Zn 2	Epoxy Powder Coated
	SS 249:1981	Class 2	Heavy	Pre-Galvanised to BS 2989. Grade Z 275	Epoxy Powder Coated

TYPE 2	SPECIFICATION	CLASSIFICATION	PROTECTION	MATERIAL COATING	FINISH
Manufactured to BS 4678: Part 1:1971	BS 4678:Pt1:1971	Class 1	Light	Electro Galvanised to BS 1706/Zn 2	None
	BS 4678:Pt1:1971	Class 2	Medium	Electro Galvanised to BS 1706/Zn 2	Light Epoxy Coating Externally Only
	BS 4678:Pt1:1971	Class 3	Heavy	Pre-Galvanised to BS 2989. Grade Z 275	None

TYPE 3	SPECIFICATION	PROTECTION	MATERIAL	FINISH
Manufactured to high corrosion resistance	Hot Dip Galvanised to BS EN ISO 1461:1999(E)	Very Heavy	Hot Roll Steel to JISG 3131 SPHC	Hot Dip Galvanised or with Epoxy/Polyester Coat over it upon request

TYPE 4	SPECIFICATION	PROTECTION	MATERIAL	FINISH
Manufactured to very high corrosion resistance & strength	Stainless Steel	Extra Heavy and Heavy Duty	Stainless Steel AISI 304, 316 or 316L	None or with Epoxy/Polyester Coat over it upon request

Dimension in Millimetre

Standard Sizes For Type 1 and 2

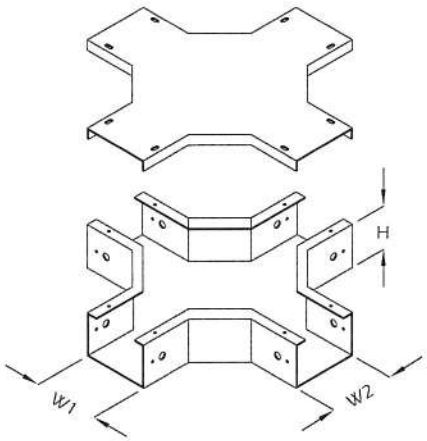
Components Ref.	Nominal Size (mm) H (Height) x W (Width)	Nominal Thickness Of Body Material (mm)	Nominal Thickness Of Cover Material (mm)
UL/TG/ST - 1 / 2	25 X 50	1.0	1.0
UL/TG/ST - 2 / 2	50 X 50	1.0	1.0
UL/TG/ST - 2 / 3	50 X 75	1.2	1.2
UL/TG/ST - 3 / 3	75 X 75	1.2	1.2
UL/TG/ST - 2 / 4	50 X 100	1.2	1.2
UL/TG/ST - 3 / 4	75 X 100	1.2	1.2
UL/TG/ST - 4 / 4	100 X 100	1.4	1.2
UL/TG/ST - 2 / 5	50 X 125	1.4	1.2
UL/TG/ST - 2 / 6	50 X 150	1.4	1.2
UL/TG/ST - 3 / 6	75 X 150	1.4	1.2
UL/TG/ST - 4 / 6	100 X 150	1.4	1.2
UL/TG/ST - 6 / 6	150 X 150	1.4	1.2
UL/TG/ST - 2 / 7	50 X 175	1.4	1.2
UL/TG/ST - 4 / 7	100 X 175	1.4	1.4
UL/TG/ST - 2 / 8	50 X 200	1.6	1.4
UL/TG/ST - 3 / 8	75 X 200	1.6	1.4
UL/TG/ST - 4 / 8	100 X 200	1.6	1.4
UL/TG/ST - 6 / 8	150 X 200	1.6	1.4
UL/TG/ST - 2 / 9	50 X 225	1.6	1.4
UL/TG/ST - 2 / 10	50 X 250	1.6	1.4
UL/TG/ST - 2 / 11	50 X 275	1.6	1.4
UL/TG/ST - 2 / 12	50 X 300	1.6	1.4
UL/TG/ST - 3 / 12	75 X 300	1.6	1.4
UL/TG/ST - 4 / 12	100 X 300	1.6	1.4
UL/TG/ST - 2 / 14	50 X 350	1.6	1.4

Preferred length 2.44m, minimum 2m, maximum 3m.

The sizes, body, cover gauges and preferred lengths of trunking as indicated in the above table are specified under BS 4678:Part 1:1971 and SS 249:1981.

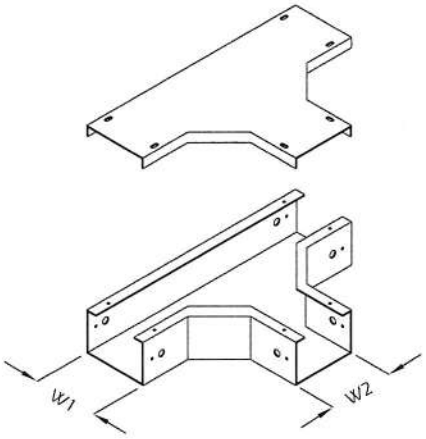
For other classification the above table could be use as a guide.

Cable Steel Trunking - Accessories



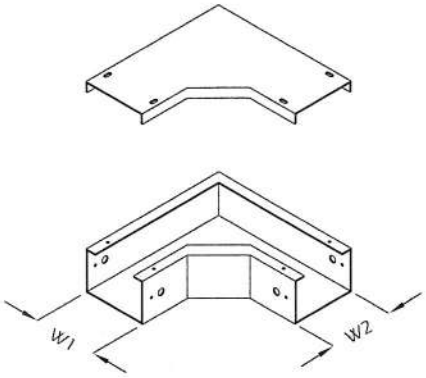
Horizontal Cross with Cover

Type: UL/TG/A-1



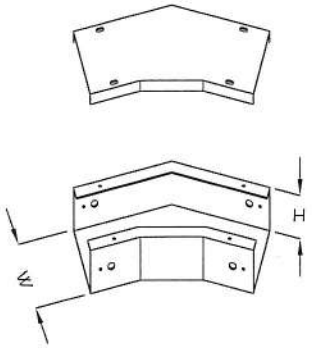
Horizontal Tee with Cover

Type: UL/TG/A-2



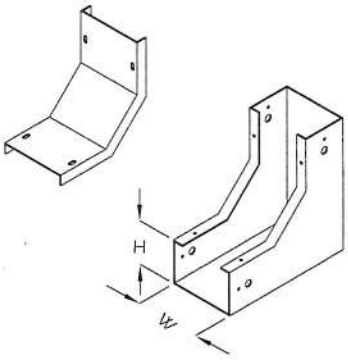
90° Horizontal Elbow with Cover

Type: UL/TG/A-3



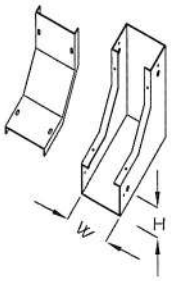
45° Horizontal Elbow with Cover

Type: UL/TG/A-4



90° Internal Riser with Cover

Type: UL/TG/A-5

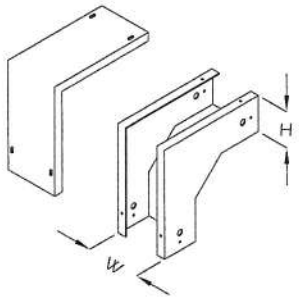


45° Internal Riser with Cover

Type: UL/TG/A-6

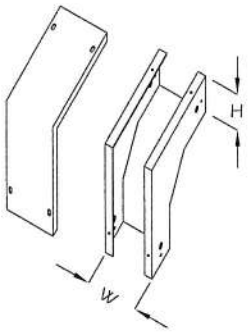
When ordering please indicate W (width), H (height) and Finish.

Steel Surface Trunking - Accessories



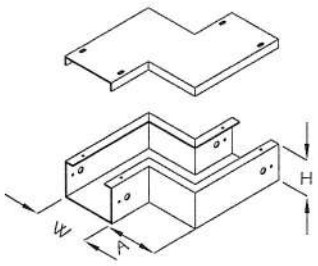
90° External Riser with Cover

Type: UL/TG/A-7



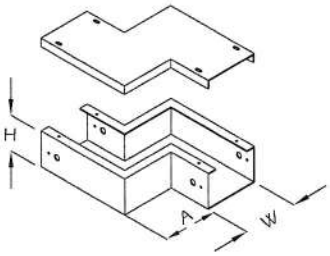
45° External Riser with Cover

Type: UL/TG/A-8



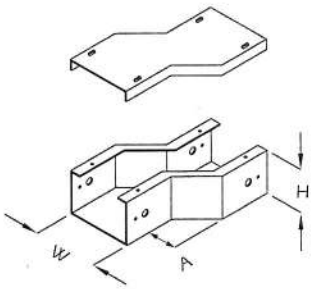
90° Horizontal Offset with Cover
(right)

Type: UL/TG/A-9



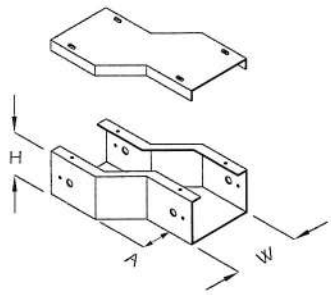
90° Horizontal Offset with Cover
(left)

Type: UL/TG/A-10



45° Horizontal Offset with Cover
(right)

Type: UL/TG/A-11

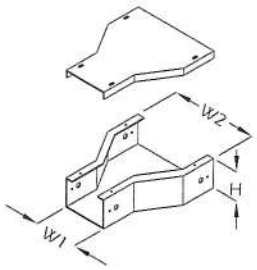


45° Horizontal Offset with Cover
(left)

Type: UL/TG/A-12

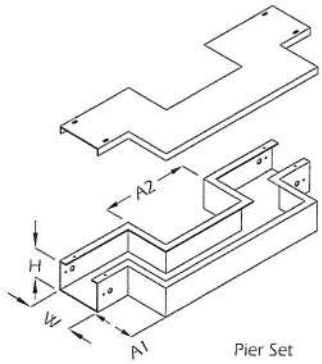
When ordering please indicate W (width), H (height), A (length) and Finish.

Steel Surface Trunking - Accessories



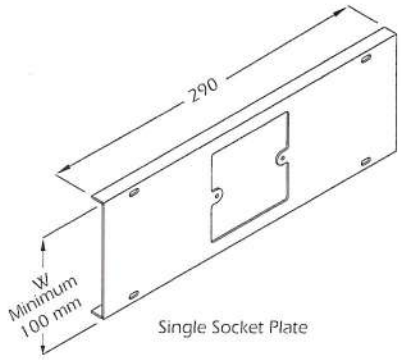
Straight Reducer with Cover

Type: UL/TG/A-13



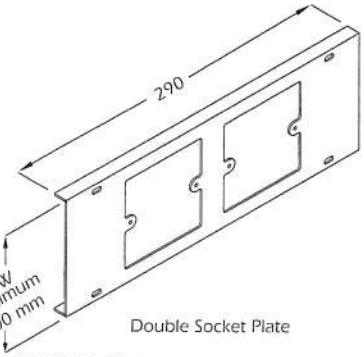
Pier Set

Type: UL/TG/A-14



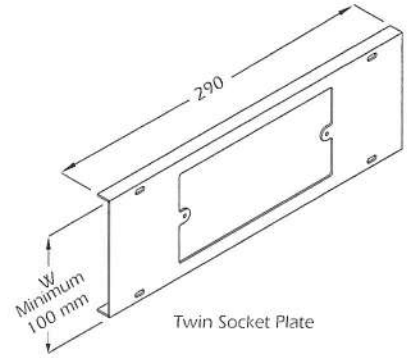
Single Socket Plate

Type: UL/TG/A-15



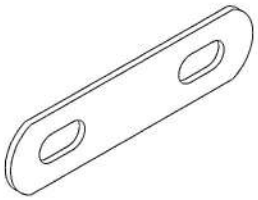
Double Socket Plate

Type: UL/TG/A-16



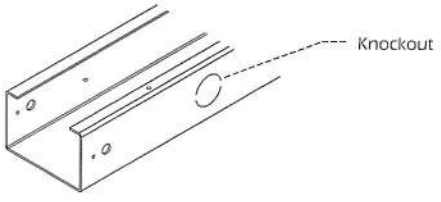
Twin Socket Plate

Type: UL/TG/A-17



Earth Link

Type: UL/TG/A-18



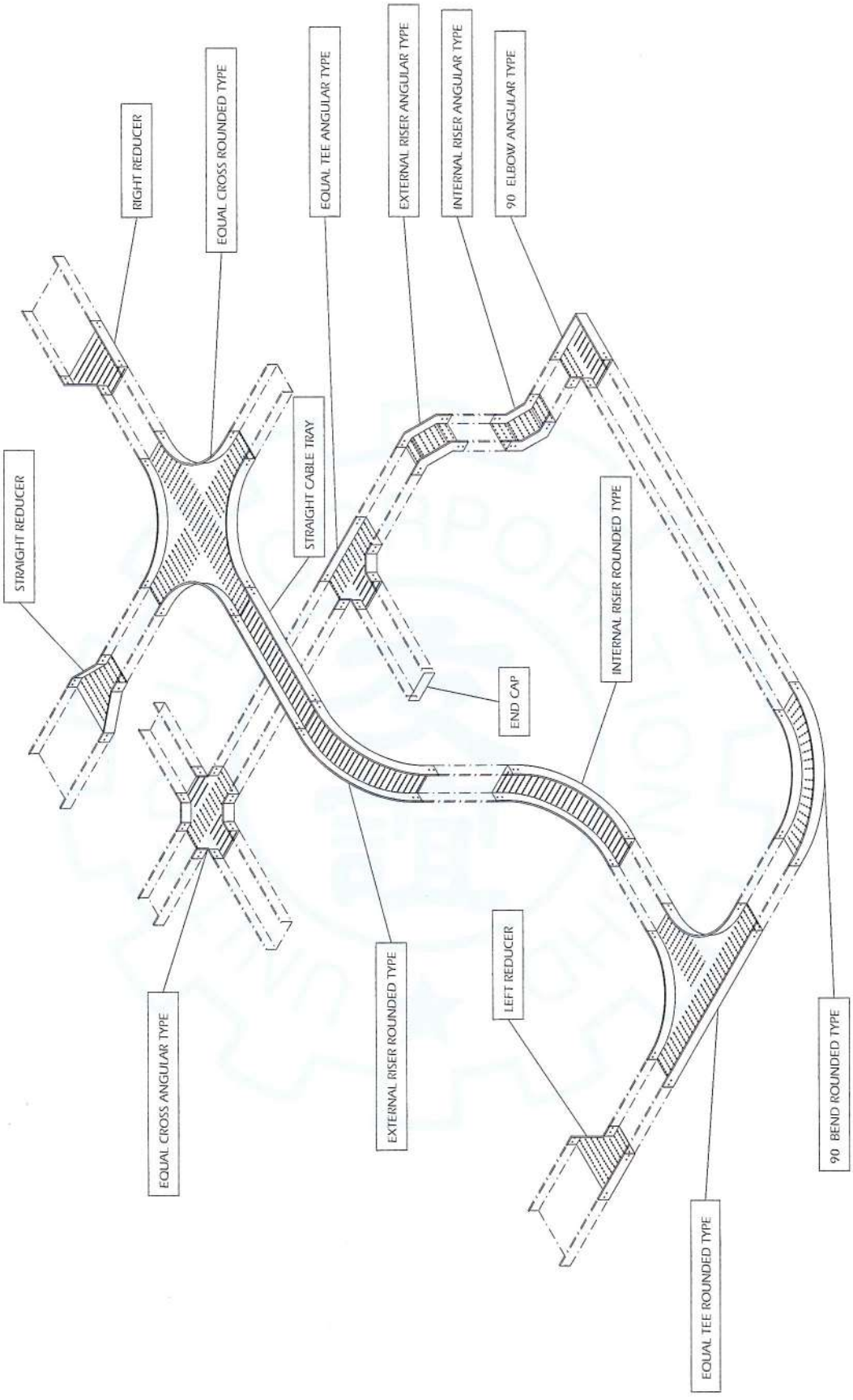
Knockout

20mm and 25mm Diameter

Type: UL/TG/A-21

When ordering please indicate W (width), H (height), A (length) and Finish.

U-LI™ Steel Cable Tray Typical Layout



U-LI™ Steel Cable Tray Product Range

U-LI™ design of Cable Ladder is compact and fast to install, with both straight Cable Tray and all accessories having a unique integrated coupling system.

U-LI™ offers a wide range of options to suit your design and with load rated to NEMA VE1. We also manufacture Cable Tray to your design.

U-LI™ offers multi side wall profile for your design needs and applications. It has the advantage of quick on site installation, cut to length and reconnection.

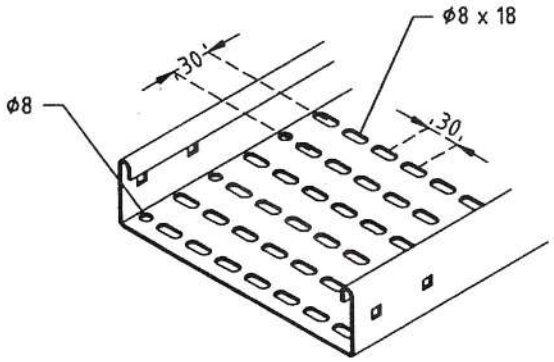
U-LI™ offers a wide range of materials to suit the site condition and also choices of final finishes.

Materials:

1. Hot roll mild steel. JISG 3131 SPHC, JISG 3101 SS400
2. Cold roll mild steel. JISG 3141 SPCC
3. Pre-Galvanised steel. BS 2989
4. Electro-Galvanised. BS 1449 Pt 1:1983
5. Stainless steel. AISI 304, 316 or 316L
6. Aluminium.
   Materials thickness range from 1mm thick to 3mm thick.

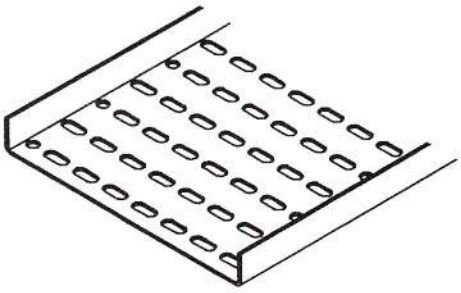
Finishing:

1. Hot dip galvanised.
   ASTM A123, BS EN ISO 1461:1999
2. Epoxy coated - ASTM D 1654, BS 6920
3. Polyester coated - ASTM D 1654, BS 6920

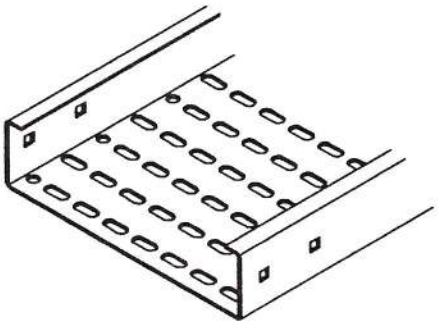


Standard Slots Configuration. Total removal of material approximately 18%. We also manufacture to other slot configurations as per customer's request

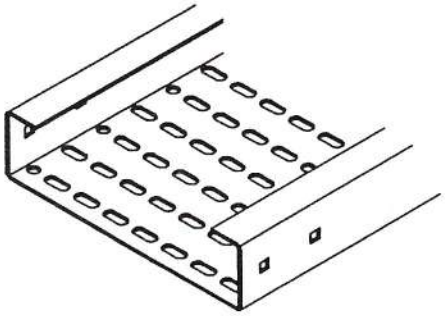
Perforated Tray Series



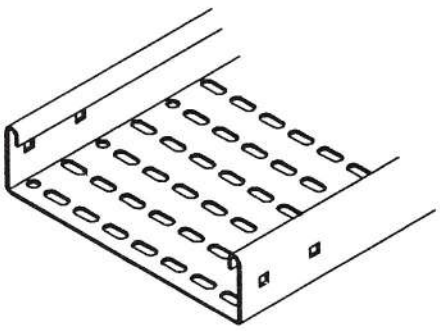
Type: TU



Type: TC



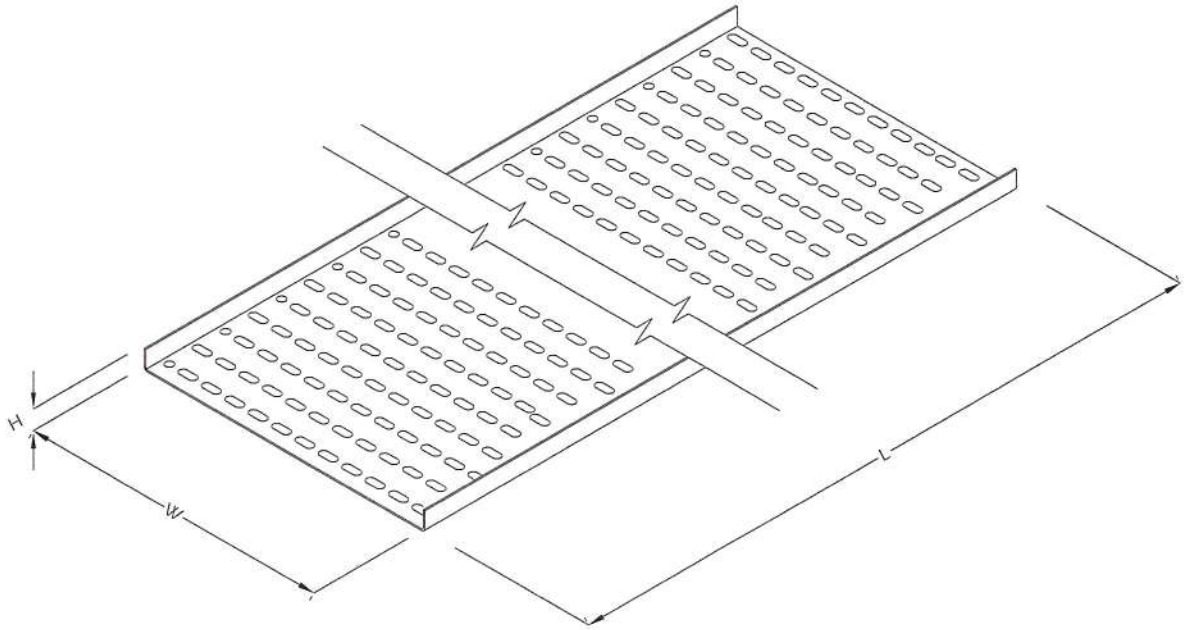
Type: TT

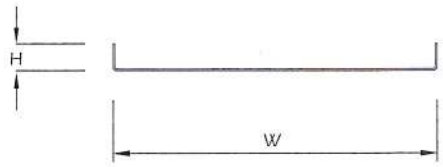


Type: TR

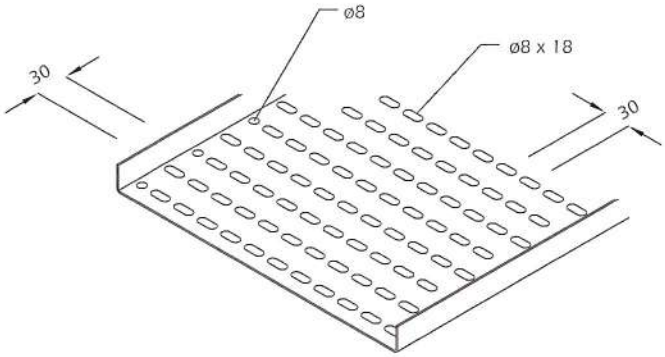
Steel Perforated Cable Tray - Straight

Type: *UL/TU/ST*





TRAY SECTION



SLOTS DETAIL

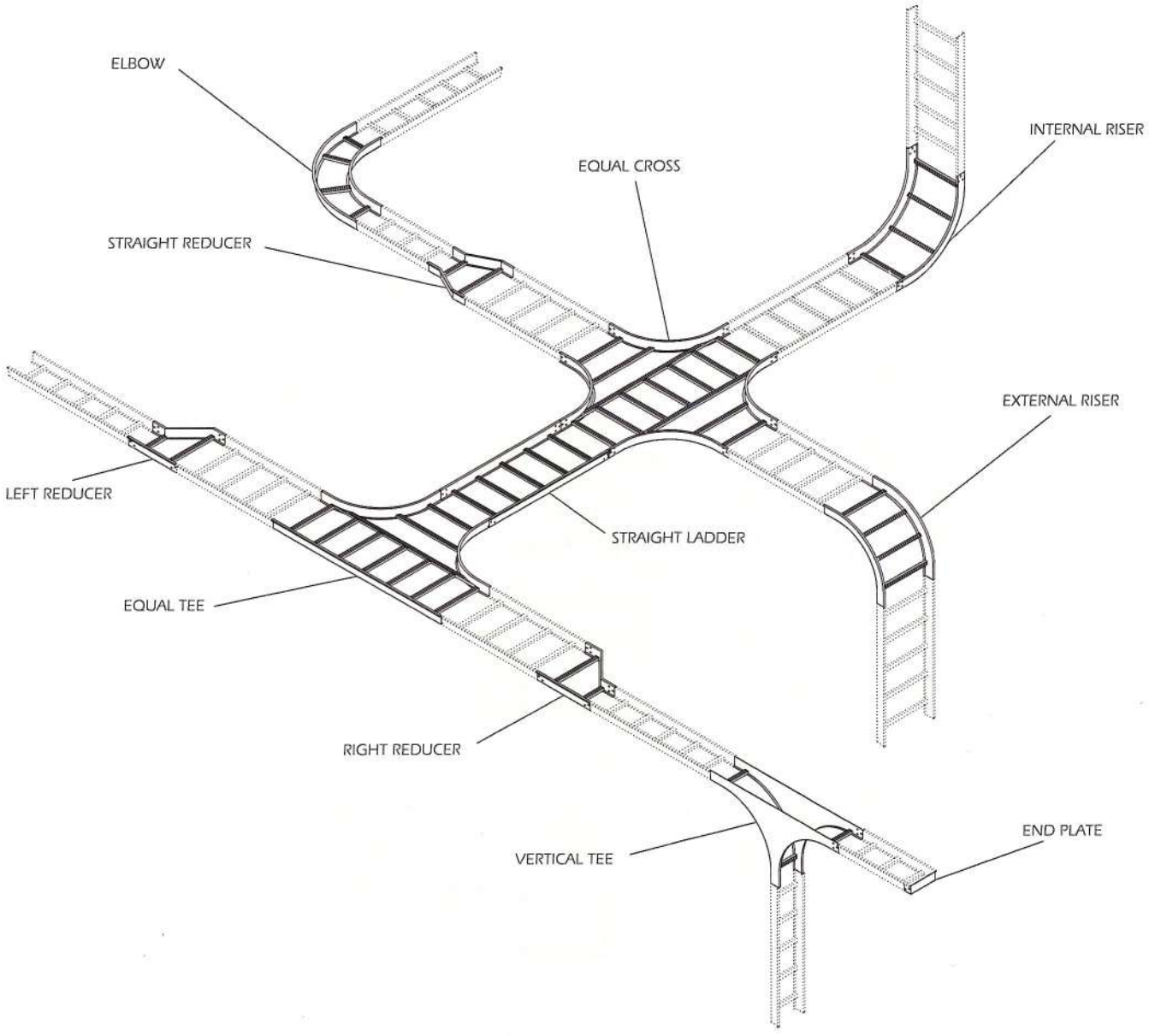
Components Ref.	H	W	Thickness	L	Finish
UL/TU/ST-1	13	50	1.5	2440 or 3000	Hot Dip Galvanised Epoxy or Polyester Coated Stainless
UL/TU/ST-2	13	100	1.5		
UL/TU/ST-3	13	150	1.5		
UL/TU/ST-4	17	200	1.5		
UL/TU/ST-5	17	300	1.5		
UL/TU/ST-6	20	350	1.5		
UL/TU/ST-7	20	450	1.5		
UL/TU/ST-8	25	500	1.5		
UL/TU/ST-9	25	600	1.5		

Components Ref.	H	W	Thickness	L	Finish
UL/TU/ST-10	25	700	2.0	2440 or 3000	Hot Dip Galvanised Epoxy or Polyester Coated Stainless
UL/TU/ST-11	25	800	2.0		
UL/TU/ST-12	25	900	2.0		
UL/TU/ST-13	25	1000	2.0		

Dimension in Millimetre
Abbreviation. W - Width H - Height L - Length

When ordering please indicate Material, Finish (F) and Length (L)
We also supply other sizes with the same profile.

ULI™ Steel Cable Ladder Typical Layout



U-LI™ Cable Ladder Product Range

U-LI™ design of Cable Ladder is compact and fast to install, with both straight Cable Ladder and all accessories having a unique integrated coupling system.

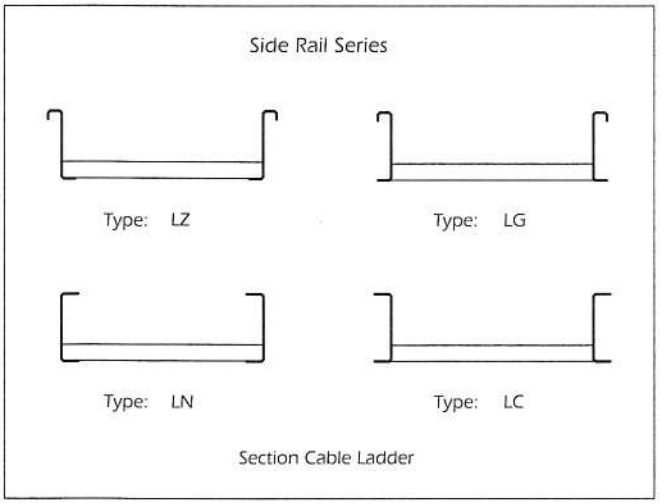
U-LI™ offers a wide range of options to suit your design and with load rated to NEMA VE1. We also manufacture Extra Heavy Duty Cable Ladder upon request.

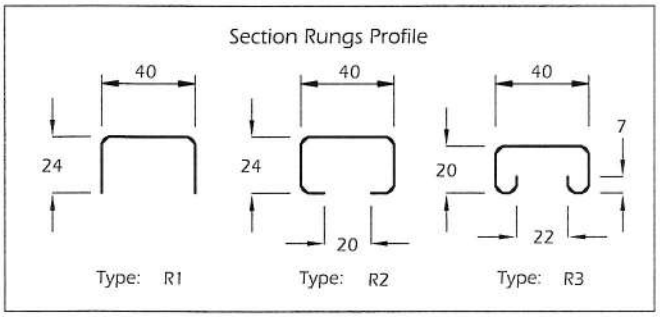
U-LI™ offers multi side rails, rungs and slots profile for your design needs and applications. It has the advantage of quick on site installation, cut to length and reconnection.

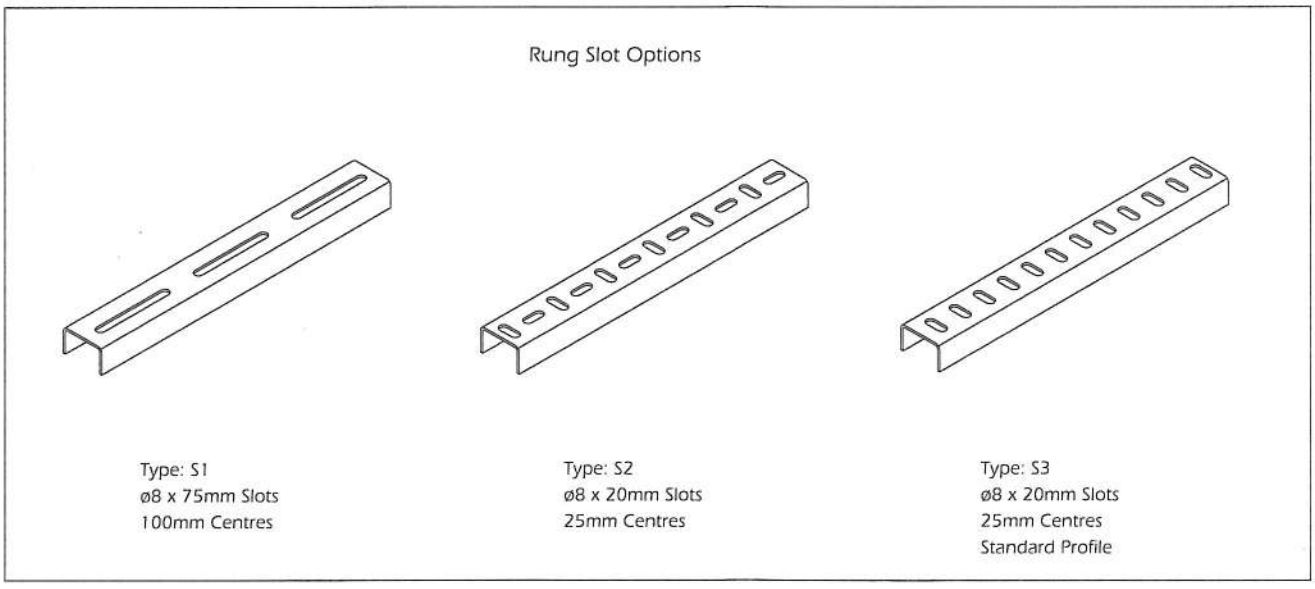
U-LI™ offers a wide range of materials to suit the site condition and also choices of final finishes.

Materials:
1. Hot roll mild steel. JISG 3131 SPHC
2. Cold roll mild steel. JISG 3141 SPCC - SD
3. Pre-Galvanised Steel BS 2989 or JISG 3302 SGCC
4. Electro-Galvanised. BS 1449 Pt 1:1983
5. Stainless steel. AISI 304, 316 or 316L
6. Aluminium.
   Materials thickness range from 1mm thick to 3mm thick.

Finishing:
1. Hot dip galvanised.
   ASTM A123, BS EN ISO 1461:1999
2. Epoxy coated - ASTM D 1654, BS 6920
3. Polyester coated - ASTM D 1654, BS 6920



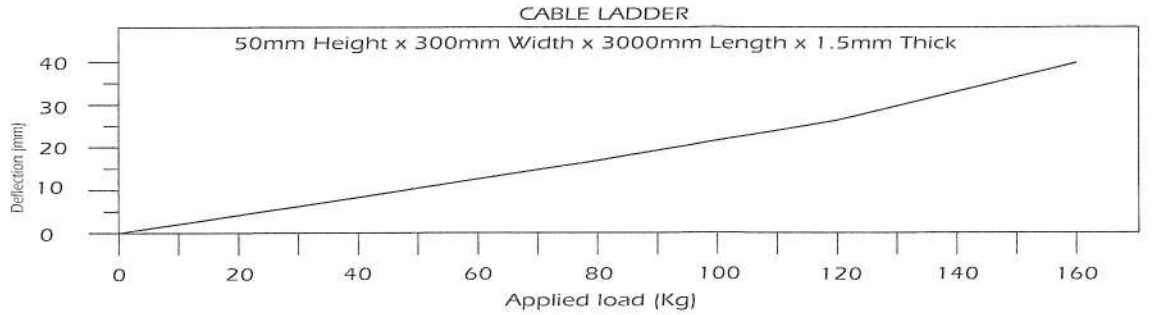


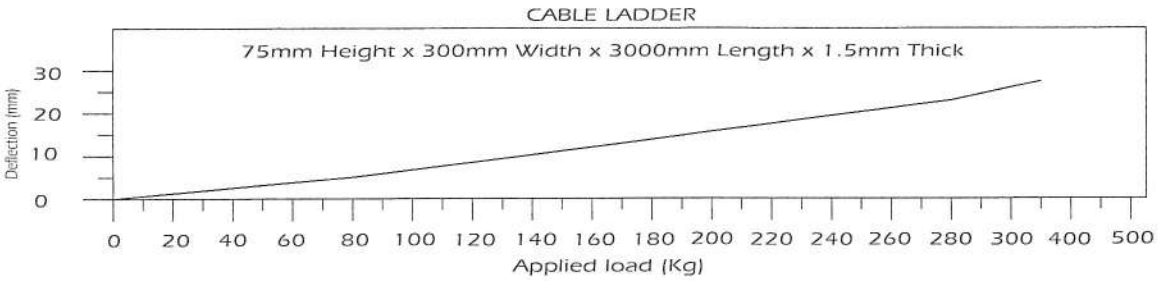


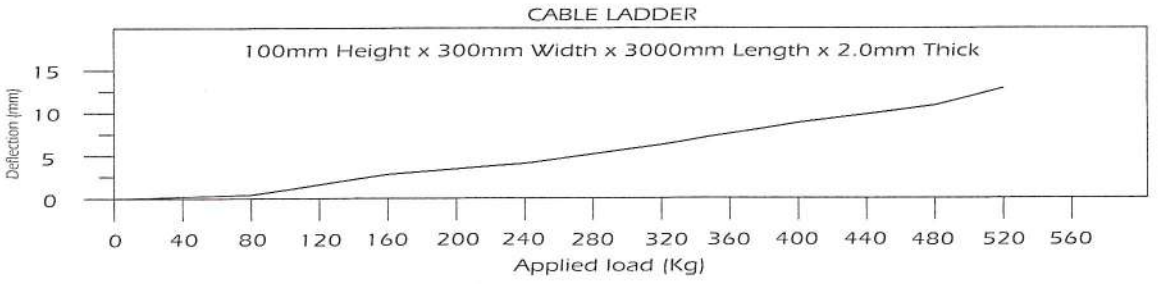
Loading Graphs

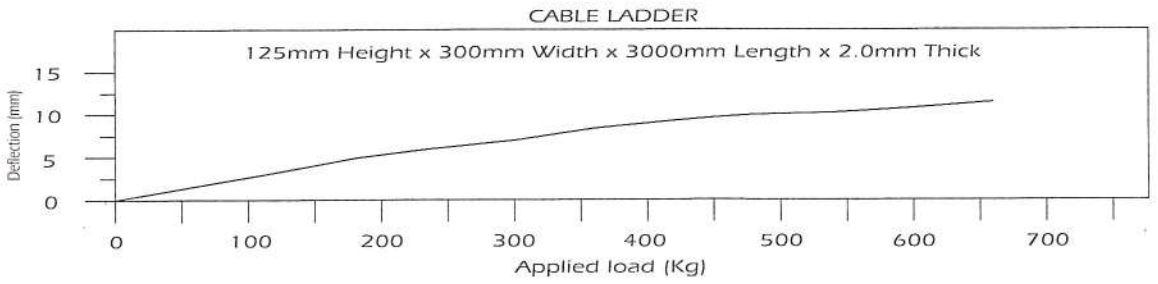
The graphs indicate deflection and save working loads for continuous horizontal runs, the cable ladder upper limits on each graph shows the maximum working load for the ladder on the given span. For information on loads and deflection in these circumstances further advice should be sought from United U-LI™.

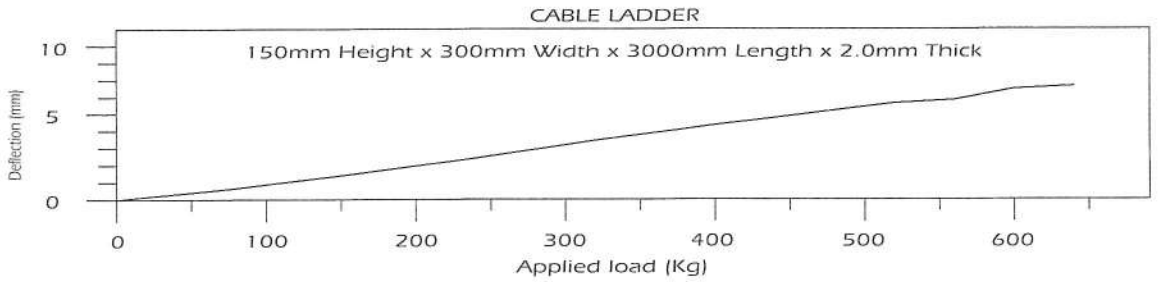
These test were carried out using cable ladder Type:LZ manufactured from mild steel. The use of other steels will cause variation to this data and further advise on this should be requested from United U-LI™. The test were conducted to NEMA VE1 specification and verified by SIRIM Qas International Sdn Bhd.

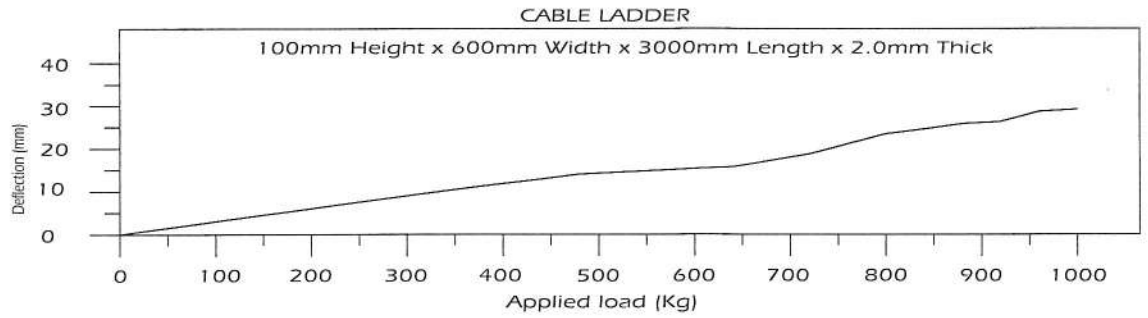


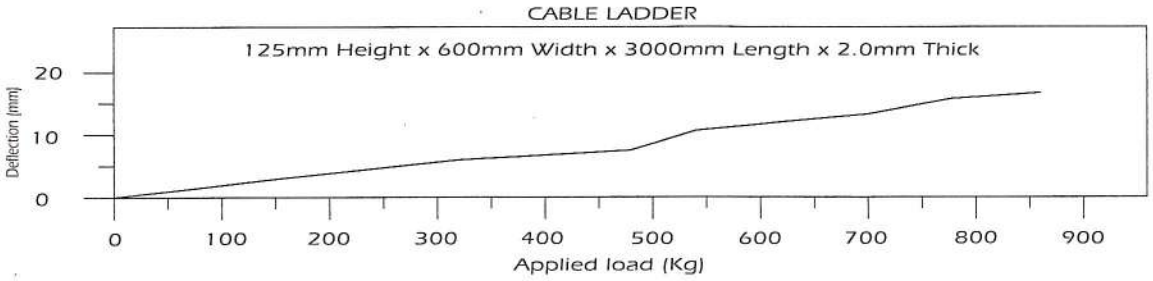


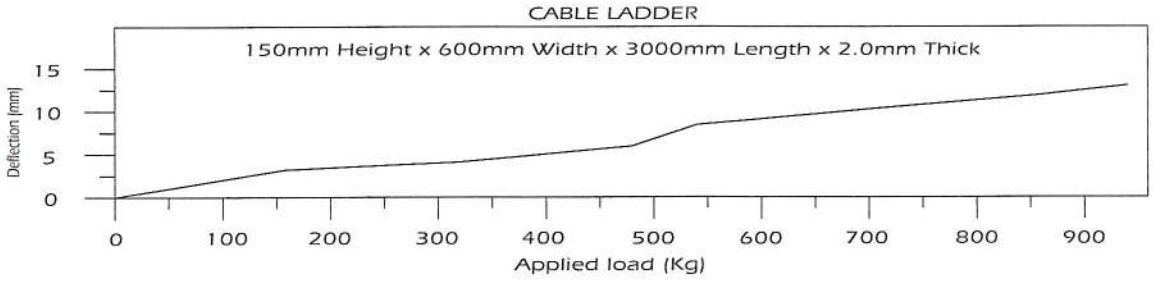


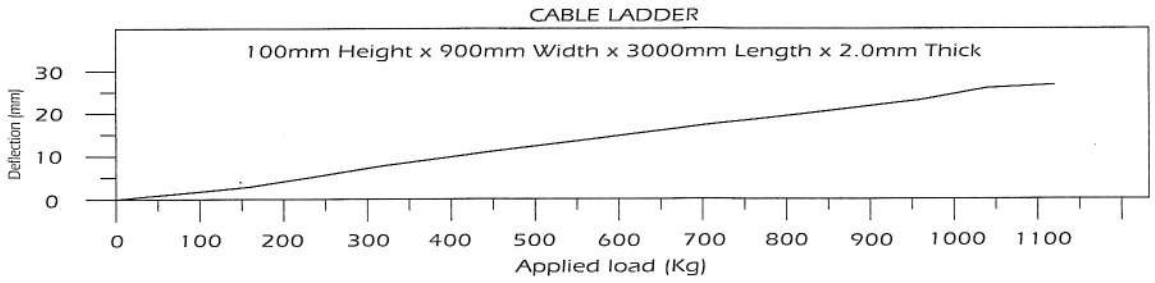


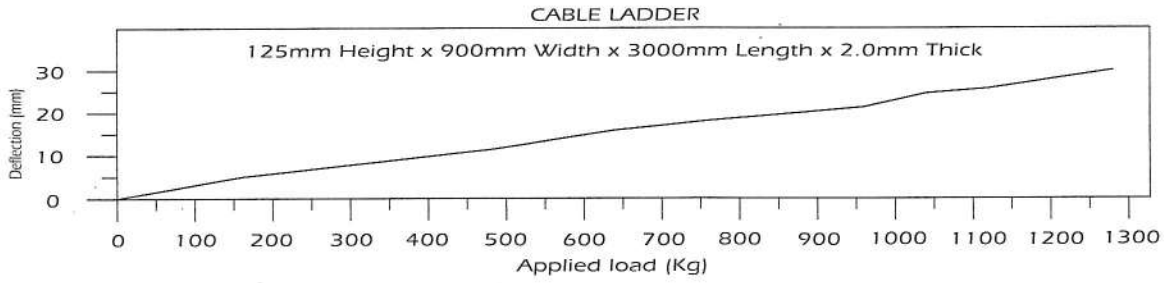


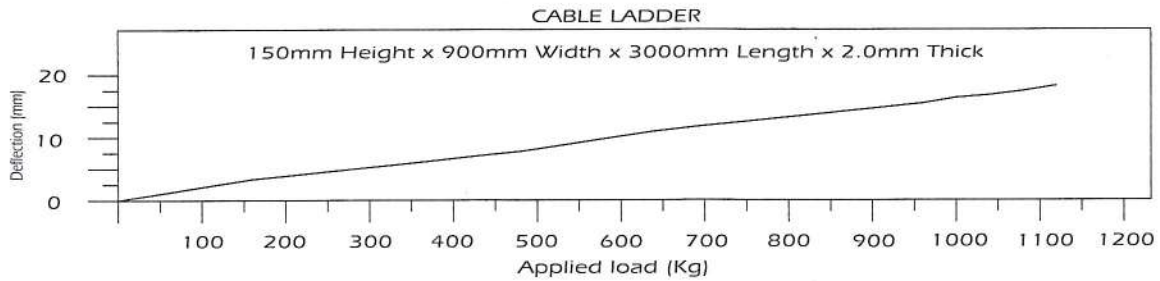

CABLE LADDER
100mm Height x 600mm Width x 3000mm Length x 2.0mm Thick
Deflection (mm)
0
10
20
30
40
0
100
200
300
400
500
600
700
800
900
1000
Applied load (Kg)


CABLE LADDER
125mm Height x 600mm Width x 3000mm Length x 2.0mm Thick
Deflection (mm)
0
10
20
0
100
200
300
400
500
600
700
800
900
Applied load (Kg)


CABLE LADDER
150mm Height x 600mm Width x 3000mm Length x 2.0mm Thick
Deflection (mm)
0
5
10
15
0
100
200
300
400
500
600
700
800
900
Applied load (Kg)

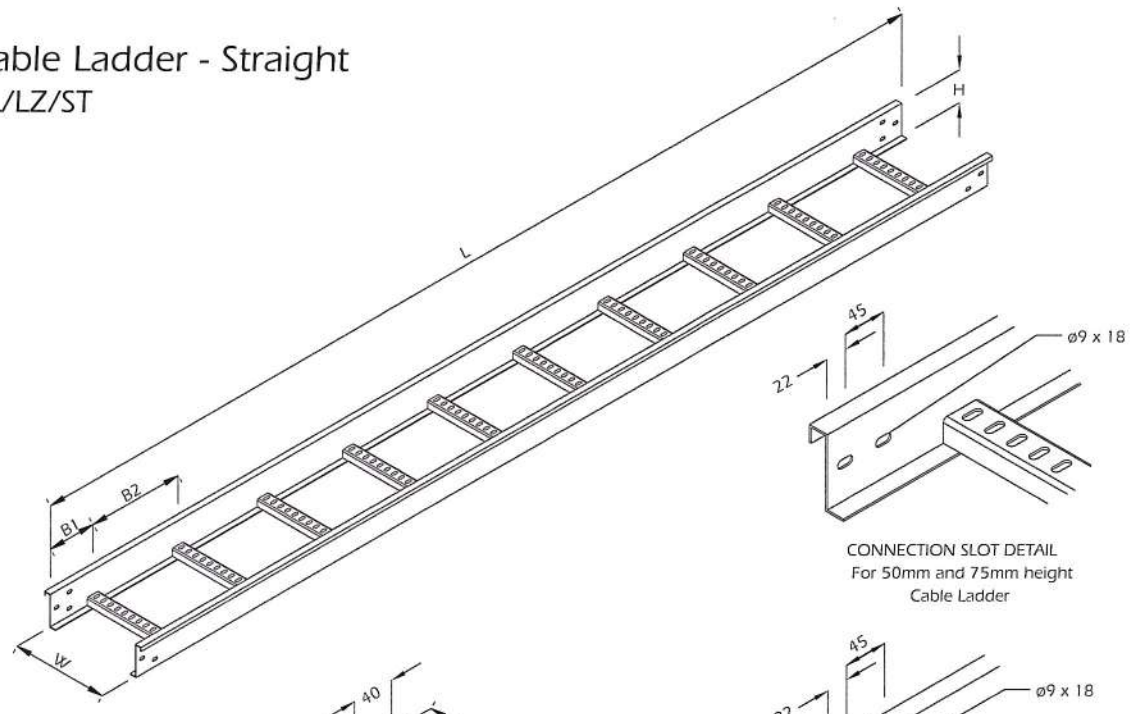

CABLE LADDER
100mm Height x 900mm Width x 3000mm Length x 2.0mm Thick
Deflection (mm)
0
10
20
30
0
100
200
300
400
500
600
700
800
900
1000
1100
Applied load (Kg)


CABLE LADDER
125mm Height x 900mm Width x 3000mm Length x 2.0mm Thick
Deflection (mm)
0
10
20
30
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
Applied load (Kg)

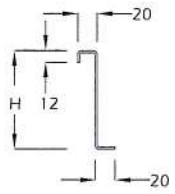

CABLE LADDER
150mm Height x 900mm Width x 3000mm Length x 2.0mm Thick
Deflection (mm)
0
10
20
100
200
300
400
500
600
700
800
900
1000
1100
1200
Applied load (Kg)

Steel Cable Ladder - Straight

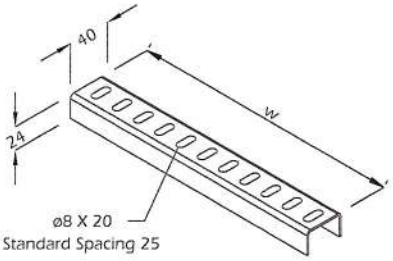
Type: *UL/LZ/ST*



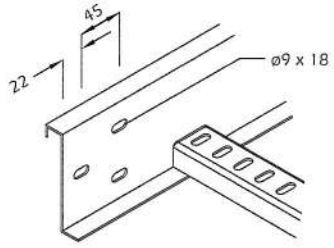
CONNECTION SLOT DETAIL
For 50mm and 75mm height
Cable Ladder



SIDE RAIL SECTION



RUNG DETAIL



CONNECTION SLOT DETAIL
For 100mm - 125mm - 150mm heigth
Cable Ladder

Components Ref.	H	W	B1	B2	L	Thickness	Finish
UL/LZ/ST/2-6	50	150	150	300	3000	1.5	Hot Dip Galvanised - Epoxy or Polyester Coated - Stainless
UL/LZ/ST/2-8	50	200	150	300	3000	1.5	
UL/LZ/ST/2-10	50	250	150	300	3000	1.5	
UL/LZ/ST/2-12	50	300	150	300	3000	1.5	
UL/LZ/ST/3-6	75	150	150	300	3000	1.5	
UL/LZ/ST/3-8	75	200	150	300	3000	1.5	
UL/LZ/ST/3-10	75	250	150	300	3000	1.5	
UL/LZ/ST/3-12	75	300	150	300	3000	1.5	
UL/LZ/ST/4-6	100	150	150	300	3000	2.0	
UL/LZ/ST/4-8	100	200	150	300	3000	2.0	
UL/LZ/ST/4-10	100	250	150	300	3000	2.0	
UL/LZ/ST/4-12	100	300	150	300	3000	2.0	
UL/LZ/ST/4-16	100	400	150	300	3000	2.0	
UL/LZ/ST/4-18	100	450	150	300	3000	2.0	
UL/LZ/ST/4-20	100	500	150	300	3000	2.0	
UL/LZ/ST/4-24	100	600	150	300	3000	2.0	
UL/LZ/ST/4-30	100	750	150	300	3000	2.0	
UL/LZ/ST/4-36	100	900	150	300	3000	2.0	
UL/LZ/ST/4-40	100	1000	150	300	3000	2.0	
UL/LZ/ST/5-8	125	200	150	300	3000	2.0	

Components Ref.	H	W	B1	B2	L	Thickness	Finish
UL/LZ/ST/5-10	125	250	150	300	3000	2.0	Hot Dip Galvanised - Epoxy or Polyester Coated - Stainless
UL/LZ/ST/5-12	125	300	150	300	3000	2.0	
UL/LZ/ST/5-16	125	400	150	300	3000	2.0	
UL/LZ/ST/5-18	125	450	150	300	3000	2.0	
UL/LZ/ST/5-20	125	500	150	300	3000	2.0	
UL/LZ/ST/5-24	125	600	150	300	3000	2.0	
UL/LZ/ST/5-30	125	750	150	300	3000	2.0	
UL/LZ/ST/5-36	125	900	150	300	3000	2.0	
UL/LZ/ST/5-40	125	1000	150	300	3000	2.0	
UL/LZ/ST/6-8	150	200	150	300	3000	2.0	
UL/LZ/ST/6-10	150	250	150	300	3000	2.0	
UL/LZ/ST/6-12	150	300	150	300	3000	2.0	
UL/LZ/ST/6-16	150	400	150	300	3000	2.0	
UL/LZ/ST/6-18	150	450	150	300	3000	2.0	
UL/LZ/ST/6-20	150	500	150	300	3000	2.0	
UL/LZ/ST/6-24	150	600	150	300	3000	2.0	
UL/LZ/ST/6-30	150	750	150	300	3000	2.0	
UL/LZ/ST/6-32	150	800	150	300	3000	2.0	
UL/LZ/ST/6-36	150	900	150	300	3000	2.0	
UL/LZ/ST/6-40	150	1000	150	300	3000	2.0	

Dimension in Millimetre

Abbreviation: B - Rung Spacing H - Height L - Length W - Width

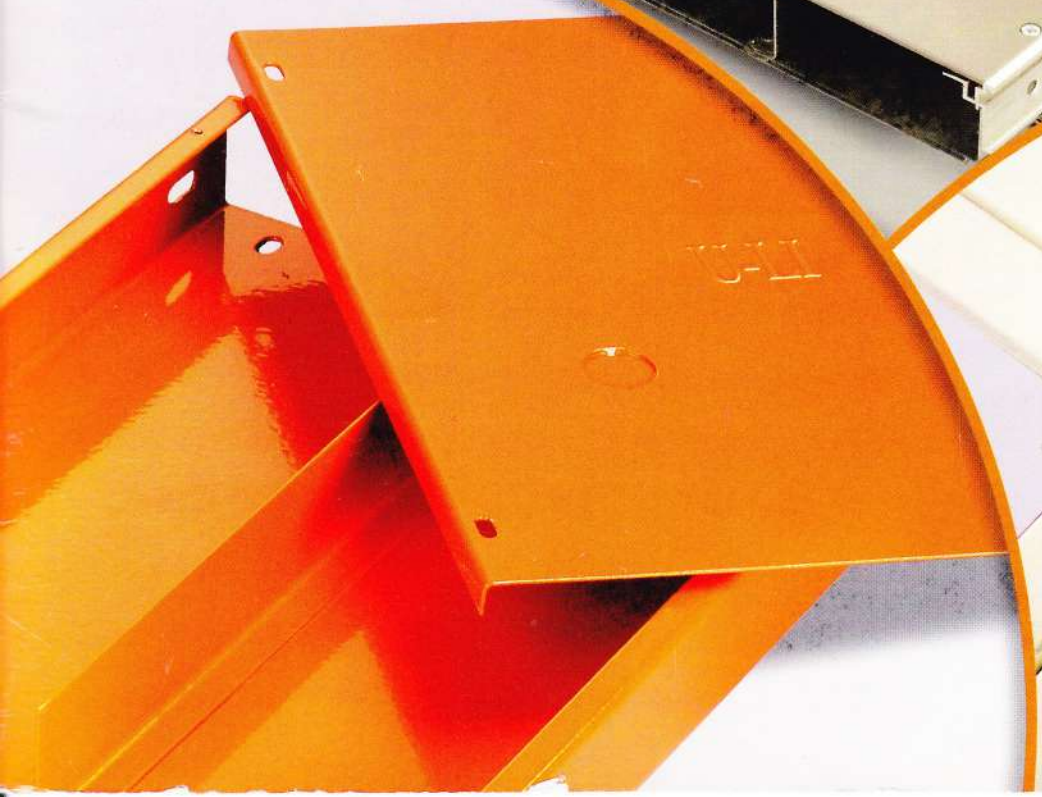
When ordering please indicate Material and Finish.

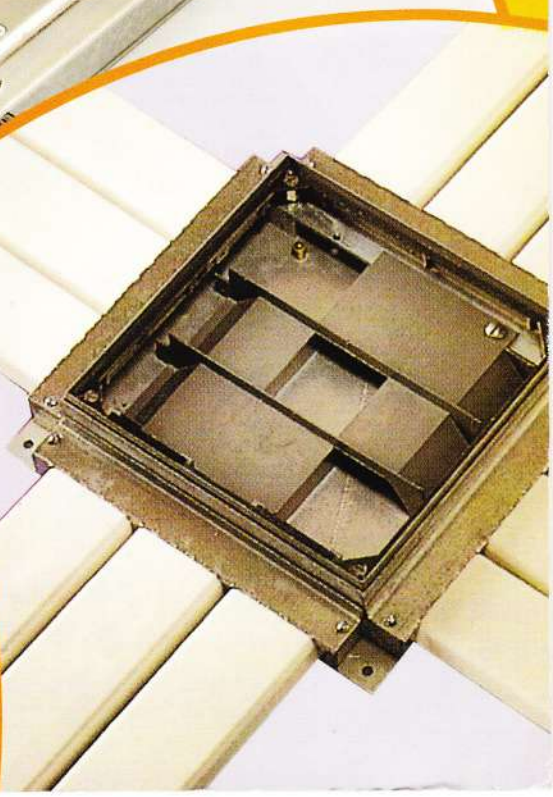
We also supply other sizes with the same Side Rail, Rung Profile and various number of Connection Slots.

UNITED U-LI CORPORATION BHD.

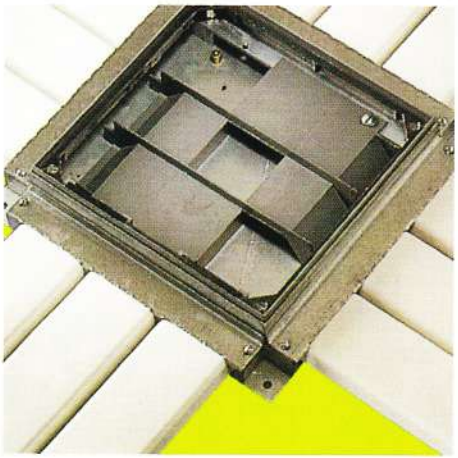
Underfloor Trunking
Raisedfloor Trunking
Flushfloor Trunking

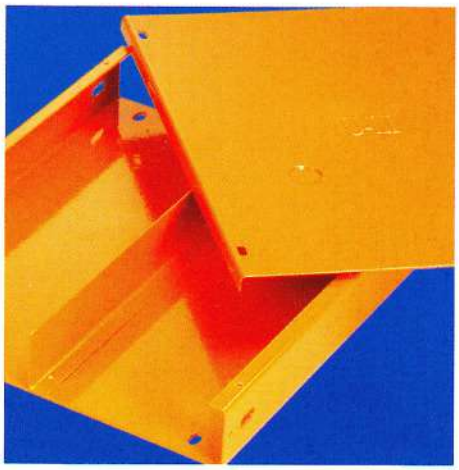


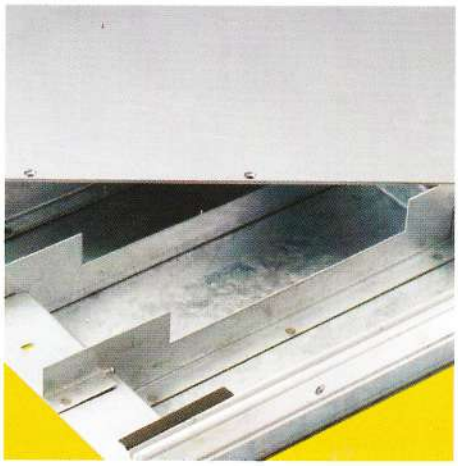




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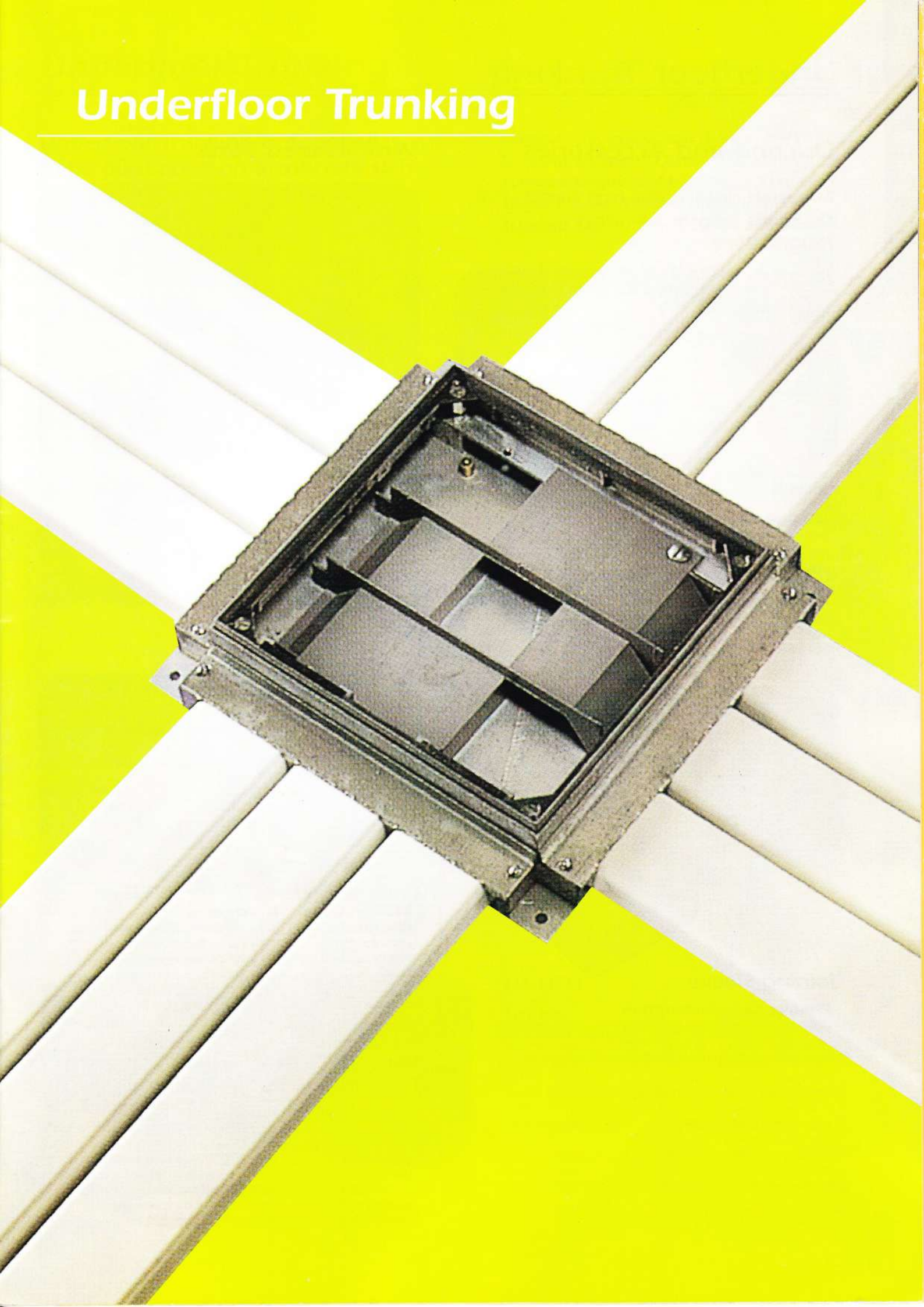
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Underfloor Trunking



Underfloor Trunking

Ducting and Accessories

Material: Heavy gauge high impact uPVC
Standard length: 2.9 metres
Height: 25mm



uPVC Underfloor Trunking

Product Code	Description
UFD 225 W	50 x 25 x 2.5mm
UFD 332 W	75 x 25 x 3.2mm
UFD 432 W	100 x 25 x 3.2mm



Joining Sleeve

Product Code	Description
UJ 225 W	50 x 25 x 2.5mm
UJ 332 W	75 x 25 x 2.5mm
UJ 432 W	100 x 25 x 2.5mm

Vertical Access Boxes



The vertical access box helps to facilitate easy accessibility from floor ducts to wall ducts. This is for connections to distribution boards or other floors.

Vertical Access Box For Max. 25mm Depth Ductings

Product Code	Description
UL-LVB 125/1	125 x 200 x 50mm 1 Compartment
UL-LVB 250/2	250 x 200 x 50mm 2 Compartments
UL-LVB 250/3	250 x 200 x 50mm 3 Compartments
UL-LVB 300/2	300 x 200 x 50mm 2 Compartments
UL-LVB 300/3	300 x 200 x 50mm 3 Compartments
UL-LVB 375/3	375 x 200 x 50mm 3 Compartments
UL-LVB 400/3	400 x 200 x 50mm 3 Compartments

Vertical Access Box For Max. 32mm Depth Ductings

Product Code	Description
UL-MVB 125/1	125 x 250 x 50mm 1 Compartment
UL-MVB 250/2	250 x 250 x 50mm 2 Compartments
UL-MVB 250/3	250 x 250 x 50mm 3 Compartments
UL-MVB 300/2	300 x 250 x 50mm 2 Compartments
UL-MVB 300/3	300 x 250 x 50mm 3 Compartments
UL-MVB 375/3	375 x 250 x 50mm 3 Compartments
UL-MVB 400/3	400 x 250 x 50mm 3 Compartments

Vertical Access Box For Max. 38mm Depth Ductings

Product Code	Description
UL-HVB 125/1	125 x 250 x 50mm 1 Compartment
UL-HVB 250/2	250 x 250 x 50mm 2 Compartments
UL-HVB 250/3	250 x 250 x 50mm 3 Compartments
UL-HVB 300/2	300 x 250 x 50mm 2 Compartments
UL-HVB 300/3	300 x 250 x 50mm 3 Compartments
UL-HVB 375/3	375 x 250 x 50mm 3 Compartments
UL-HVB 400/3	400 x 250 x 50mm 3 Compartments

Underfloor Trunking

Underfloor Trunking is designed to be positioned on a concrete slab and completely covered by the floor screed.

Material: Galvanised steel sheet to BS2989
Standard thickness: 1.6mm
Standard lengths: 2.44 metres or 3.0 metres
Single, double or triple compartments
Standard depths: 25mm, 32mm and 38mm

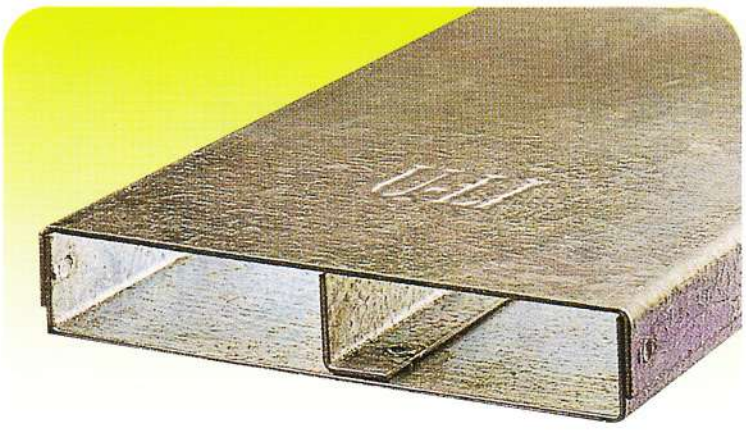
Cut to length can be arranged and is subjected to price confirmation and availability

Metal Trunking



UL-UFL

List No.	Description
UL-UFL 50/1/6	50 x 25 x 1.6mm 1 Compartment
UL-UFL 75/1/6	75 x 25 x 1.6mm 1 Compartment
UL-UFL 100/1/6	100 x 25 x 1.6mm 1 Compartment
UL-UFL 150/2/6	100 x 25 x 1.6mm 2 Compartments
UL-UFL 150/3/6	150 x 25 x 1.6mm 3 Compartments
UL-UFL 200/2/6	200 x 25 x 1.6mm 2 Compartments
UL-UFL 225/3/6	225 x 25 x 1.6mm 3 Compartments
UL-UFL 250/3/6	250 x 25 x 1.6mm 3 Compartments
UL-UFL 275/3/6	275 x 25 x 1.6mm 3 Compartments
UL-UFL 300/3/6	300 x 25 x 1.6mm 3 Compartments
UL-UFL 375/3/6	375 x 25 x 1.6mm 3 Compartments



UL-UFM

List No.	Description
UL-UFM 50/1/6	50 x 32 x 1.6mm 1 Compartment
UL-UFM 75/1/6	75 x 32 x 1.6mm 1 Compartment
UL-UFM 100/1/6	100 x 32 x 1.6mm 1 Compartment
UL-UFM 150/2/6	100 x 32 x 1.6mm 2 Compartments
UL-UFM 150/3/6	150 x 32 x 1.6mm 3 Compartments
UL-UFM 200/2/6	200 x 32 x 1.6mm 2 Compartments
UL-UFM 225/3/6	225 x 32 x 1.6mm 3 Compartments
UL-UFM 250/3/6	250 x 32 x 1.6mm 3 Compartments
UL-UFM 275/3/6	275 x 32 x 1.6mm 3 Compartments
UL-UFM 300/3/6	300 x 32 x 1.6mm 3 Compartments
UL-UFM 375/3/6	375 x 32 x 1.6mm 3 Compartments



UL-UFH

List No.	Description
UL-UFH 50/1/6	50 x 38 x 1.6mm 1 Compartment
UL-UFH 75/1/6	75 x 38 x 1.6mm 1 Compartment
UL-UFH 100/1/6	100 x 38 x 1.6mm 1 Compartment
UL-UFH 150/2/6	100 x 38 x 1.6mm 2 Compartments
UL-UFH 150/3/6	150 x 38 x 1.6mm 3 Compartments
UL-UFH 200/2/6	200 x 38 x 1.6mm 2 Compartments
UL-UFH 225/3/6	225 x 38 x 1.6mm 3 Compartments
UL-UFH 250/3/6	250 x 38 x 1.6mm 3 Compartments
UL-UFH 275/3/6	275 x 38 x 1.6mm 3 Compartments
UL-UFH 300/3/6	300 x 38 x 1.6mm 3 Compartments
UL-UFH 375/3/6	375 x 38 x 1.6mm 3 Compartments

Underfloor Trunking

Junction Box

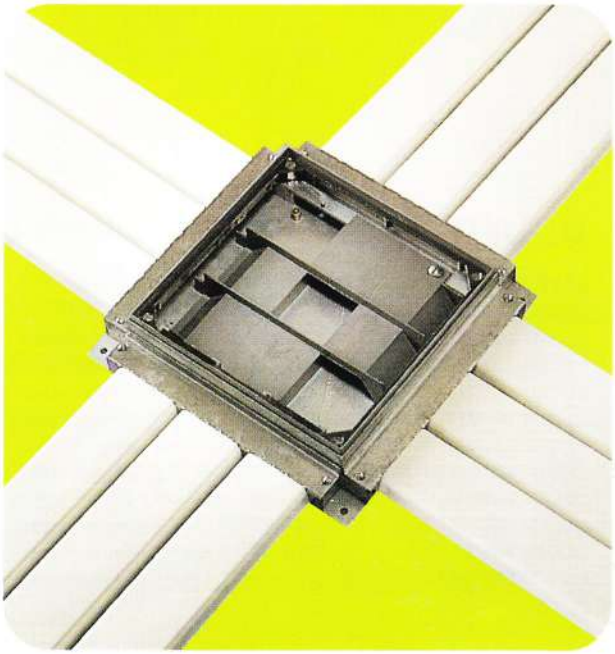
U-LI junction boxes are specially designed to facilitate cabling management in high rise buildings. U-LI junction boxes consists of three main features:

- **Box base frame**
- **Flyover bridge**
- **Trap and frame**

The box frame is made of high pressure die-cast zinc alloy, a non-ferrous and rust-proof material.

The flyover bridge can be fabricated from ABS plastic or eletro-galvanised steel with powder coating to give it a good finish. The flyover bridge which is used to segregate all the service cables can be supplied in two or three compartments.

The trap and frame are made of high pressure die-cast zinc alloy and powder coated to further enhance the rust resistance and good appearance. The trap and frame are secured by countersunk stainless steel screws, recessed 6mm to enable it to accept carpet or vinyl tile finishes.





Junction Box For Max. 25mm Depth Ductings

Product Code	Description
UL-UFJBL 250/1	250 x 125 x 53 - 70mm 1 Compartment
UL-UFJBL 250/2	250 x 250 x 53 - 70mm 2 Compartments
UL-UFJBL 250/3	250 x 250 x 53 - 70mm 3 Compartments
UL-UFJBL 300/2	300 x 300 x 53 - 70mm 2 Compartments
UL-UFJBL 300/3	300 x 300 x 53 - 70mm 3 Compartments
UL-UFJBL 375/3	375 x 375 x 53 - 70mm 3 Compartments
UL-UFJBL 400/2	400 x 400 x 53 - 70mm 2 Compartments
UL-UFJBL 400/3	400 x 400 x 53 - 70mm 3 Compartments

Junction Box For Max. 32mm Depth Ductings

Product Code	Description
UL-UFJBM 250/1	250 x 125 x 75 - 90mm 1 Compartment
UL-UFJBM 250/2	250 x 250 x 75 - 90mm 2 Compartments
UL-UFJBM 250/3	250 x 250 x 75 - 90mm 3 Compartments
UL-UFJBM 300/2	300 x 300 x 75 - 90mm 2 Compartments
UL-UFJBM 300/3	300 x 300 x 75 - 90mm 3 Compartments
UL-UFJBM 375/3	375 x 375 x 75 - 90mm 3 Compartments
UL-UFJBM 400/2	400 x 400 x 75 - 90mm 2 Compartments
UL-UFJBM 400/3	400 x 400 x 75 - 90mm 3 Compartments

Junction Box For Max. 38mm Depth Ductings

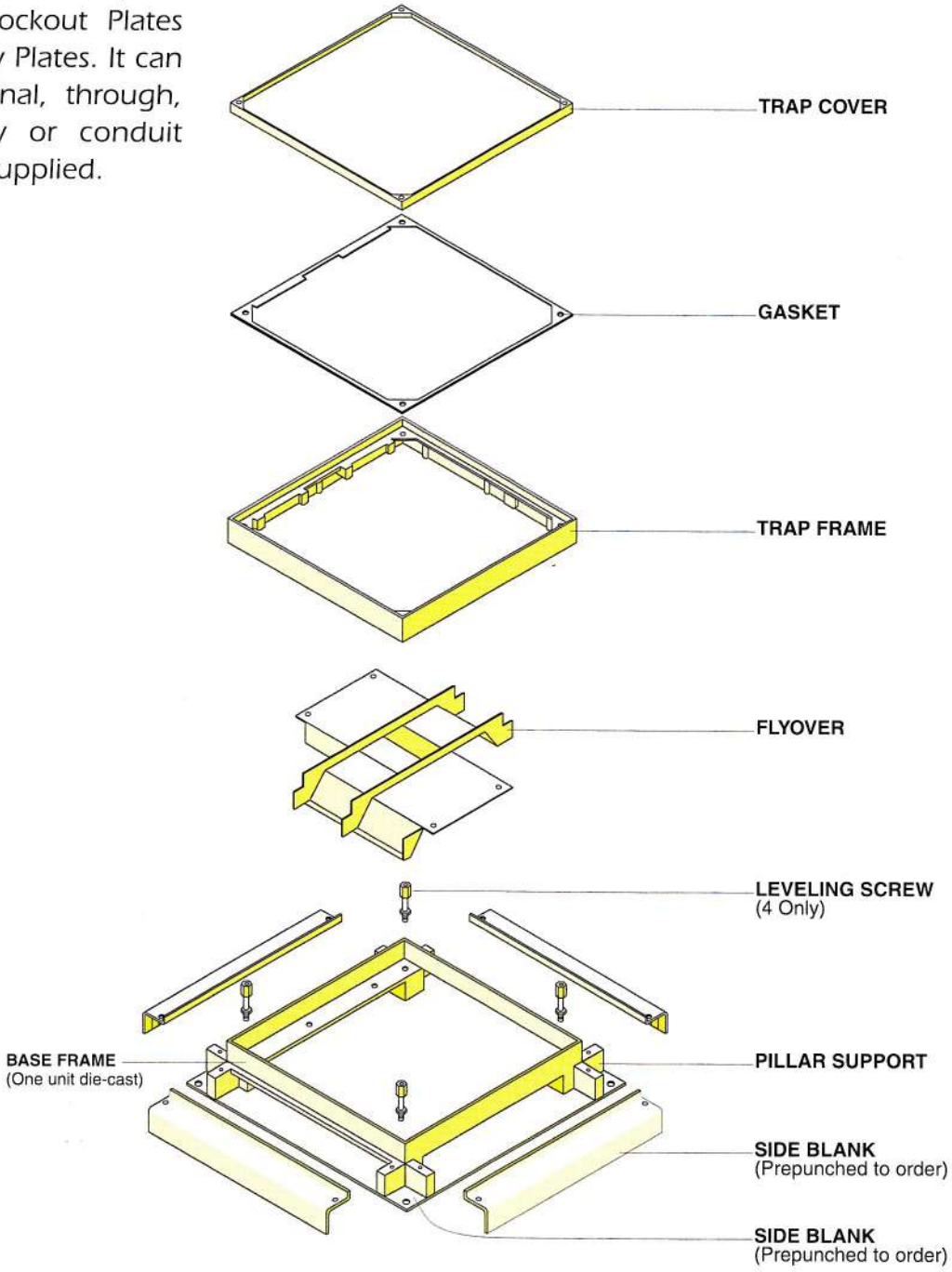
Product Code	Description
UL-UFJBH 250/1	250 x 125 x 75 - 90mm 1 Compartment
UL-UFJBH 250/2	250 x 250 x 75 - 90mm 2 Compartments
UL-UFJBH 250/3	250 x 250 x 75 - 90mm 3 Compartments
UL-UFJBH 300/2	300 x 300 x 75 - 90mm 2 Compartments
UL-UFJBH 300/3	300 x 300 x 75 - 90mm 3 Compartments
UL-UFJBH 375/3	375 x 375 x 75 - 90mm 3 Compartments
UL-UFJBH 400/2	400 x 400 x 75 - 90mm 2 Compartments
UL-UFJBH 400/3	400 x 400 x 75 - 90mm 3 Compartments

Underfloor Trunking

Junction Box

- Adjustable upwards by 15mm
- Overall depth 60mm for 25mm trunking
- Overall depth 75mm for 38mm trunking
- Lid recess 6mm

The Junction Box comes complete with 4 Conduit Knockout Plates and 4 Trunking Entry Plates. It can be used as a terminal, through, bend, tee, fourway or conduit box. Flyover is also supplied.



Underfloor Trunking

Service Outlet Box





Service Outlet Box For Max. 25mm Depth Ductings

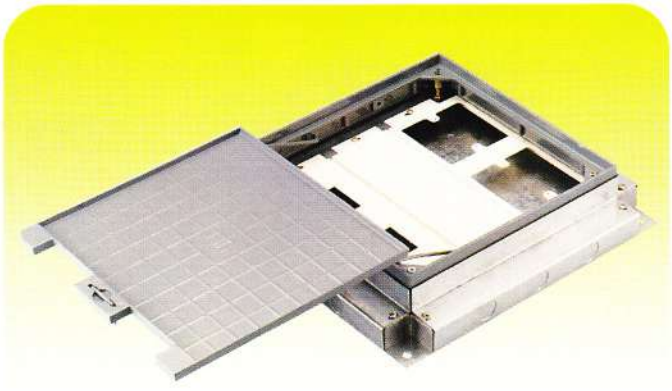
Product Code	Description
UL-UFSBL 125/1/1	125 x 125 x 53 - 70mm 1 Compartment 1 Trap
UL-UFSBL 125/2/2	125 x 125 x 53 - 70mm 2 Compartments 2 Traps
UL-UFSBL 250/1/1	250 x 125 x 53 - 70mm 1 Compartment 1 Trap
UL-UFSBL 250/2/1	250 x 250 x 53 - 70mm 2 Compartments 1 Trap
UL-UFSBL 250/2/2	250 x 250 x 53 - 70mm 2 Compartments 2 Traps
UL-UFSBL 250/3/1	250 x 250 x 53 - 70mm 3 Compartments 1 Trap
UL-UFSBL 300/2/1	300 x 300 x 53 - 70mm 2 Compartments 1 Trap
UL-UFSBL 300/3/1	300 x 300 x 53 - 70mm 3 Compartments 1 Trap
UL-UFSBL 375/3/2	375 x 250 x 53 - 70mm 3 Compartments 2 Traps
UL-UFSBL 375/3/3	375 x 250 x 53 - 70mm 3 Compartments 3 Traps

Service Outlet Box For Max. 32mm Depth Ductings

Product Code	Description
UL-UFSBM 125/1/1	125 x 125 x 75 - 90mm 1 Compartment 1 Trap
UL-UFSBM 125/2/2	125 x 125 x 75 - 90mm 2 Compartments 2 Traps
UL-UFSBM 250/1/1	250 x 125 x 75 - 90mm 1 Compartment 1 Trap
UL-UFSBM 250/2/1	250 x 250 x 75 - 90mm 2 Compartments 1 Trap
UL-UFSBM 250/2/2	250 x 250 x 75 - 90mm 2 Compartments 2 Traps
UL-UFSBM 250/3/1	250 x 250 x 75 - 90mm 3 Compartments 1 Trap
UL-UFSBM 300/2/1	300 x 300 x 75 - 90mm 2 Compartments 1 Trap
UL-UFSBM 300/3/1	300 x 300 x 75 - 90mm 3 Compartments 1 Trap
UL-UFSBM 375/3/2	375 x 250 x 75 - 90mm 3 Compartments 2 Traps
UL-UFSBM 375/3/3	375 x 250 x 75 - 90mm 3 Compartments 3 Traps

Service Outlet Box For Max. 38mm Depth Ductings

Product Code	Description
UL-UFSBH 125/1/1	125 x 125 x 75 - 90mm 1 Compartment 1 Trap
UL-UFSBH 125/2/2	125 x 125 x 75 - 90mm 2 Compartments 2 Traps
UL-UFSBH 250/1/1	250 x 125 x 75 - 90mm 1 Compartment 1 Trap
UL-UFSBH 250/2/1	250 x 250 x 75 - 90mm 2 Compartments 1 Trap
UL-UFSBH 250/2/2	250 x 250 x 75 - 90mm 2 Compartments 2 Traps
UL-UFSBH 250/3/1	250 x 250 x 75 - 90mm 3 Compartments 1 Trap
UL-UFSBH 300/2/1	300 x 300 x 75 - 90mm 2 Compartments 1 Trap
UL-UFSBH 300/3/1	300 x 300 x 75 - 90mm 3 Compartments 1 Trap
UL-UFSBH 375/3/2	375 x 250 x 75 - 90mm 3 Compartments 2 Traps
UL-UFSBH 375/3/3	375 x 250 x 75 - 90mm 3 Compartments 3 Traps



Service Outlet Box

Overall Depth: 60mm for 25mm trunking
75mm for 38mm trunking

Standard Finish: Epoxy Powder Coated

The Service Box comes complete with 2 conduit knockout plates and 2 trunking entry plates. It can be used as a trough terminal or conduit outlet module.

Outlet Plates
Must be ordered separately from Service Outlet Module.

Underfloor Trunking

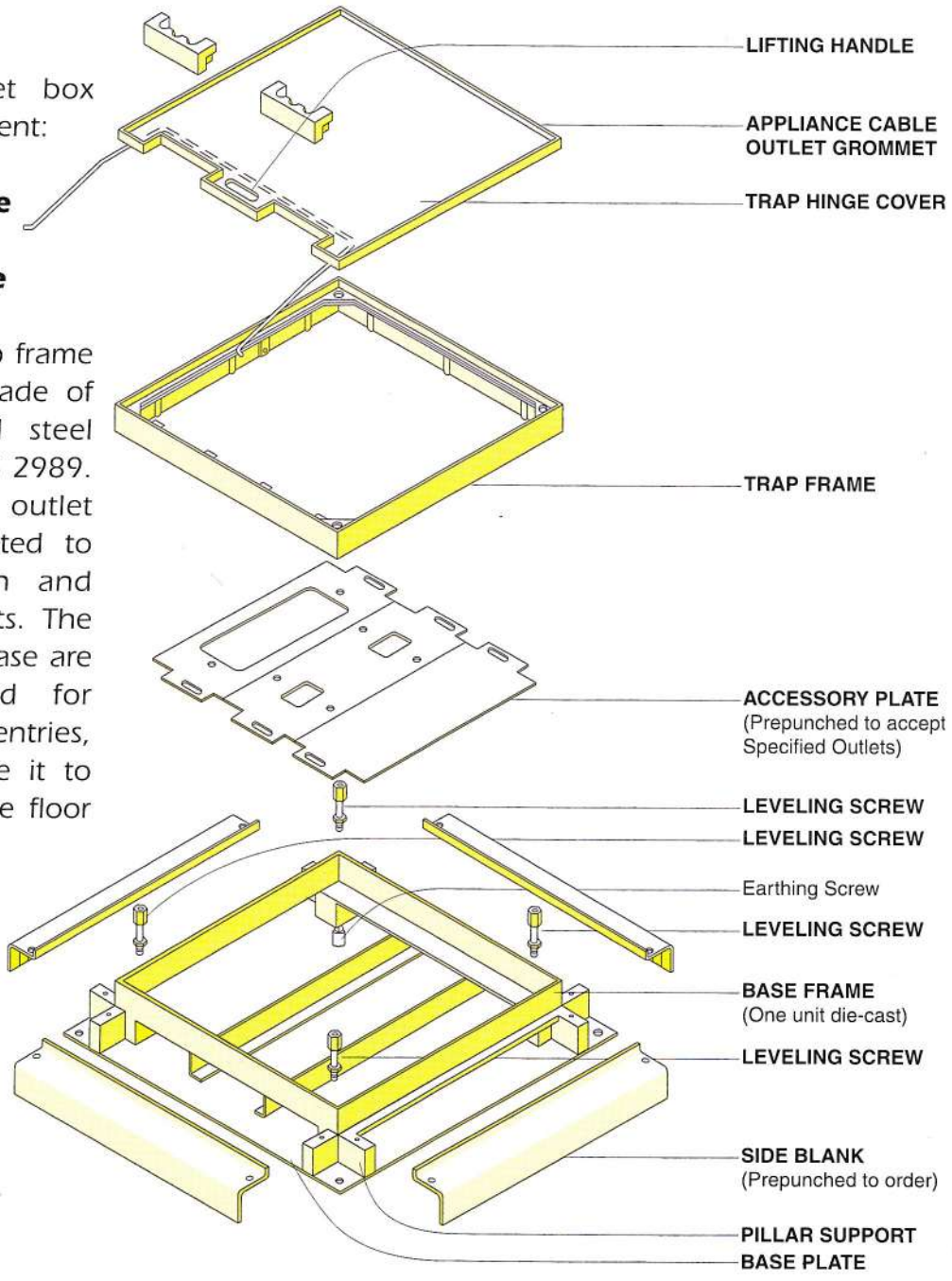
Service Outlet Box

U-LI service outlet boxes are specially designed to segregate cable for power, telephone and computer circuits. The service boxes are provided with service outlet plates that mount to the necessary outlet. The type and number of sockets can be tailor made to the customer's requirement

The U-LI service outlet box consists of three component:

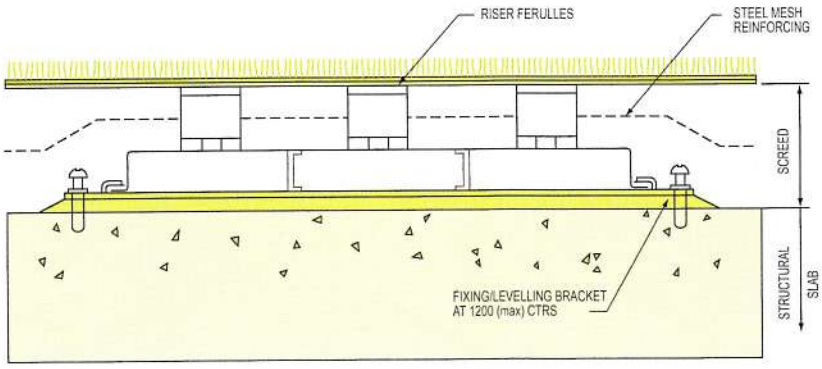
- **Box base frame**
- **Flyover bridge**
- **Trap and frame**

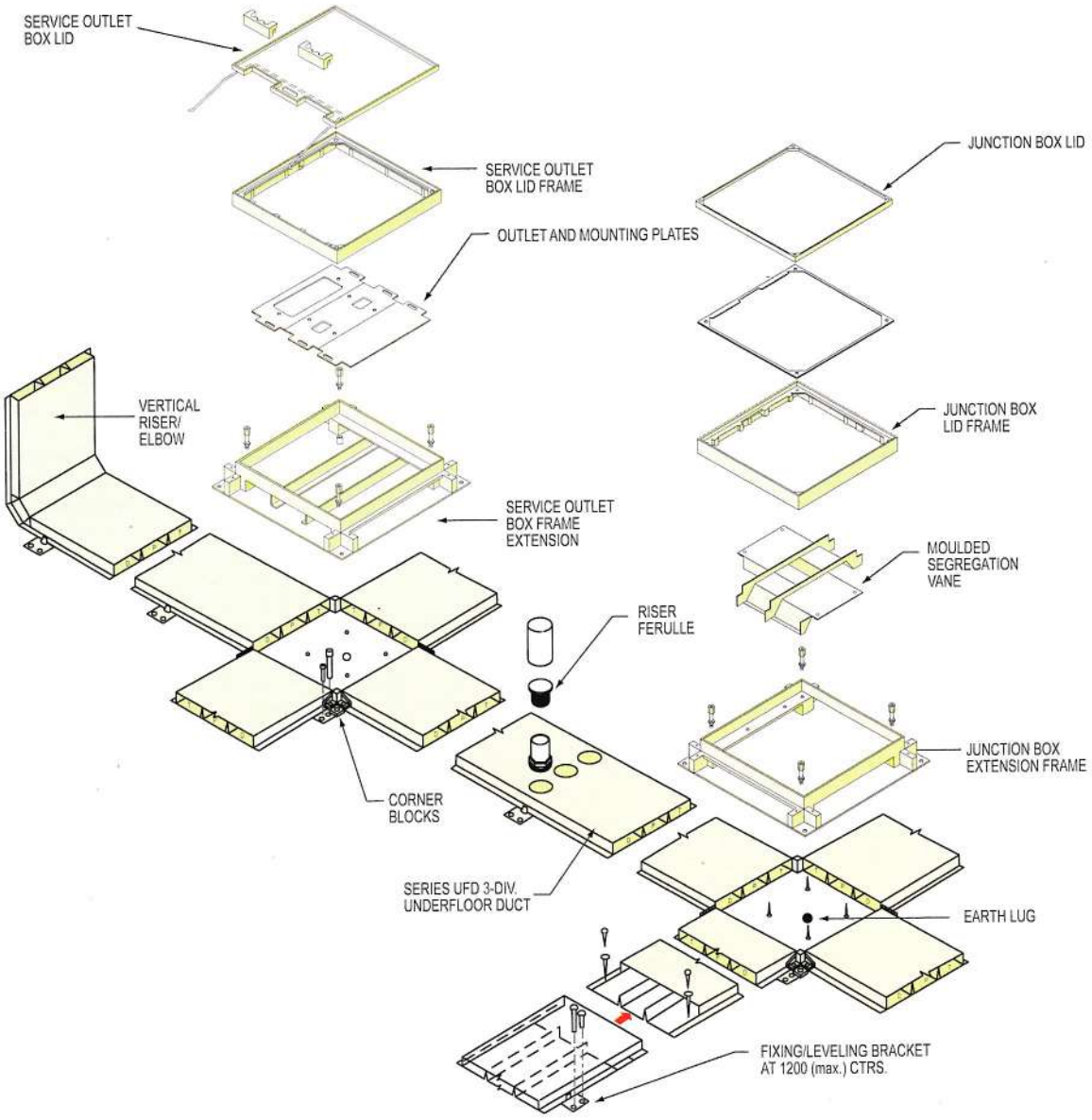
The box base frame, trap frame and outlet panel are made of hot dipped galvanised steel sheet that conform to BS 2989. Trap and frame and outlet panels are powder coated to provide a good finish and protection to visible parts. The side plates for the box base are designed to be used for trunking and conduit entries, recessed 6mm to enable it to accept carpet or vinyl tile floor finishes.



Underfloor Trunking

Underfloor Trunking System





MEGA
KABEL
SDN. BHD.
(CO. NO. 197671-P)
http://www.megakabel.com.my



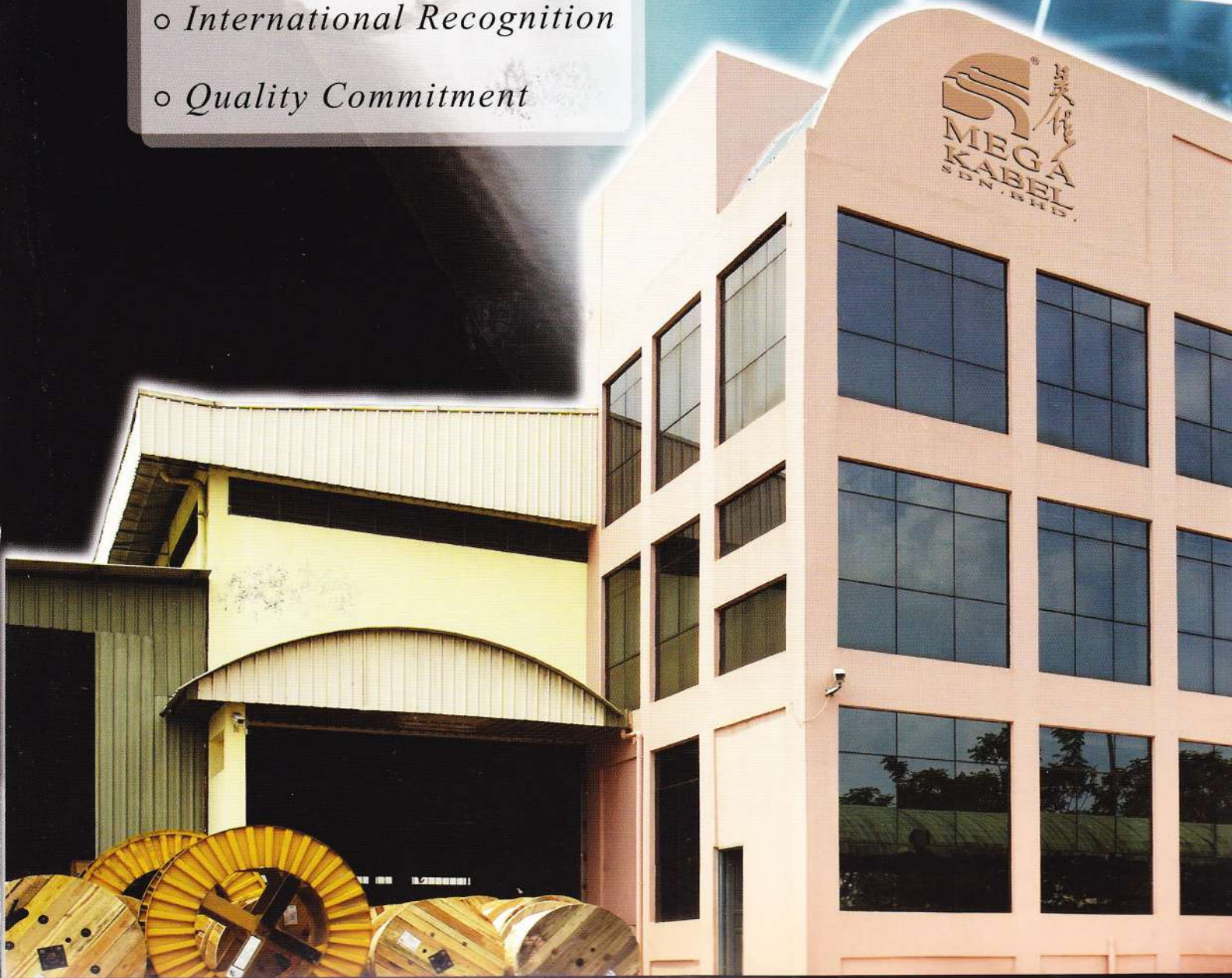
YOUR GUARANTEE OF PRECISION AND RELIABILITY

MEGA KABEL SDN. BHD. (Co. No. 197671-P)

MEGA KABEL

Company Profile

- *Introduction*
- *Corporate Philosophy*
- *Products Range*
- *Achievements*
- *International Recognition*
- *Quality Commitment*



Introduction

The Fast Track Of A Market Segment Leader

Mega Kabel Sdn Bhd was established in 1990 specifically to produce a range of effective low voltage cables for various applications.

A member of the Malaysian Cable Manufacturers Association (MCMA), Mega Kabel is now firmly entrenched in the 1 KV-and-below sector of the industry.

The company maintains a policy of strategic enlargement and diversification while still leveraging its strengths in core competencies.

As a result, Mega Kabel has gained a strong foothold in the development of new areas in wholesaler markets in Asia and Europe.



MEGA KABEL SDN. BHD. (Co. No. 197671-P)

MEGA KABEL PRODUCTS SPECIFICATION

• PVC INSULATED CABLES •



CONSTRUCTION

CONDUCTOR	:	PLAIN ANNEALED COPPER CONDUCTOR
INSULATION	:	PVC
COLOUR OF INSULATION	:	RED, YELLOW, BLUE, GREEN, BLACK AND WHITE
SHEATH	:	PVC
COLOUR OF CORES	:	SINGLE-CORE : RED OR BLACK, OTHER COLOURS UPON REQUEST
		TWIN-CORE : RED AND BLACK
		THREE-CORE : RED, YELLOW AND BLUE
		FOUR-CORE : RED, YELLOW, BLUE AND BLACK
COLOUR OF SHEATH	:	BLACK/ WHITE/ RED

PVC-INSULATED, NON-SHEATHED CABLES.

MS 136 / BS 6004 | **450 / 750 VOLTS**

MAXIMUM CONDUCTOR TEMPERATURE: 70 °C

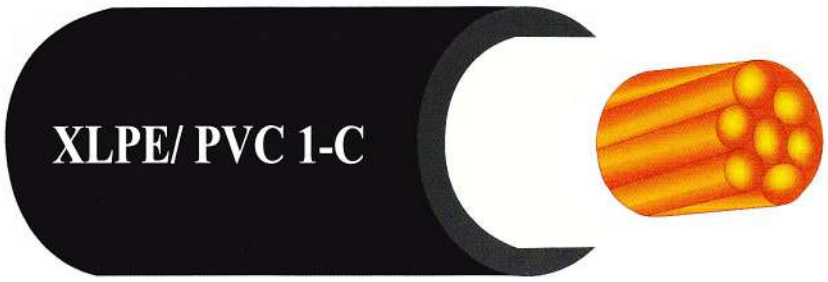
Cross Sectional Area of Conductor	Insulation Thickness	Approx. Overall Diameter (Upper Limit)	Max. Conductor Resistance at 20°C	Minimum Insulation Resistance at 70 °C	Approx. Weight Per 100 Meter
			Plain Annealed Copper		
mm^2	mm	mm	Ω/Km	MΩ/Km	Kg
1.5	0.7	3.3	12.10	0.0110	2.1
1.5	0.7	3.5	12.10	0.0100	2.1
2.5	0.8	3.9	7.41	0.0100	3.3
2.5	0.8	4.2	7.41	0.0090	3.2
4	0.8	4.8	4.61	0.0077	4.9
6	0.8	5.4	3.08	0.0065	6.9
10	1.0	6.8	1.83	0.0065	11.6
16	1.0	8.0	1.15	0.0050	17.9
25	1.2	9.8	0.727	0.0050	28.0
35	1.2	11.0	0.524	0.0040	37.5
50	1.4	13.0	0.387	0.0045	50.5
70	1.4	15.0	0.268	0.0035	71.5
95	1.6	17.0	0.193	0.0035	98.5
120	1.6	19.0	0.153	0.0032	122.0
150	1.8	21.0	0.124	0.0032	150.5
185	2.0	23.5	0.0991	0.0032	188.5
240	2.2	26.5	0.0754	0.0032	246.0
300	2.4	29.5	0.0601	0.0030	307.5
400	2.6	33.5	0.0470	0.0028	391.5
500	2.8	37.0	0.0366	0.0028	499.2
630	2.8	41.0	0.0283	0.0025	634.3
*1.25	0.7	3.5	14.6	0.0110	2.0

* Product produce according to Mega Kabel specification.

Notes : Current rating and voltage drop refer to Page A-1

MEGA KABEL PRODUCTS SPECIFICATION

• XLPE INSULATED, PVC SHEATHED CABLES •



CONSTRUCTION

CONDUCTOR	:	PLAIN ANNEALED COPPER CONDUCTOR	
INSULATION	:	XLPE (CROSS-LINKED POLYETHYLENE) RATED 90°C	
SHEATH	:	PVC	
COLOUR OF CORES	:	SINGLE-CORE	: NATURAL, RED OR BLACK, OTHER COLOURS UPON REQUEST
		TWIN-CORE	: RED AND BLACK
		THREE-CORE	: RED, YELLOW AND BLUE
		FOUR-CORE	: RED, YELLOW, BLUE AND BLACK
COLOUR OF SHEATH	:	BLACK	

XLPE INSULATED, PVC-SHEATHED CABLES.

IEC 60502 | **600 / 1000 VOLTS**

Cross Sectional Area of Conductor mm²	Shape of Conductor	Insulation Thickness mm	Sheath Thickness mm	Approx. Overall Diameter mm	Approx. Cable Weight Kg/km
16	C.C.	0.7	1.4	9.7	210
25	C.C.	0.9	1.4	11.0	310
35	C.C.	0.9	1.4	12.3	410
50	C.C.	1.0	1.4	13.7	540
70	C.C.	1.1	1.4	15.7	750
95	C.C.	1.1	1.5	17.8	1020
120	C.C.	1.2	1.5	19.7	1260
150	C.C.	1.4	1.6	21.9	1560
185	C.C.	1.6	1.6	24.1	1920
240	C.C.	1.7	1.7	27.1	2470
300	C.C.	1.8	1.8	30.5	3090
400	C.C.	2.0	1.9	33.5	4010
500	C.C.	2.2	2.0	37.4	5035
630	C.C.	2.4	2.2	42.0	6500

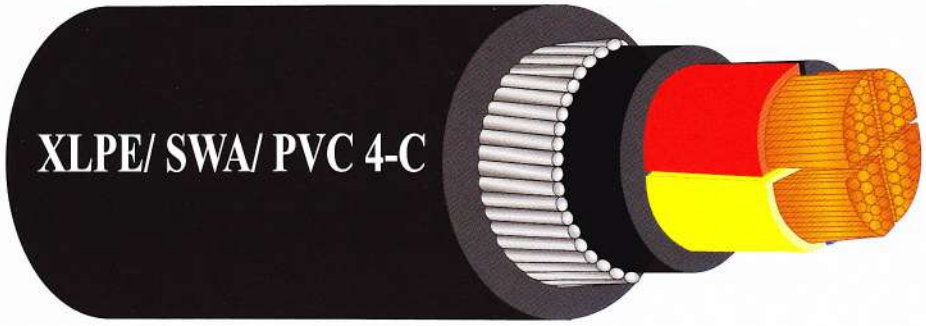
Shape : C.C. : Circular Compacted Stranded Conductor (Class 2).

Notes : Current rating and voltage drop refer to Page A-2

MEGA KABEL SDN. BHD. (Co. No. 197671-P)

MEGA KABEL PRODUCTS SPECIFICATION

• XLPE INSULATED, PVC SHEATHED ARMOURED CABLES •



XLPE-INSULATED, PVC-SHEATHED ARMOURED CABLES.

IEC 60502 | **600 / 1000 VOLTS**

Cross Sectional Area of Conductor mm²	Shape of Conductor	Insulation Thickness mm	Nominal diameter of steel wire mm	Sheath Thickness mm	Approx. Overall Diameter mm	Approx. Cable Weight Kg/km
1.5	C.S.	0.7	0.9	1.8	16.0	420
2.5	C.S.	0.7	0.9	1.8	17.0	485
4	C.S.	0.7	0.9	1.8	18.5	590
6	C.C.	0.7	0.9	1.8	19.5	715
10	C.C.	0.7	0.9	1.8	21.5	940
16	C.C.	0.7	1.6	1.8	24.5	1480
25	C.C.	0.9	1.6	1.8	28.0	1957
35	S.S.	0.9	1.6	1.9	29.5	2400
50	S.S.	1.0	1.6	2.0	32.5	3160
70	S.S.	1.1	2.0	2.2	38.0	4320
95	S.S.	1.1	2.0	2.3	41.0	5500
120	S.S.	1.2	2.5	2.5	46.0	7120
150	S.S.	1.4	2.5	2.6	51.0	8550
185	S.S.	1.6	2.5	2.8	58.0	10400
240	S.S.	1.7	2.5	3.0	64.0	13100
300	S.S.	1.8	2.5	3.2	68.0	15800
400	S.S.	2.0	3.2	3.5	77.0	21120

Colours for core identification: red, yellow blue and black.
Black sheath.

Shape : C.S. : Circular Stranded Conductor (Class 2).
C.C. : Circular Compacted Stranded Conductor (Class 2).
S.S. : Shaped Stranded Conductor (Class 2).

Notes : Current rating and voltage drop refer to Page A-6

MEGA KABEL SDN. BHD. (Co.No 197671-P)

CURRENT CARRYING CAPACITY

SINGLE CORE PVC INSULATED CABLE
SINGLE CORE PVC INSULATED PVC SHEATHED CABLE

VOLTAGE 300/500 V, 450/750V OR 600/1000V
AMBIENT TEMPERATURE 30°C
CONDUCTOR OPERATING TEMPERATURE 70°C

CURRENT CARRYING CAPACTY

Size of Conductor	Enclosed In Conduit or In Trunking		On Perforated Cable Tray		
	2 cables 1- phase ac or dc	3 or 4 cables 3- phase ac	2 cables 1- phase ac or dc flat and touching	3 or 4 cables 3- phase ac, touching	
				Flat	Trefoil
(mm²)	(amp)	(amp)	(amp)	(amp)	(amp)
1.0	13.5	12			
1.5	17.5	15.5			
2.5	24	21			
4	32	28			
6	41	36			
10	57	50			
16	76	68			
25	101	89	131	114	110
35	125	110	162	143	137
50	151	134	196	174	167
70	192	171	251	225	216
95	232	207	304	275	264
120	269	239	352	321	308
150	300	262	406	372	356
185	341	296	463	427	409
240	400	346	546	507	485
300	458	394	629	587	561
400	546	467	754	689	656
500	626	533	868	789	749
630	720	611	1005	905	855
800			1086	1020	971
1000			1216	1149	1079

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Size of Conductor	2 cables dc	2 cables 1- phase ac		3 or 4 cables 3 - phase ac		
		Enclosed in conduit	on cable tray, touching	Enclosed in conduit	on cable tray, flat and touching	on cable tray, trefoil
(mm²)	(Mv/A/m)	(Mv/A/m)	(Mv/A/m)	(Mv/A/m)	(Mv/A/m)	(Mv/A/m)
1.0	44	44	44	38	38	38
1.5	29	29	29	25	25	25
2.5	18	18	18	15	15	15
4	11	11	11	9.5	9.5	9.5
6	7.3	7.3	7.3	6.4	6.4	6.4
10	4.4	4.4	4.4	3.8	3.8	3.8
16	2.8	2.8	2.8	2.4	2.4	2.4
25	1.75	1.80	1.75	1.55	1.55	1.50
35	1.25	1.30	1.25	1.10	1.10	1.10
50	0.93	1.00	0.95	0.85	0.84	0.82
70	0.63	0.72	0.66	0.61	0.60	0.57
95	0.46	0.56	0.50	0.48	0.47	0.43
120	0.36	0.47	0.41	0.41	0.40	0.36
150	0.29	0.41	0.34	0.36	0.34	0.30
185	0.23	0.37	0.29	0.32	0.31	0.26
240	0.180	0.33	0.25	0.29	0.27	0.22
300	0.145	0.31	0.22	0.27	0.25	0.190
400	0.105	0.29	0.20	0.25	0.24	0.175
500	0.086	0.28	0.185	0.25	0.23	0.160
630	0.068	0.27	0.175	0.24	0.22	0.150
800	0.053		0.165		0.22	0.145
1000	0.042		0.160		0.21	0.140

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

MEGA KABEL SDN. BHD. (Co No. 197671-P)

CURRENT CARRYING CAPACITY

SINGLE CORE XLPE INSULATED PVC SHEATHED CABLE

VOLTAGE 600/1000 V
AMBIENT TEMPERATURE 30°C
CONDUCTOR OPERATING TEMPERATURE 90°C

CURRENT CARRYING CAPACTY

Size of Conductor	Enclosed In Conduit or In Trunking		On Perforated Cable Tray		
	2 cables 1-phase ac or dc	3 or 4 cables 3-phase ac	2 cables 1-phase ac or dc flat and touching	3 or 4 cables 3-phase ac touching	
				flat	trefoil
(mm²)	(amp)	(amp)	(amp)	(amp)	(amp)
1.0	17	15			
1.5	23	20			
2.5	31	28			
4	42	37			
6	54	48			
10	75	66			
16	100	88			
25	133	117	161	141	135
35	164	144	200	176	169
50	198	175	242	216	207
70	253	222	310	279	268
95	306	269	377	342	328
120	354	312	437	400	383
150	393	342	504	464	444
185	449	384	575	533	510
240	528	450	679	634	607
300	603	514	783	736	703
400	683	584	940	868	823
500	783	666	1083	998	946
630	900	764	1254	1151	1088
800			1358	1275	1214
1000			1520	1436	1349

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Size of Conductor	2 cables dc	2 cables 1-phase ac		3 or 4 cables 3-phase ac		
		Enclosed in conduit	on cable tray, touching	Enclosed in conduit	on cable tray, flat and touching	on cable tray trefoil
(mm²)	(mv/A/m)	(mv/A/m)	(mv/A/m)	(mv/A/m)	(mv/A/m)	(mv/A/m)
1.0	46	46	46	40	40	40
1.5	31	31	31	27	27	27
2.5	19	19	19	16	16	16
4	12	12	12	10	10	10
6	7.9	7.9	7.9	6.8	6.8	6.8
10	4.7	4.7	4.7	4.0	4.0	4.0
16	2.9	2.9	2.9	2.5	2.5	2.5
25	1.85	1.90	1.85	1.65	1.60	1.60
35	1.35	1.35	1.35	1.15	1.15	1.15
50	0.99	1.05	1.00	0.90	0.87	0.87
70	0.68	0.75	0.71	0.65	0.62	0.61
95	0.49	0.58	0.52	0.50	0.46	0.45
120	0.39	0.48	0.43	0.42	0.38	0.37
150	0.32	0.43	0.36	0.37	0.32	0.31
185	0.25	0.37	0.30	0.32	0.28	0.26
240	0.190	0.33	0.25	0.29	0.24	0.22
300	0.155	0.31	0.22	0.27	0.21	0.195
400	0.120	0.29	0.20	0.25	0.195	0.175
500	0.093	0.28	0.185	0.24	0.180	0.160
630	0.072	0.27	0.175	0.23	0.170	0.150
800	0.056		0.170		0.165	0.145
1000	0.045		0.165		0.165	0.140

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

MEGA KABEL SDN. BHD. (Co.No.197671-P)

CURRENT CARRYING CAPACITY

PVC INSULATED PVC SHEATHED MULTI-CORE CABLE

VOLTAGE 300/500V OR 600/1000 V
AMBIENT TEMPERATURE 30°C
CONDUCTOR OPERATING TEMPERATURE 70°C

CURRENT CARRYING CAPACTY

Size of Conductor	Enclosed In Conduit or In Trunking		On Perforated Cable Tray	
	two-core cable 1 phase ac or dc	three or four-core cable 3 phase ac	two core cable 1 phase ac or dc	three or four-core cable 3 phase ac
(mm²)	(amp)	(amp)	(amp)	(amp)
1.0	13	11.5	17	14.5
1.5	16.5	15	22	18.5
2.5	23	20	30	25
4	30	27	40	34
6	38	34	51	43
10	52	46	70	60
16	69	62	94	80
25	90	80	119	101
35	111	99	148	126
50	133	118	180	153
70	168	149	232	196
95	201	179	282	238
120	232	206	328	276
150	258	225	379	319
185	294	255	434	364
240	344	297	514	430
300	394	339	593	497
400	470	402	715	597

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Conductor cross-section area	Two-core cable,dc	Two-core cable, single-phase a.c	Three- or four-core, three-phase a.c
(mm²)	(mv/A/m)	(mv/A/m)	(mv/A/m)
1.0	44	44	38
1.5	29	29	25
2.5	18	18	15
4	11	11	9.5
6	7.3	7.3	6.4
10	4.4	4.4	3.8
16	2.8	2.8	2.4
25	1.75	1.75	1.50
35	1.25	1.25	1.10
50	0.93	0.94	0.81
70	0.63	0.65	0.57
95	0.46	0.50	0.43
120	0.36	0.41	0.35
150	0.29	0.34	0.29
185	0.23	0.29	0.25
240	0.180	0.24	0.21
300	0.145	0.21	0.185
400	0.105	0.185	0.160

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

MEGA KABEL SDN. BHD. (Co.No.197671-P)

CURRENT CARRYING CAPACITY

XLPE INSULATED PVC SHEATHED MULTI-CORE CABLE

VOLTAGE 600/1000 V
AMBIENT TEMPERATURE 30°C
CONDUCTOR OPERATING TEMPERATURE 90°C

CURRENT CARRYING CAPACTY

Size of Conductor	Enclosed In Conduit or In Trunking		On Perforated Cable Tray	
	two-core cable 1 phase ac or dc	three or four-core cable 3 phase ac	two core cable 1 phase ac or dc	three or four-core cable 3 phase ac
(mm²)	(amp)	(amp)	(amp)	(amp)
1	17	15	21	18
1.5	22	19.5	26	23
2.5	30	26	36	32
4	40	35	49	42
6	51	44	63	54
10	69	60	86	75
16	91	80	115	100
25	119	105	149	127
35	146	128	185	158
50	175	154	225	192
70	221	194	289	246
95	265	233	352	298
120	305	268	410	346
150	334	300	473	399
185	384	340	542	456
240	459	398	641	538
300	532	455	741	621
400	625	536	865	741

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Conductor cross-section area	Two-core cable,dc	Two-core cable, single-phase a.c	Three- or four-core, three-phase a.c
(mm²)	(mv/A/m)	(mv/A/m)	(mv/A/m)
1.0	46	46	40
1.5	31	31	27
2.5	19	19	16
4	12	12	10
6	7.9	7.9	6.8
10	4.7	4.7	4.0
16	2.9	2.9	2.5
25	1.85	1.90	1.65
35	1.35	1.35	1.15
50	0.98	1.00	0.87
70	0.67	0.69	0.60
95	0.49	0.52	0.45
120	0.39	0.42	0.37
150	0.31	0.35	0.30
185	0.25	0.29	0.26
240	0.195	0.24	0.21
300	0.155	0.21	0.185
400	0.120	0.190	0.165

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

MEGA KABEL SDN. BHD. (Co No. 197671-P)

CURRENT CARRYING CAPACITY

PVC INSULATED PVC SHEATHED
MULTI-CORE ARMOURED CABLE

VOLTAGE 600/1000 V
AMBIENT TEMPERATURE 30°C
GROUND TEMPERATURE 20°C
CONDUCTOR OPERATING TEMPERATURE 70°C

CURRENT CARRYING CAPACTY

Size of Conductor	On Perforated Cable Tray		Direct In Ground or In Duct In Ground	
	1 two- core cable 1 phase ac or dc	1 three or four-core cable 3 phase ac	1 two core cable 1 phase ac or dc	1 three or four-core cable 3 phase ac
(mm²)	(amp)	(amp)	(amp)	(amp)
1.5	22	19	22	18
2.5	31	26	29	24
4	41	35	37	30
6	53	45	46	38
10	72	62	60	50
16	97	83	78	64
25	128	110	99	82
35	157	135	119	98
50	190	163	140	116
70	241	207	173	143
95	291	251	204	169
120	336	290	231	192
150	386	332	261	217
185	439	378	292	243
240	516	445	336	280
300	592	510	379	316
400	683	590		

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Conductor cross-section area	Two-core cable,dc	Two-core cable, single-phase a.c	Three- or four-core, three-phase a.c
1	2	3	4
(mm²)	(mv/A/m)	(mv/A/m)	(mv/A/m)
1.5	29	29	25
2.5	18	18	15
4	11	11	9.5
6	7.3	7.3	6.4
10	4.4	4.4	3.8
16	2.8	2.8	2.4
25	1.75	1.75	1.50
35	1.25	1.25	1.10
50	0.93	0.94	0.81
70	0.63	0.65	0.57
95	0.46	0.50	0.43
120	0.36	0.41	0.35
150	0.29	0.34	0.29
185	0.23	0.29	0.25
240	0.180	0.24	0.21
300	0.145	0.21	0.185
400	0.105	0.185	0.160

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

CURRENT CARRYING CAPACITY

XLPE INSULATED PVC SHEATHED
MULTI-CORE ARMOURED CABLE

VOLTAGE 600/1000 V
AMBIENT TEMPERATURE 30°C
GROUND TEMPERATURE 20 °C
CONDUCTOR OPERATING TEMPERATURE 90°C

CURRENT CARRYING CAPACTY

Size of Conductor	On Perforated Cable Tray		Direct In Ground or In Duct In Ground	
	1 two-core cable 1 phase ac or dc	1 three or four-core cable 3 phase ac	1 two core cable 1 phase ac or dc	1 three or four-core cable 3 phase ac
(mm²)	(amp)	(amp)	(amp)	(amp)
1.5	29	25	25	21
2.5	39	33	33	28
4	52	44	43	36
6	66	56	53	44
10	90	78	71	58
16	115	99	91	75
25	152	131	116	96
35	188	162	139	115
50	228	197	164	135
70	291	251	203	167
95	354	304	239	197
120	410	353	271	223
150	472	406	306	251
185	539	463	343	281
240	636	546	395	324
300	732	628	446	365
400	847	728		

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Conductor cross-section area	Two-core cable,dc	Two-core cable, single-phase a.c	Three- or four-core, three-phase a.c
1	2	3	4
(mm²)	(mv/A/m)	(mv/A/m)	(mv/A/m)
1.5	31	31	27
2.5	19	19	16
4	12	12	10
6	7.9	7.9	6.8
10	4.7	4.7	4
16	2.9	2.9	2.5
25	1.85	1.90	1.65
35	1.35	1.35	1.15
50	0.98	1.00	0.87
70	0.67	0.69	0.60
95	0.49	0.52	0.45
120	0.39	0.42	0.37
150	0.31	0.35	0.30
185	0.25	0.29	0.26
240	0.195	0.24	0.21
300	0.155	0.21	0.185
400	0.120	0.190	0.165

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

CURRENT CARRYING CAPACITY

XLPE INSULATED PVC SHEATHED
SINGLE-CORE ARMOURED CABLE

VOLTAGE 600/1000 V
AMBIENT TEMPERATURE 30°C
CONDUCTOR OPERATING TEMPERATURE 90°C

CURRENT CARRYING CAPACTY

Size of Conductor	On Perforated Cable Tray	On Perforated Cable Tray	
	two cables 1-phase ac or dc flat and touching	Three or four cables three phase ac touching	
		flat	trefoil
(mm²)	(amp)	(amp)	(amp)
50	253	232	222
70	322	293	285
95	389	352	346
120	449	405	402
150	516	462	463
185	587	524	529
240	689	612	625
300	792	700	720
400	899	767	815
500	1016	851	918
630	1146	935	1027
800	1246	987	1119
1000	1345	1055	1214

VOLTAGE DROP

VOLTAGE DROP (PER AMP PER METER)

Size of Conductor	On Perforated Cable Tray		On Perforated Cable Tray	
	two cables ,dc	two cables, 1 phase ac, touching	three or four cables, three-phase, ac, touching	
			flat	trefoil
(mm²)	(mv/A/m)	(mv/A/m)	(mv/A/m)	(mv/A/m)
50	0.98	1.00	0.88	0.87
70	0.67	0.71	0.65	0.62
95	0.49	0.55	0.52	0.47
120	0.39	0.45	0.44	0.39
150	0.31	0.38	0.39	0.33
185	0.25	0.33	0.34	0.28
240	0.195	0.28	0.30	0.24
300	0.155	0.25	0.28	0.21
400	0.115	0.22	0.27	0.195
500	0.093	0.21	0.25	0.180
630	0.073	0.195	0.24	0.170
800	0.056	0.190	0.23	0.165
1000	0.045	0.180	0.21	0.155

Note : Correction factors for ambient temperature and group installation, please refer Page B-1

CORRECTION FACTORS FOR AMBIENT TEMPERATURE AND GROUP INSTALLATION

AMBIENT TEMPERATURE			10	15	20	25	30	35	40	45
IN AIR	PVC	70 °C				1.03	1	0.94	0.87	0.79
	XLPE	90 °C				1.02	1	0.96	0.91	0.87

AMBIENT TEMPERATURE				50	55	60	65	70	75	80
IN AIR	PVC	70 °C		0.71	0.61	0.5				
	XLPE	90 °C		0.82	0.76	0.71	0.65	0.58	0.5	0.41

AMBIENT TEMPERATURE			10	15	20	25	30	35	40	45
IN	PVC	70 °C	1.10	1.05	1.00	0.95	0.89	0.84		
GROUND	XLPE	90 °C	1.07	1.04	1.00	0.96	0.93	0.89	0.85	0.80

GROUP INSTALLATION	Number of Circuits or Multi-Core Cables						
	2	3	4	5	6	7	8
Enclosed in Conduit or in Trunking	0.80	0.70	0.65	0.60	0.57	0.54	0.52
	9	10	12	14	16	18	20
	0.5	0.48	0.45	0.43	0.41	0.39	0.38

GROUP INSTALLATION			Number of Circuits or Multi-Core Cables					
			1	2	3	4	5	6
On a Perforated Cable Tray, Single core Single Layer Touching	Touching (Flat)	Horizontal	0.98	0.91	0.87			
		Vertical	0.96	0.86	-			
	Spaced* (Trefoil)	Horizontal	1.0	0.98	0.96			
		Vertical	1.0	0.91	0.89			

GROUP INSTALLATION			Number of Circuits or Multi-Core Cables						
			2	3	4	5	6	7	8
On a Perforated Cable Tray, Multi-core Layer Vertical or Horizontal	Touching		0.88	0.82	0.77	0.75	0.73	0.73	0.72
	Spaced*	Horizontal	1.0	0.98	0.95	-	0.91	-	-
		Vertical	0.91	0.89	0.88	-	0.87	-	-
			9	10	12				
	Touching		0.72	0.72	0.72				
	Spaced*	Horizontal	-	-	-				
		Vertical	-	-	-				

* " Spaced " means a clearance between adjacent surface of at least one cable diameter (De). Where the horizontal clearences between adjacent cable exceeds 2 x De, no correction factor need to be applied.

CORRECTION FACTORS FOR AMBIENT TEMPERATURE AND GROUP INSTALLATION

GROUP INSTALLATION		Number of Circuits or Multi-Core Cables						
		2	3	4	5	6	7	8
Laid Directly In The Ground	Touching	0.75	0.65	0.6	0.55	0.5	-	-
	Spaced*	0.8	0.7	0.6	0.55	0.55	-	-

GROUP INSTALLATION		Number of Circuits or Multi-Core Cables						
		2	3	4	5	6	7	8
Laid In Duct In The Ground	Touching	0.85	0.75	0.7	0.65	0.6	-	-
	Spaced*	0.90	0.85	0.80	0.80	0.80	-	-

Value given apply to an installation depth of 0.7 m and a soil thermal resistivity of 2.5 K.m/W

Spaced *

Laid direct , one cable diameter clearance

Laid in duct , 0.25m duct-to-duct clearance

SHORT CICRCUIT CURRENT FOR XLPE AND PVC INSULATED CABLES

VOLTAGE 450/750V AND 600/1000V

COPPER CONDUCTOR SIZE	MAX.CONDUCTOR RESISTANCE AT 20°C	SHORT CIRCUIT CURRENT RATING AT 1 SECOND	
		XLPE CABLE	PVC CABLE
(mm²)	ohm/km	KA	KA
1.5	12.1	0.215	0.173
2.5	7.41	0.358	0.288
4	4.61	0.572	0.46
6	3.08	0.858	0.69
10	1.83	1.43	1.15
16	1.15	2.288	1.84
25	0.727	3.575	2.875
35	0.524	5.005	4.025
50	0.387	7.15	5.75
70	0.268	10.01	8.05
95	0.193	13.585	10.925
120	0.153	17.16	13.8
150	0.124	21.45	17.25
185	0.0991	26.455	21.275
240	0.0754	34.32	27.6
300	0.0601	42.9	34.5
400	0.047	57.2	41.2
500	0.0366	71.5	51.5
630	0.0283	90.09	64.89
800	0.0221	114.4	82.4
1000	0.0176	143	103

NOTE :

XLPE Cable $I = \frac{0.143\ A}{\sqrt{t}}$

PVC Cable $I = \frac{0.115\ A}{\sqrt{t}}$ For A equal and less than 300 mm²

$I = \frac{0.103\ A}{\sqrt{t}}$ For A greater than 400 mm²

I : SHORT CICUIT CURRENT in KA

A : CONDUCTOR CROSS-SECTION AREA in mm²

t : TIME OF SHORT CIRCUIT in second

Olympic Cable

LPCB
Cert No: 1122A

JKR

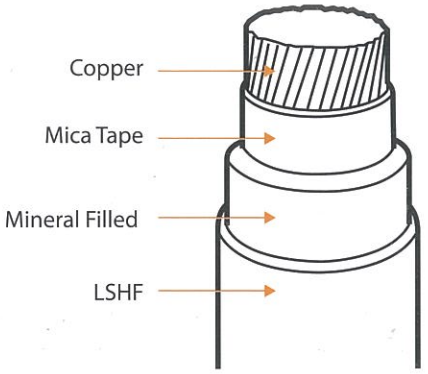
PSB TEST

Fire Resistant Cables



Fire Resistant Cables (MI)





600/1000 V FRMI Non-Armoured Fire Resistant Cables

Application

These cables offer enhanced circuit integrity over the same rated power cable. It is mainly used in installation where vital circuits are required to continue to operate in the event of a fire. It is suited for use in public buildings like shopping complex, hospitals, theatres, mass transit utilities, oil & gas plants, etc.

Specification

Mica fire barrier, cross-linked low smoke halogen free mineral insulated, low smoke halogen free compound inner sheathed, with or without metallic screen copper tape, low smoke halogen free compound outer sheathed Non-Armoured FRMI cables meets the following cable specifications :

BS 6387	Performance requirements for cables to maintain circuit integrity under fire conditions
IEC 60331	Fire resisting characteristics of electric cables
IEC 60332-1	Flame retardant characteristics of electric cables
IEC 60332-3	Tests on electric cables under fire conditions Part 3 : Tests on bunched wires or cables
IEC 60754	Test on gases evolved during combustion of materials from cables
IEC 61034	Measurement of smoke density of cables burning under defined conditions

Construction

The conductor comprises of circular / compacted circular stranded plain annealed copper wires according to IEC 60228. The insulation material consists of a layer of extruded cross-linkable low smoke halogen free mineral filled polyolefin material (FRMI) with a temperature index of 300°C as per IEC 60092/351 HF 90.

The core identification is by coloured insulation FRMI or bicolour lining throughout the core length.

For multicore cables, the cores shall be laid up with non-hygroscopic material as the filler and a layer of binder shall be applied over the laid up cores.

The inner sheath shall consists of a layer of extruded low smoke halogen free mineral filled (LSHF) compound applied over the FRMI insulation for single core cable and the binder around the laid up cores for multicore cables.

The cable may also consist a layer of metallic screen to serve as the short circuit current carrier which is helically applied with suitable overlap over the LSHF inner sheathing.

The outer sheathing shall consist of a layer of extruded LSHF compound in accordance with IEC 60092-359. Special outer sheathing material such as LSHF with termite or rodent protection and UV protection are available upon request.

1 Core CU/MICA/XLEVA/SCT/LSHF 600/1000V (FRMI)

Nominal cross-sectional area (mm2)	Approx. Overall Diameter (mm)	Approx. Cable Weight (kg/km)	Test Voltage (kV/5min)	Max. phase conductor DC resistance at 20°C (Ω/km)	Current rating based on clipped direct at 30°C (Amp)	Current rating based on laid in air at 40°C (Amp)	Volt drop for 3 phase (V/A/km)
1.5	8.4	102	3.5	12.1	23	21	27
2.5	8.8	117	3.5	7.41	31	29	16
4	9.4	140	3.5	4.61	41	37	10
6	10.1	171	3.5	3.08	54	46	6.8
10	10.9	221	3.5	1.83	74	62	4.0
16	11.8	288	3.5	1.15	99	94	2.5
25	13.5	406	3.5	0.727	130	126	1.60
35	14.7	512	3.5	0.524	161	156	1.15
50	16.2	654	3.5	0.387	209	202	0.87
70	18.0	876	3.5	0.268	268	259	0.61
95	20.0	1148	3.5	0.193	326	315	0.45
120	21.5	1397	3.5	0.153	379	366	0.37
150	23.6	1700	3.5	0.124	436	421	0.31
185	25.7	2089	3.5	0.0991	500	481	0.26
240	28.5	2668	3.5	0.0754	590	569	0.22
300	30.9	3265	3.5	0.0601	681	655	0.20
400	35.1	4164	3.5	0.0470	793	742	0.18
500	38.6	5240	3.5	0.0366	904	835	0.16
630	43.4	6720	3.5	0.0283	1033	935	0.15
800	48.3	8471	3.5	0.0221	1179	1018	0.15
1000	52.1	10452	3.5	0.0176	1323	1105	0.14

Note :

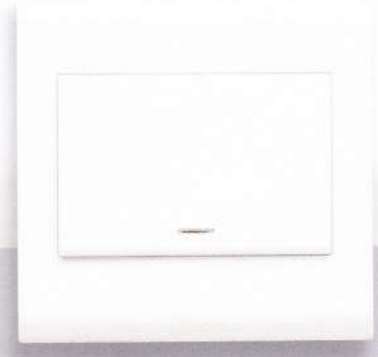
1. The cables having conductors of nominal cross-sectional area 10mm^2 and below are available upon request.

* The content of this catalogue is provided for information only and is to the best of our knowledge correct at the time of printing. The company makes no representations or warranties about the accuracy, reliability, completeness or timeliness of the information in this catalogue. The company in its sole discretion may revise the information contained herein at any time without prior notice. Users should independently evaluate the suitability of each product for the desired application.

A brand of

MEGAPOWER | legrand

5IMPLE REASONS TO SWITCH





BELANKO™ / NEW RANGE OF WIRING DEVICES

legrand®

legrand®

5IMPLE REASONS TO SWITCH TO BELANKO™

With Belanko™, simplicity is beauty. Now, discover 5 good reasons why Belanko™ should be your choice for wiring devices.

IDEAL CHO1CE 02
NEAT PRE2ENTATION 04
EASY & SAF3 INSTALLATION 06
MORE FUNCTION4LITIES 08
WIDE AS5ORTMENT 12
PRODUCT CATALOGUE 14

legrand®

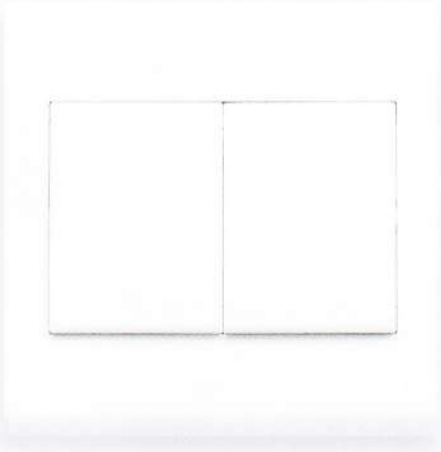
IDEAL CHO1CE



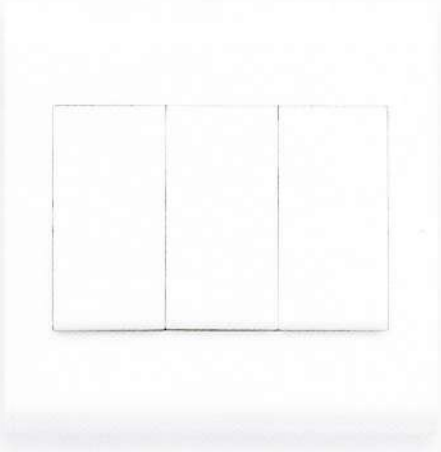
With Belanko™, switches perform exactly the way you expect them to. Beyond performance, we give you a choice between large rockers and the conventional small one.



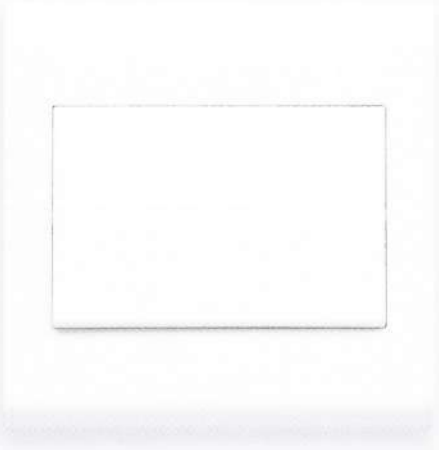
It is your choice. Go with the large rockers that feature 1 to 4 gangs.



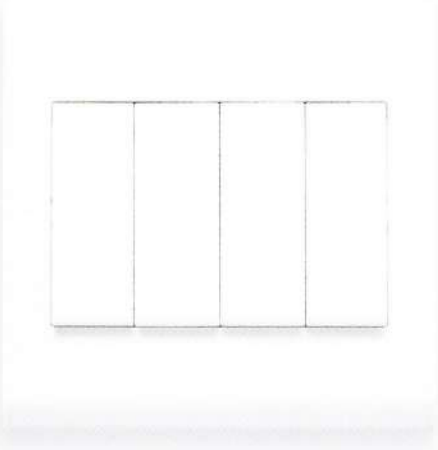
FUNCTIONAL AND RELIABLE
2 gang switch with large rocker



COMPACT AND VERSATILE
3 gang switch with large rocker



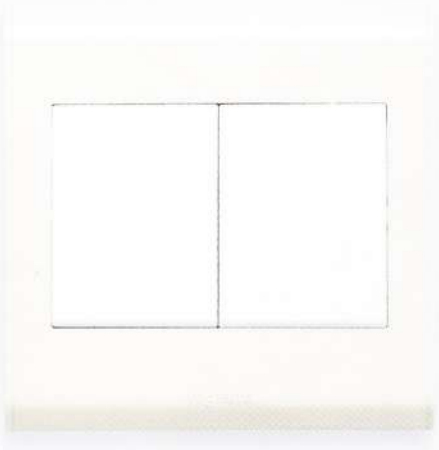
CONTEMPORARY AND APPEALING
1 gang switch with large rocker



AESTHETICS MEETS FUNCTION
4 gang switch with large rocker

Colour Plates

Something more to go along with?



SUBTLE BEIGE
2 gang switch with large rocker and beige plate



DISTINCTIVE TAUPE
Double pole switch with red neon indicator and large rocker and taupe plate

NEAT PRE2ENTATION

We know how important it is for professionals like you to deliver perfect installations fast – always. Because your goal is also our goal, we ensure that our switches are always neatly wrapped with a soft protection film.



You now enjoy peace of mind. Your switch stays clean and neat until it is delivered to the customer.



The soft protection film keeps the product safe from dust.



Only the soft protection film will get stained by the ongoing wall paintwork.



The result is a perfectly neat installation – every time.

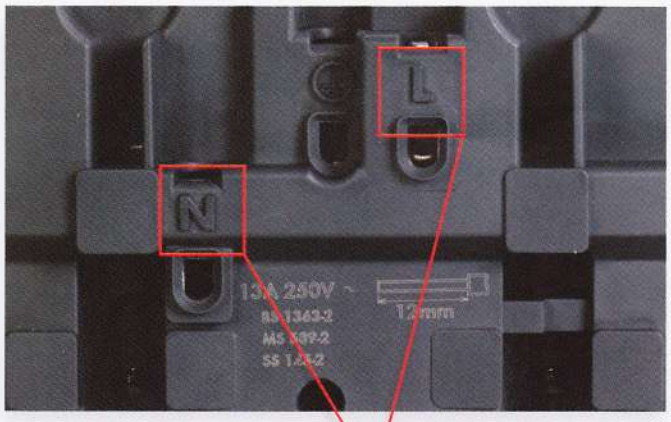
EASY & SAF3 INSTALLATION





Fitting switches is probably only one of the many tasks that you have to undertake. By making sure that installation is safe and easy, you are left with more time to tackle other tasks.

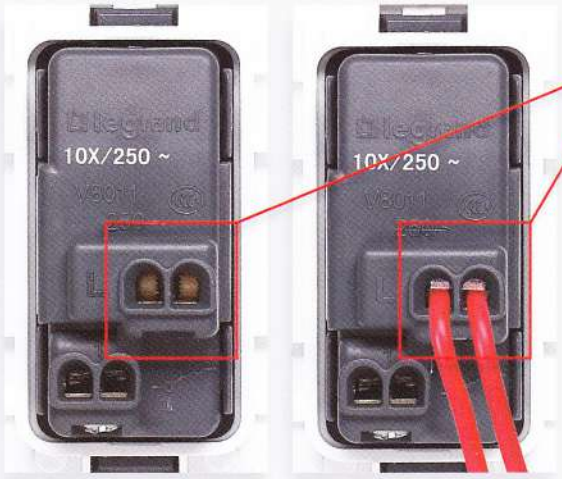
The safety features of Belanko™ wiring devices make installation both easy and safe.



Clear marking of terminals for easy identification and safe wiring



Double entry for each terminal facilitates wiring



Wires are held in place with the clamping plate. This reduces the risk of damaging wires. The combination of double entry and clamping plate ensures long term reliability of the connection.

Certified Quality

Your safety is our top priority. That's why Belanko™ wiring devices are compliant with safety standards.



legrand®

MORE FUNCTION4LITIES





Need something extra? Belanko™ has just that.
We provide additional functions to suggest just a few more possibilities to meet your everyday lifestyle needs.

For enhanced comfort, Belanko™ offers dimming solutions for complex lighting.

1000W Dimmer

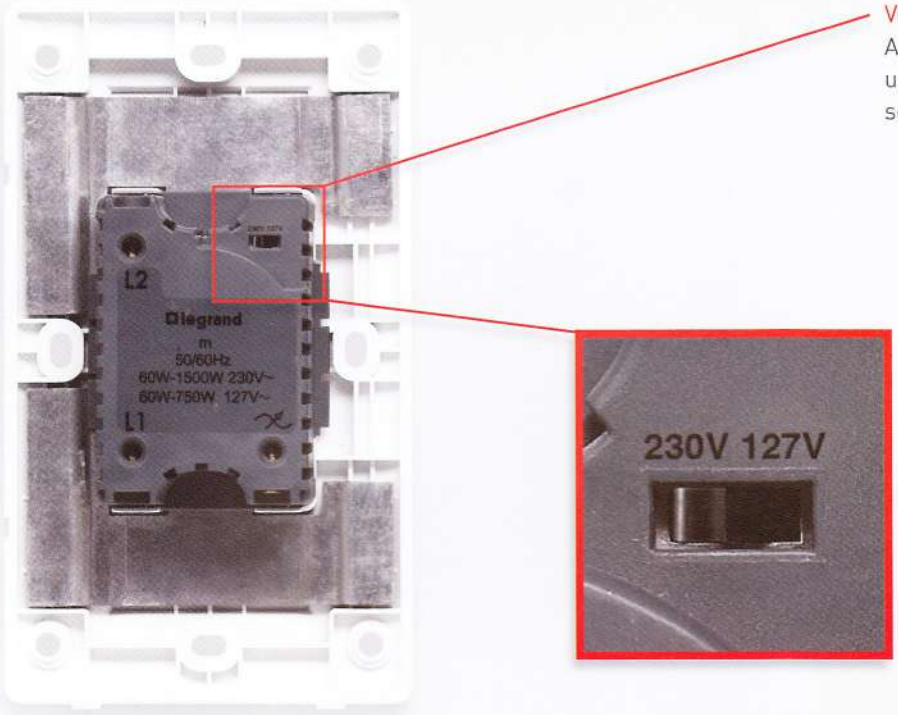


1500W Dimmer

1000W and 1500W Dimmers

These new 2-way Push ON/OFF Rotary dimmers can be associated with a switch for remote ON/OFF control from another point in the installation.

They memorise the last light level set before switch-off – and when switched on again, light level will be restored as previously memorised.



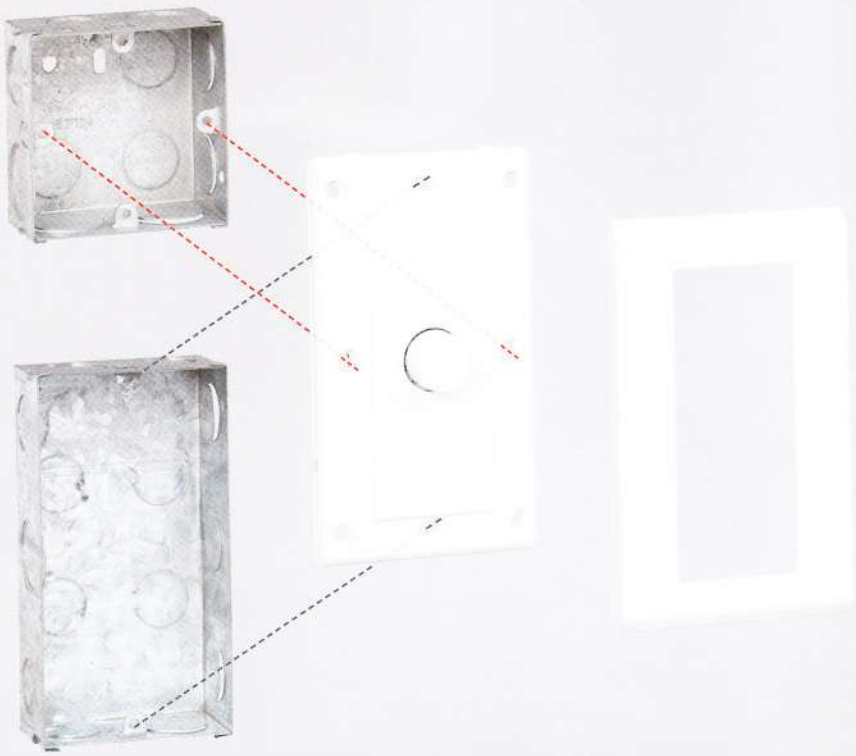
Voltage Selection (for 1500W dimmers)

A rated voltage converting switch on the upper right part of the base allows you to select – 230V or 127V. Factory setting is 230V.

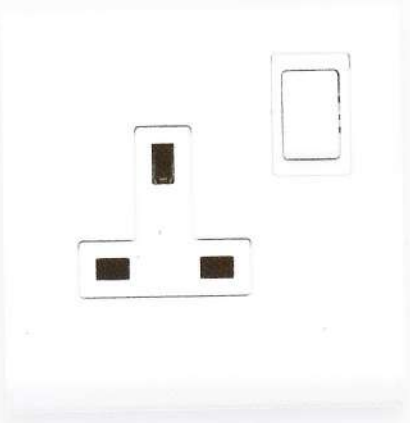
MORE FUNCTION4LITIES

1500W dimmer
Ideal for upgrade or retrofit

With the 1500W dimmer, upgrading of existing installations is really easy. It can be fitted in either 1 gang or 2 gang boxes, so that there is no need to change boxes in case of retrofit.



Safely connected to power – in different standards



1 gan single pole switched with external rocker



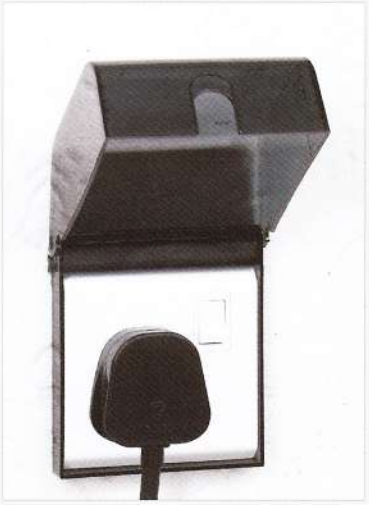
15 A US socket outlet, 2P + E



16 A German standard socket outlet, 2P + E

Socket protection IP44





The splash-proof cover for socket protection ensures IP44 with or without plug engaged.





Single TV socket, "F" type

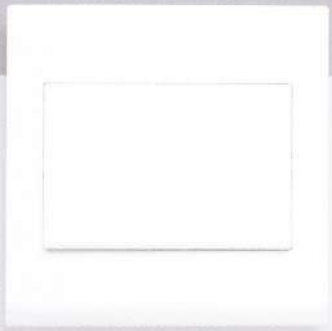
Get connected with TV, telephone and data sockets

Complete with TV, telephone and data sockets, Belanko™ not only keeps you connected to power but also to the rest of the world.

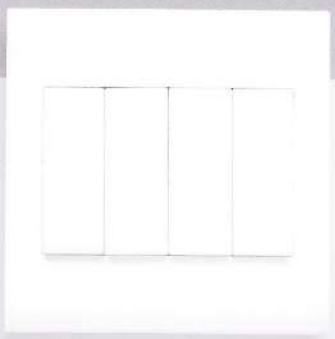
Double RJ 11 socket

Double RJ 45 socket

WIDE AS5ORTMENT



1 gang switch



4 gang switch



1 gang switch with red neon indicator



1500W Push ON/OFF Rotary dimmer

Fan control



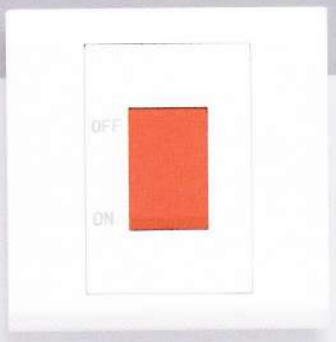
Single TV socket, "F" type

Double RJ 11 telephone socket

Double RJ 45 data socket



Push-button with bell symbol



45 A Double pole switch



1000W Push ON/OFF
Rotary dimmer



Key card switch



Hotel bedroom call indicators



Multistandard socket outlet

Fused connection unit

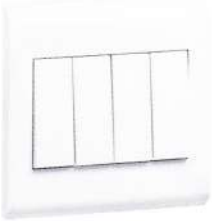
Cable outlet

PRODUCT CATALOGUE

Belanko™
single pole switches and push-buttons, large rocker



6 171 00



6 170 06

Colour: White T084
Material: Thermoplastic with glossy finish
Dimensions: 86 x 86 x 9.5 mm (1 gang) / 86 x 146 x 9.5 mm (2 gang)
Supplied with 2 screws M3.5 for BS boxes

Pack	Cat.Nos	Single pole switches - large rocker
		Conform to BS EN 60669-1
		10 AX - 250 V~
10	6 170 00	1 gang - 1-way switch
10	6 170 01	1 gang - 2-way switch
10	6 170 02	2 gang - 1-way switch
10	6 170 03	2 gang - 2-way switch
10	6 170 04	3 gang - 1-way switch
10	6 170 05	3 gang - 2-way switch
10	6 170 06	4 gang - 1-way switch
10	6 170 07	4 gang - 2-way switch
10	6 170 09	Intermediate switch
		20 AX - 250 V~
10	6 170 20	1 gang - 1-way
10	6 170 21	1 gang - 2-way
10	6 170 22	2 gang - 1-way
10	6 170 23	2 gang - 2-way

Belanko™
single pole switches and push-buttons, large rocker

6 170 11

Colour: White T084
Material: Thermoplastic with glossy finish
Dimensions: 86 x 86 x 9.5 mm (1 gang) / 86 x 146 x 9.5 mm (2 gang)
Supplied with 2 screws M3.5 for BS boxes

Pack	Cat.Nos	Push-button 4 A - 250 V~
		Conform to BS EN 60669-1
10	6 170 11	Bell push
10	6 170 15	2 gang push button

Belanko™
double pole switches and cooker control unit



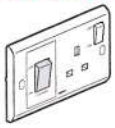
6 170 72



6 170 76

Colour: White T084
Material: Thermoplastic with glossy finish
Dimensions: 86 x 86 x 9.5 mm (1 gang) / 86 x 146 x 9.5 mm (2 gang)
Supplied with 2 screws M3.5 for BS boxes

Pack	Cat.Nos	Double pole switches
		Conform to BS EN 60669-1
		20 A - 250 V~
10	6 170 70	 1 gang - 1-way switch + red neon indicator
10	6 170 71	 1 gang - 1-way switch + red neon indicator + earth connection
10	6 170 72	 1 gang - 1-way switch + red neon indicator + earth connection with "Water Heater" marking
		32 A - 250 V~
10	6 170 74	 1 gang - 1-way switch + red neon indicator, white rocker
		45 A - 250 V~
10	6 170 75	 1 gang - 1-way switch
10	6 170 76	 1 gang - 1-way switch + red neon indicator

		Cooker Control Unit - 250 V
5	6 170 78	 45 A DP switch + red neon and 13 BS switched socket outlet + red neon

Belanko™
dimmers and ventilation control



6 170 31



6 170 33

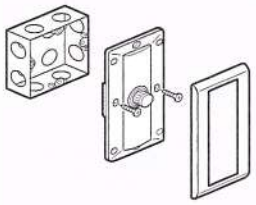
Colour: White T084
Material: Thermoplastic with glossy finish
Dimensions: 86 x 86 x 9.5 mm (1 gang) / 86 x 146 x 9.5 mm (2 gang)
Supplied with 2 screws M3.5 for BS boxes

Pack	Cat.Nos	Dimmers
		Conform to BS EN 60669-1
1	6 170 30	 600 W - 230 V 50 Hz 1 gang - 1-way 86 x 86 mm Rotary on/off dimmer
1	6 170 31	 1000 W (230 V) - 500 W (127 V) 50/60 Hz 1 gang - 2-way 86 x 86 mm Push on/off and rotary dimmer
1	6 170 32	 1500 W (230 V) - 750 W (127 V) 50/60 Hz 2 gang - 2-way 86 x 146 mm Push on/off and rotary dimmer Can be mounted on 1 gang or 2 gang boxes

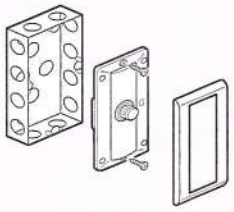
		Ventilation control
		Conform to BS EN 60669-1
1	6 170 33	 Fan control 250 V~ 50 Hz

Belanko™
dimmers

■ Fixing in 1 or 2 gang boxes - Dimmer Cat.No 6 170 32 - 1500 W



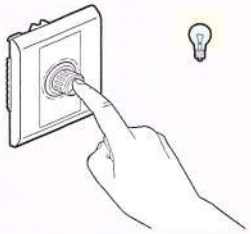
Preparation with 1-gang box



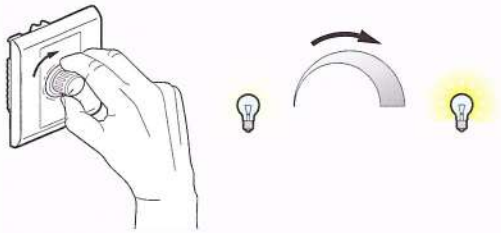
Preparation with 2-gang box

■ Choose your brightness adjustment - Dimmer Cat.Nos 6 170 31/0 32 - 1000 W / 1500 W

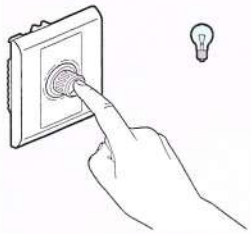
Push ON/OFF and rotary dimming



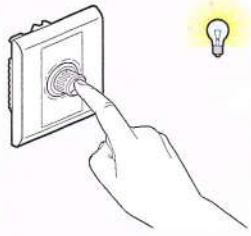
Push to turn ON



Rotate for brightness adjustment



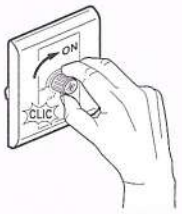
Push to turn OFF
When pushed OFF, the dimmer memorizes the light level for the next switching ON



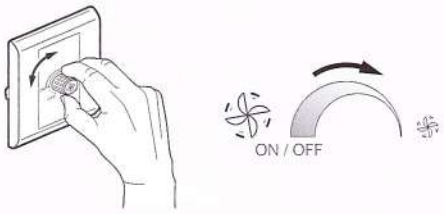
Push ON
The light level will be restored as previously memorized

Belanko™
ventilation control

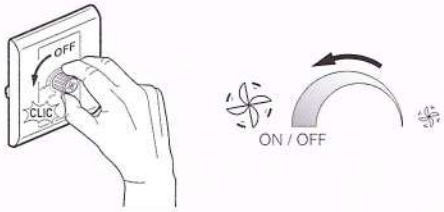
■ Ventilation control Cat.No 6 170 33



Rotate to turn ON
When turned ON the fan control works at full capacity. This ensures that the whole ventilation system - fan included - is effectively ON.



Rotate to reduce the speed



Rotate to turn OFF
Going back to full capacity before turning OFF ensures that the whole ventilation system - and not only the fan - will be effectively switched OFF

Kavacha

About Schneider Electric

As a global specialist in energy management with operations in more than 100 countries, Schneider Electric offers integrated solutions across multiple market segments, including leadership positions in Utilities & Infrastructure, Industries & Machines Manufacturers, Non-residential Building, Data Centres & Networks and in Residential. Focused on making energy safe, reliable, efficient, productive and green, the Group's 140,000 plus employees achieved sales of 24 billion euros in 2012, through an active commitment to help individuals and organizations make the most of their energy.

www.schneider-electric.com



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Fax : (6088) 216 900

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SE003-0513-00V1



Are your home electrical points safe from the danger of rain, moisture and splashes?

Mixing electricity with rain, moisture and water is a serious hazard that can wreck electrical appliances and endanger people. It is dangerous when water leaks into a non-waterproof electrical device and when a person touches electrical sockets with wet hands or accidentally splashes it with water.

Although small electrical currents are not as noticeable, larger currents may cause fibrillation of the heart and damage to tissues. You and your family members could even be electrocuted if not careful.

Such alarming dangers raise concerns about home electrical safety. There's a need for high quality weatherproof devices to protect you and your family members from the risk of electrocution both inside and outside the home.

Schneider Electric provides the ideal domestic weatherproof and waterproof electricity solution with Kavacha.

What is full-time protection?

The conventional approach to achieve waterproof protection is to add a waterproof cover that closes over an electrical point to keep it dry. But typically these covers don't offer full-time protection since they must be opened manually to access the switch or socket – the protection is gone when you need it most.

With patent-pending design, Kavacha Full-Time Waterproof Covers enable electrical points to be operative even when the covers are closed. There is complete protection in humid environments and even when someone touches the area with wet hands. Across the entire Kavacha range, safety is uninterrupted and full-time protection is offered for complete peace of mind.

Kavacha by Schneider Electric is a uniquely designed range of weatherproof devices developed specially to offer full-time protection in areas around the home that are susceptible to water, rain and moisture such as the door entrance, bathroom and kitchen, and the garage and gardens.

Full-time protection

Ingress Protection Ratings – the key to recognising quality

Ingress Protection Ratings (IP Ratings) is a standard rating system that classifies and rates the degree of protection provided against the intrusion of solid objects, dust, accidental contact, and water in mechanical casings and electrical enclosures.

The IP Rating takes the form of rating by a two-digit number, for example IP56 or IP66. The first digit indicates the size of solid particles the device can keep out. The second digit indicates the pressure of liquids it can keep out. Higher numbers mean more protection. You can find the IP Rating of a device on the product itself, the packaging or user manual, depending on the manufacturer.

It is important to note that there is a difference between "certified" and "designed according to" on weatherproof products. Products with "designed according to" are NOT certified. Beware since there are products on the market that are not truly IP certified. All Kavacha products have been rigorously tested and have achieved full IP certification.

	FIRST DIGIT	
	TEST	PROTECTION
0	No Test applied	Inherent degree of protection
1		Protected against solid objects larger than 50 mm (e.g. accidental contact with hand)
2		Protected against solid objects larger than 12 mm (e.g. finger of the hand)
3		Protected against solid objects larger than 2.5 mm (e.g. tools, wires)
4		Protected against solid objects larger than 1 mm (e.g. fine tools and wires)
5		Protected against dust. Prevent entry in sufficient quantity to interfere with satisfactory operation
6		Completely protected against dust

	SECOND DIGIT	
	TEST	PROTECTION
0	No Test applied	Inherent degree of protection
1		Protected against drops of water falling vertically
2		Protected against drops of water falling at up to 15° from the vertical
3		Protected against spraying water at up to 60° from the vertical
4		Protected against splashing water from all directions
5		Protected against jets of water from all directions
6		Protected against jets of water of similar force to heavy seas
7		Protected against the effects of immersion
8		Protected against the effects of submersion



A friendly and safe home environment

Kavacha is friendly in your home because every product is specifically designed for a domestic environment. Your home is not the same as an industrial space.

A home must be safe, yet it has to be pleasing and comfortable with attractive interior design. Heavy industrial switches and socket outlets might make your home safe, but fitting them in your home is not the ideal solution because they are not designed for domestic interiors and are not compatible with normal household plugs.

Kavacha won't ruin your décor
Kavacha ensures home safety without compromising your home décor. Kavacha products are designed to last and are practical too.

Kavacha is effortlessly easy to use
Kavacha is easy to use yet provides industrial-strength protection. Industrial switches and socket outlets require heavier and specially designed plugs which makes it a real hassle for home users. Kavacha doesn't require you to change your plugs, yet you still achieve industrial grade weatherproofing protection.



When it comes to electricity there are many potentially dangerous hazards around the home. Fortunately you can stay safe with Kavacha and simultaneously achieve full-time protection and a friendly home environment.

Welcome your visitors safely with an easily-installed Kavacha Weatherproof Door Bell

It's one of the first things you'll encounter in a home and is a leading indicator of a quality residence. The Kavacha Weatherproof Door Bell is not only the ultimate doorbell but is also ideal to operate as an outdoor electric gate switch in a weather-exposed entrance.

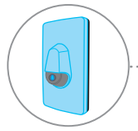
Ingress Protection Rating

IP44 Certified
- Protected against solid objects larger than 1 mm (e.g. fine tools and wires)
- Protected against splashing water from all directions

Colour availability



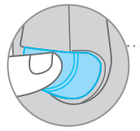
Grey White



Seamless polycarbonate cover plate leaves no gap for leakage



Long-life and energy efficient blue LED locator provides higher visibility



Large press dolly which is easy to press



Slimmest and best looking design



Co-injection moulded gasket on the base plate seals tight with the cover plate, avoiding any penetration of water and is more durable than the conventional O-ring design

Recessed flush back makes installation easy and effective even on rough wall surfaces

Keep everyone smiling with extra-safe switches protected by the Kavacha Full-Time Weatherproof Membrane Switch Cover

The dangers of electricity lurk everywhere in indoor areas. The biggest risk is around water sources where people have wet hands or places such as bathrooms or kitchens where moisture easily accumulates. That's why you need protective switch covers.

Conventional waterproof covers help keep switches dry when they are closed but must be opened when used. Offering uninterrupted protection, with Kavacha Full-Time Weatherproof Membrane Switch Covers, switches can be operated even when cover are tightly closed.

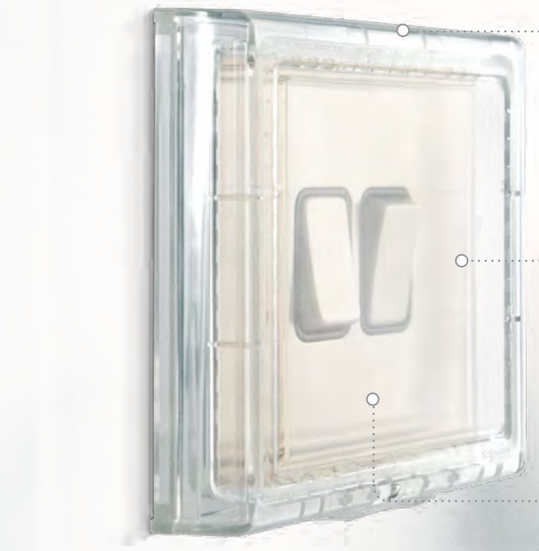
Ingress Protection Rating

IP55 Certified
- Protected against dust. Prevent entry in sufficient quantity to interfere with satisfactory operation
- Protected against jets of water from all directions

Colour availability

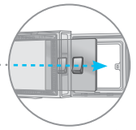


Transparent White





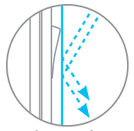
Attractive see-through cover and frame does not affect home décor and allows the switch to be easily seen



Compatible with most British format (86mm x 86mm) wall plates which can be quickly retrofitted and are easily to install



Flexible and durable membrane allows switch to be pressed easily when cover is tightly closed



UV-impervious membrane filters out UV and protects the switch from damage caused by sunlight



Double-injection moulded cover increases the level of protection from any moisture or dust entering

Double-injection moulded base is constructed from soft plastic for a higher level of waterproof protection on any surface

Patented detachable cover is operable with a lock in place, which can be simply, conveniently and safely unlocked for removal

Kavacha Full-Time Weatherproof Socket Cover provides high quality weatherproof electrical socket outlet protection at all times.

Many electrical sockets in your home are near sources of water. People often have wet hands around your home, and around these potentially dangerous outlets. Moisture also easily accumulates in laundry rooms, kitchens and bathrooms where electrical sockets exist.

Conventional socket covers can keep sockets dry when they are tightly closed but when sockets have a plug present socket covers must be opened, thus creating a scenario where the protection is missing when you need it most.

All your home electrical sockets need full-time protection. That's why the Kavacha Full-Time Weatherproof Socket Cover should be installed on every electrical socket in your home.

Full-time protection means sockets work even when the covers are tightly closed.

Ingress Protection Rating

IP55 Certified
- Semi-protected against dust
- Protected against jets of water from all directions

Colour availability



Transparent White



Attractive see-through cover does not affect home décor. Tough polycarbonate resin socket cover does not break easily



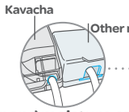
Curvy covers with spacious room for plugs in various sizes to fit in and covers can still be tightly closed



Compatible with most British format (86mm x 86mm) wall plates which can be quickly retrofitted and are easily to install



Padlock facility provides added safety



Water and moisture can be completely kept out of the socket cover at all times even with a plug present, since the cover snugly clicks shut around the plug cord, leaving no gap around the plug cord



Strike out danger with Kavacha AS industrial strength electrical point protection for the great outdoors

This sturdy range of switches and sockets are for outdoor areas that are susceptible to heavy blows, longtime exposure to sunlight and (extra space) risk being splashed by chemicals. Balconies, swimming pools, exterior walls and gardens will all be much safer from exposed electricity with Kavacha AS.

Kavacha AS protects you and your family outdoors in five important ways. It guards against water sprayed from a hose. It guards against rain or water, is dust proof, impact resistant, UV resistant and also chemical resistant.

Nevertheless, Kavacha AS ensures home safety without compromising on home design -- they are practical and designed to last.

Ingress Protection Rating

IP56 Certified
(For switched socket and socket outlet)
- Semi-protected against dust
- Protected against jets of water of similar force to heavy seas

IP66 Certified
(For switch and isolating switch)
- Completely protected against dust
- Protected against jets of water of similar force to heavy seas

Models and colour availability



Switched socket (Grey) | Socket outlet (Grey) | Switch (Grey) | Isolating switch (Grey)



Your air conditioner won't leave you cold with a professional grade Kavacha W isolating switch installed

Government regulations in some countries require electric motors and servo-motors (e.g. split-type air conditioners) to be equipped with an easily accessible isolating switch so that electrical currents can be quickly cut.

To conform to any such regulations in your country and to play safe, it is best to install Kavacha W isolating switches in outdoor areas for safe isolation of air conditioners and other heavy duty motorised appliances.

The lever of Kavacha W can be locked in the off position, thus making sure the current of the electrical motors are cut which provides extra protection.

Kavacha W gives air conditioners five levels of protection. It guards against rain or water, is dust proof, impact resistant, UV resistant and also chemical resistant. It is the best ingress protection you can get for your heavy duty appliances.

Ingress Protection Rating

IP66 Certified
- Completely protected against dust
- Protected against jets of water of similar force to heavy seas

Colour availability



Grey



Catalogue Number	Commercial Description

Kavacha Weatherproof Door Bell

A3031WBP_WE	Weatherproof Surface Mount Door Bell with Blue LED Indicator (White) IP44
A3031WBP_GY	Weatherproof Surface Mount Door Bell with Blue LED Indicator (Grey) IP44


A3031WBP_WE


A3031WBP_GY

Kavacha AS

CSC313 GY	13A 250V Surface Mount Single Pole Switched Socket IP56
CSC315RP GY	15A 250V Surface Mount Single Pole Switched Socket IP56
CSC313N GY	13A 250V Surface Mount Single Pole Switched Socket with Neon IP56
CSO313 GY	13A 250V Surface Mount Single Gang Socket Outlet IP56
CSS120 GY	20A 250V Surface Mount Single Pole Isolating Switch IP66
CSS232 GY*	32A 500V Surface Mount Double Pole Isolating Switch IP66
CSS320 GY*	20A 500V Surface Mount Triple Pole Isolating Switch IP66
CSS332 GY*	32A 500V Surface Mount Triple Pole Isolating Switch IP66
CSS220N GY	20A 500V Surface Mount Double Pole Isolating Switch with Neon IP66
CSW110 GY	10A 250V Surface Mount One Gang Switch IP66
CSW110BPR GY	10AX 250V Surface Mount One Gang Two Way Press Return Switch IP66
CSW220 GY*	20A 250V Surface Mount One Gang Double Pole Switch IP66
CSW220N GY	20A 250V Surface Mount One Gang Double Pole with Neon IP66
CSW110/2 GY	10AX 250V Surface Mount Two Gang Two Way Switch IP66
WS226 RG	15A 250V Surface Mount One Gang Two Way IP56
WS226/2 RG	15A 250V Surface Mount Two Gang Two Way IP56
WS226/2PB RG	10A 440V Surface Mount Start/Stop Push Button IP66


CSW110 GY
CSW110BPR GY
CSW220 GY


CSW220N GY


CSW110/2 GY


CSS120 GY
CSS232 GY
CSS320 GY
CSS332 GY


CSS220N GY


CSC313 GY
CSC315RP GY


CSC313N GY


CSO313 GY


WS226


WS226/2



WS226/2PB

* Indent item. Refer to customer care for details.

Catalogue Number	Commercial Description

Kavacha Full-Time Weatherproof Cover

E223M_TR	Full-Time Weatherproof Membrane Switch Cover (Transparent) IP55
E223M_WE	Full-Time Weatherproof Membrane Switch Cover (White) IP55
E223R_TR	Full-Time Weatherproof Single Gang Socket Cover (Transparent) IP55
E223R_WE	Full-Time Weatherproof Single Gang Socket Cover (White) IP55
ET223R_TR	Full-Time Weatherproof Twin Gang Socket Cover (Transparent) IP55
ET223R_WE	Full-Time Weatherproof Twin Gang Socket Cover (White) IP55


E223M_TR


E223M_WE


E223R_TR


E223R_WE


ET223R_TR


ET223R_WE

Kavacha W

WHS20 GY	20A 250V Surface Mount Single Pole Isolating Switch IP66
WHS35 GY	35A 250V Surface Mount Single Pole Isolating Switch IP66
WHS55 GY*	55A 250V Surface Mount Single Pole Isolating Switch IP66
WHD20 GY	20A 440V Surface Mount Double Pole Isolating Switch IP66
WHD35 GY	35A 440V Surface Mount Double Pole Isolating Switch IP66
WHD63 GY	63A 440V Surface Mount Double Pole Isolating Switch IP66
WHT20 GY	20A 440V Surface Mount Triple Pole Isolating Switch IP66
WHT35 GY	35A 440V Surface Mount Triple Pole Isolating Switch IP66
WHT63 GY	63A 440V Surface Mount Triple Pole Isolating Switch IP66
WHT80 GY	80A 440V Surface Mount Triple Pole Isolating Switch IP66



S-Classic E30


E31WP

Catalogue Number	Commercial Description
E31WP	S-Classic One Gang Flush Plate Waterproof Switch Cover IP54

Towards an accident-free home

Zero accidents should be the goal of every homeowner. Electrical fittings have always carried the risk of injury and misadventure. Now you can end the risk by fitting practical, cost-effective and quality-engineered full-time Kavacha protection throughout your home.



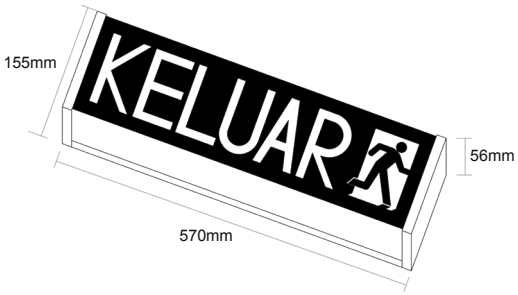
We Serve You Better

Box Up Keluar Sign



TR408

Power Consumption	: <5VA
Lamp-Mains “On”	: 16 x 0.2W SMD LED
Lamp-Mains “Off”	: 16 x 0.2W SMD LED
Battery Type	: 4.8V 900mAh Ni-Cd battery
Weight	: 1.4 kg
Product Dimension	: L570mm x W155mm x H56mm
Input Voltage	: 230V±10%,50/60
Rated Duration	: 3 Hours
Mode of operation	: Maintained
Charger	: Solid State Electronic Automatic
Charging Monitor	: Red LED 5MM diameter
Test Facility	: Independent testing
Operation Temperature	: ta 40°C
Safety Feature	: Low voltage cut-off to prevent over-discharge of the battery
Fitting Construction	: Metal casing finish in epoxy powder coating
Diffuser	: Acrylic Diffuser
Mounting	: Wall mounting
Warranty	: 24 months from the date of delivery
Compliance	: Malaysian Standards MS619 BOMBA approved



MALAYSIA Power Brand 2011 MARK OF QUALITY

MS SIRIM

Manufactured by:

JM We Serve You Better

JUMBOHAN MARKETING SDN. BHD.
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Distrubuted by:

Due to continuous development and improvement, Jumbohan Marketing S/B reserves the right to change the specifications without prior notice

We Serve You Better

Twin Lamp Emergency Light

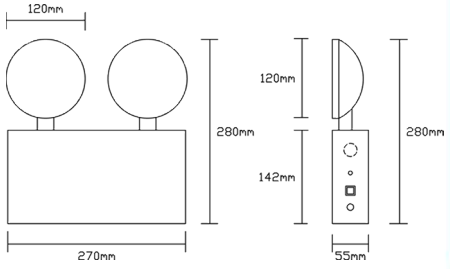


MALAYSIA Power Brand 2011 MARK OF QUALITY

TRE66

Product Dimension	:	L270 X W55 X H142MM
Lamp Used	:	2×18 X 0.06W Super bright SMD LED
Weight	:	1.09 kg
Battery Type	:	4.8V 1800mAh NI-CD battery
Input Voltage	:	240V+10%,50/60Hz
Rated Duration(hours)	:	3Hours
Mode of operation	:	Non-maintained
Charger	:	Solid State Electronic Automatic
Charging Monitor	:	Red LED 5MM diameter
Test Facility	:	Independent testing
Operation Temperature	:	ta50°C
Safety Feature	:	Low voltage cut-off to prevent over-discharge of the battery Incoming AC fuse .
Fitting Construction	:	Metal casing finish in epoxy powder coating
Mounting	:	Wall mounting
Compliance	:	Malaysia Standards MS619 BOMBA approved
Warranty	:	24 months from the date of delivery

MS SIRIM



Manufactured by:

JM We Serve You Better

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Kawasan Perindustrian Batu Caves,
68100 Selangor, Malaysia
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enquiry@jumbohan.com www.jumbohan.com

Distrubuted by:

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We Serve You Better

Recess LED Emergency Light

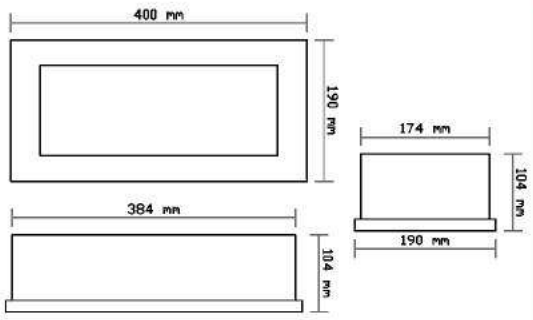


MALAYSIA Power Brand 2011 MARK OF QUALITY

TRE208LR / TRE208LR-PC

Mode of operation	:	Non-maintained
Input Voltage	:	230V+10%, 50/60Hz
Rated Duration	:	3 hours
Battery Type	:	4.8V 900mAh Ni-Cd battery
Lamp Used	:	12 X 0.2W SMD LED
Charger	:	Solid State Electronic Automatic
Charging Monitor	:	Red LED 5mm diameter
Test Facility	:	Independent testing
Operation Temperature	:	ta50°C
Safety Feature	:	Low voltage cut-off to prevent over-discharge of the battery, Incoming AC fuse
Fitting Construction	:	Metal casing finish in epoxy powder coating
Diffuser	:	Prismatic Acrylic/Polycarbonate
Product Dimension	:	L400mm X W190mm X H104mm
Mounting	:	Wall or ceiling mounting
Compliance	:	Malaysia Standards MS619 BOMBA approved
Warranty	:	24 months from the date of delivery
Weight	:	2 kgs

MS SIRIM



Manufactured by:

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enquiry@jumbohan.com www.jumbohan.com

Distrubuted by:

Due to continuous development and improvement, Jumbohan Marketing S/B reserves the right to change the specifications without prior notice.

Schneider Electric



SCHNEIDER HWX
11kV SWITCHGEAR

INTRODUCTION

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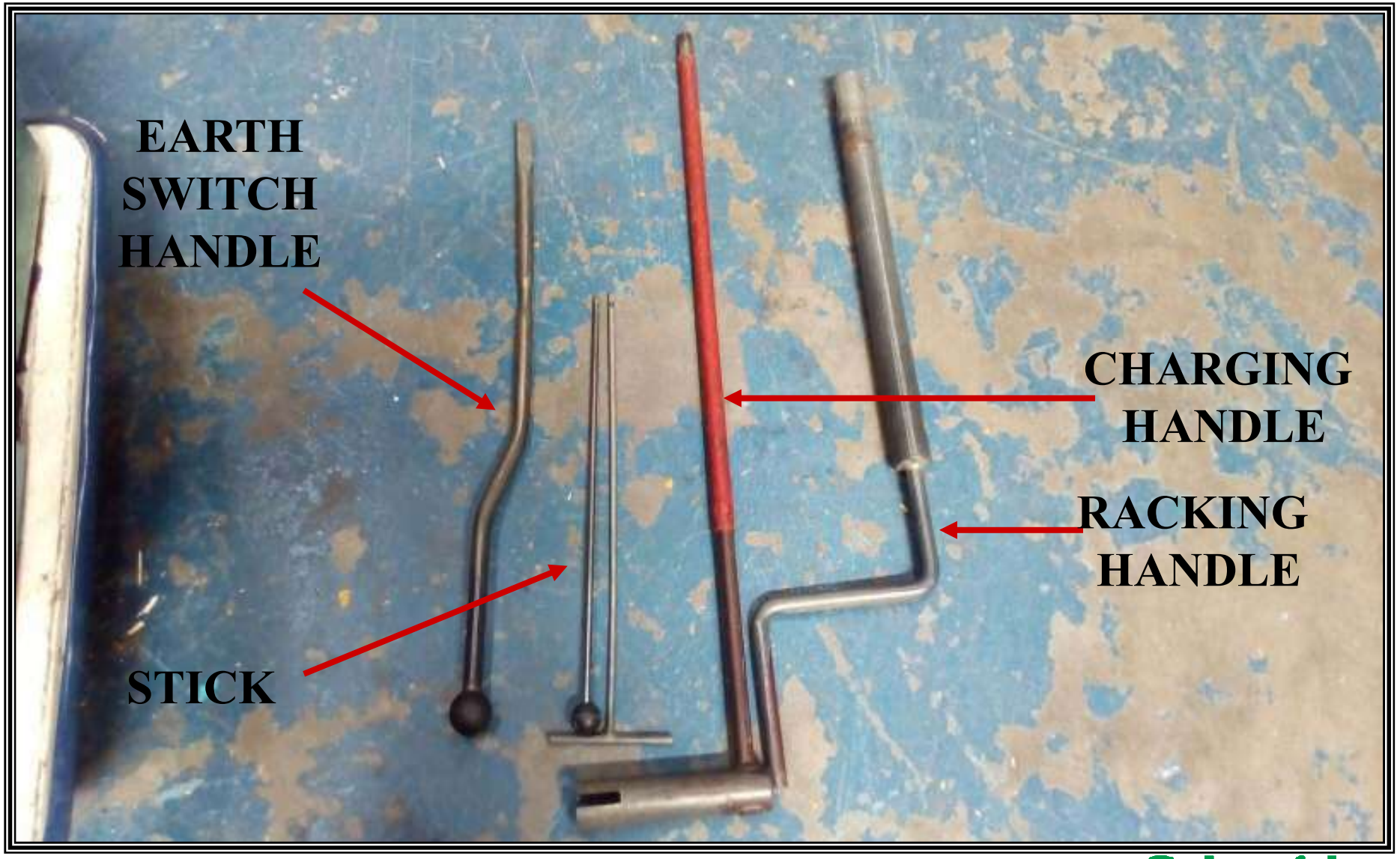
BREAKER

- Truck Type
- Model: **HWX-C**
- Voltage Rating : 12kV
- Breaker Type : Vacuum
- Air Insulated Switchgear (AIS)



Schneider Electric

HAND TOOL



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1) **CHARGING HANDLE -** Charging motor manually



2) **RACK IN HANDLE –** Rack in & Rack out Breaker



3) **STICK –** For by pass Trip & Close



4) **EARTH SWITCH HANDLE –** Turn on earth switch when breaker removed

Schneider Electric

MECHANISM FACIA



MANUAL CHARGE (SHAFT ROD)

SPRING CHARGE INDICATOR

VCB KNOB (TRUCK INTERLOCK)

PUSH BUTTON CLOSE (ON)

VCB OFF/ON INDICATOR

TRIP COUNTER

PUSH BUTTON TRIP (OFF)

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LV COMPARTMENT



VCB COMPARTMENT

MULTICORE CABLE BOX



CABLE COMPARTMENT

Operation Method Statement for
Truck type Vacuum Circuit Breaker

Schneider Electric

GENERAL

- This guideline covers the recommended procedures for the operation of SCHNEIDER *HWX Truck type Vacuum Circuit Breakers*.

- The circuit breaker operating mechanism may be one of 2 types :

> **Manually** : Using push button on breaker for closing and tripping with motor manual charging using the handle

> **Electrically** : Using local remote selector switch (TNC Switch) for tripping and closing the breaker with motor automatically recharged the mechanism spring

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Racking Out the VCB
(Services position to Test position)

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Ensure the VCB is in “trip” status.



ELECTRICALLY



MANUALLY

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Set the VCB knob from “lock to free”.

Note: *While turning the knob, press and hold the “push to trip” button (red color button).*



KNOB

TRIP BUTTON

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- Rack out the VCB fully (in anti clockwise direction) using the proper racking handle provided.
- Withdraw the VCB into the “test” position to allow the panel shutter to close.
- Set the VCB knob from “free” to “lock”.

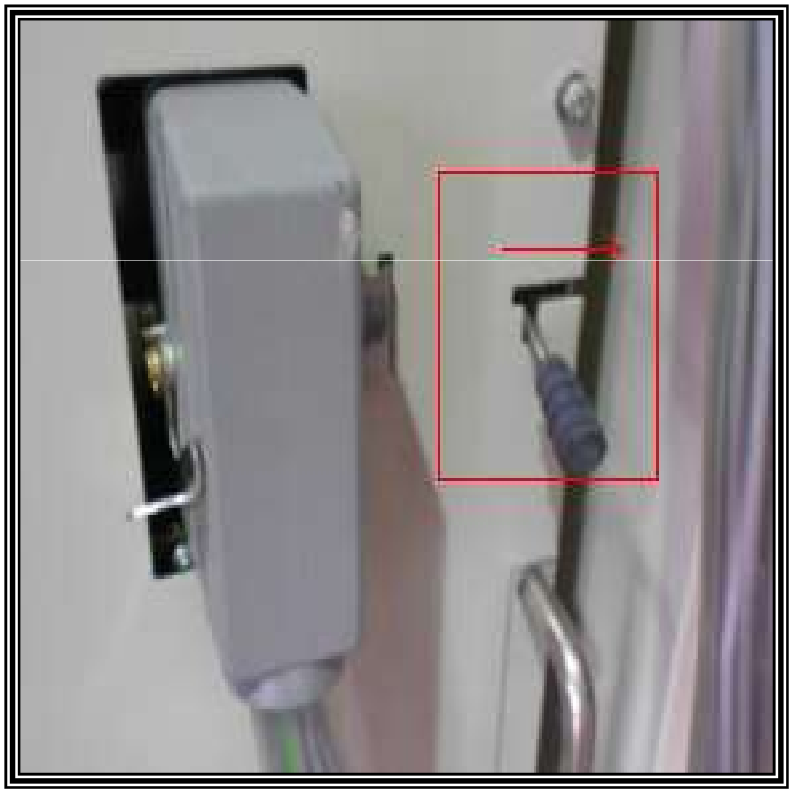


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Racking Out the VCB
(Test position to Outside)

Schneider Electric

- Position/Change the knob from *"lock"* to *"free"*.
- Withdraw the VCB out from the panel.
- Pull the LV plug shutter to the left to unlock the LV plug





Remove the LV plug from the VCB.



Withdraw the VCB out from the panel.



ON/ OFF EARTH SWITCH

1. Insert the earth switch handle in the earth switch hole
2. Pull it up to ON the earth
3. Pull it down to OFF the earth switch

Note: The Earthing switch is on the Left side of the panel, use the proper earthing handle provided.

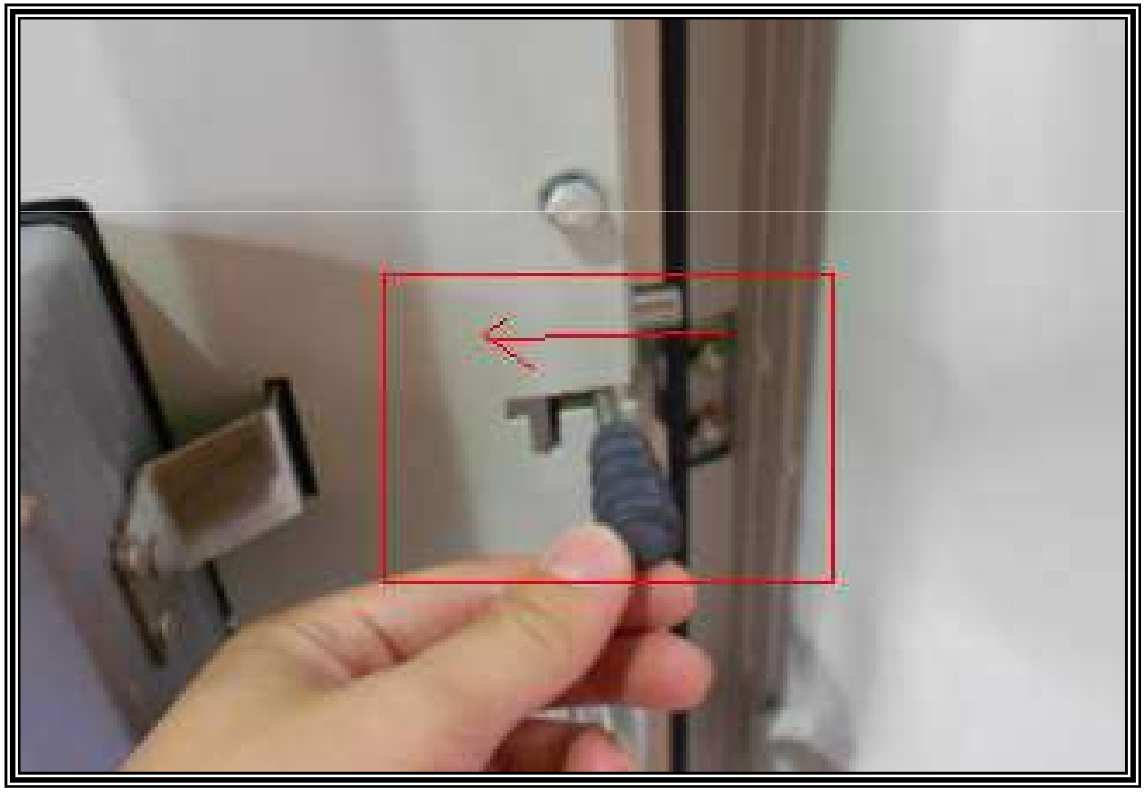


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Racking the VCB
(Test position to Service position)

Schneider Electric

- Earth switch OFF position.
- Attach the LV plug and pull the LV shutter to the right.
- Turn the VCB knob to *"free"* position.
- Push in the VCB from the *"test position"* to allow the panel shutter to open.



- Close the VCB compartment door and rack in the VCB (in clockwise direction).
- Open the VCB compartment door and turn the VCB knob from *"free"* to *"lock"* position.

Note: *The VCB must be able to "close and trip" for service.*



Schneider Electric

PROJECT / OWNER:

RHB TRUSTEES BERHAD

DISTRIBUTOR:

ABLECON POWER SYSTEM SDN BHD

EQUIPMENT:

SCHNEIDER

11kV VCB SWITCHGEAR (STANDALONE)

SUBSTATION:

CONSUMER 11kV SWITCHBOARD

REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: COVER PAGE

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	1	13

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1	COVER PAGE	0	03/04/2017	NIL
2	TABLE OF CONTENT	0	03/04/2017	NIL
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4	LEGEND	0	03/04/2017	NIL
5	SINGLE LINE DIAGRAM	0	03/04/2017	NIL
6	GENERAL ARRANGEMENT & FOUNDATION DETAILS	0	03/04/2017	NIL
7	SECTIONAL VIEW	0	03/04/2017	NIL
8	AC/DC DISTRIBUTION CIRCUIT	0	03/04/2017	NIL
9	SCHEMATIC DIAGRAM TNB INCOMING	0	03/04/2017	NIL
10	CONTROL CIRCUIT STANDALONE	0	03/04/2017	NIL
11	HEATER & MOTOR CONTROL CIRCUIT	0	03/04/2017	NIL
12	TERMINAL DIAGRAM	0	03/04/2017	NIL
13	TERMINAL DIAGRAM	0	03/04/2017	NIL

ITEM / LEGEND	DESCRIPTION	MAKE	TYPE
-HB	Indicator Light (Blue) Blue Phase 110V AC	Atec	AD16-22
-HF	Indicating Light (Green) VCB Off 30V DC	Atec	AD16-22
-HH	Indicator Light (White) Heater 240V AC	Atec	AD16-22
-HN	Indicator Light (Red) VCB On 30V DC	Atec	AD16-22
-HR	Indicator Light (Red) Red Phase 110V AC	Atec	AD16-22
-HY	Indicator Light (Yellow) Yellow Phase 110V AC	Atec	AD16-22
-TI1	Current Transformer CL 5P10	Bilt/EPE	R10
-TI2	Current Transformer CL 1.0	Bilt/EPE	R10
-TU	Voltage Transformer	Bilt/Kappa	UP1111/2165-VEC-213-29
-KA	Auxiliary Relay Anti Pumping	Carlo Gavazzi	RPY2
-FMCBCL	Miniature Circuit Breaker Closing 10A DP	Chint	NB1
-FMCBH	Miniature Circuit Breaker Heater 6A DP	Chint	NB1
-FMCBM	Miniature Circuit Breaker Motor 10A DP	Chint	NB1
-FMCBTR	Miniature Circuit Breaker Tripping 16A DP	Chint	NB1
-FMR	Miniature Circuit Breaker Voltage Transformer 6A 3P	Chint	NB1
-HVI	Capacitive Phase Indicator Light	Etah	PIL
-F51OCEF	Overcurrent, Earthfault Relay & IDMT Relay	Mikro	MK2200L
-PDPM	Digital Power Meter	Mikro	DPM380
-Q0	Vacuum Circuit Breaker	Schneider	HWX-C
-SHS	Heater Switch	Seiko	ESN-D201-NS40S
-STNC	Circuit Breaker Trip / Neutral / Close Selector Switch	Seiko	ESRL-10-NS40S

ITEM / LEGEND	DESCRIPTION	MAKE	TYPE

SYMBOL	LETTER CODE	IEC 60617 REF.	DESCRIPTION
	NIL	02-15-01	EARTH, GROUND
	NIL	03-01-02	CONNECTION 3 LINE (CONDUCTORS)
	-W	03-01-07	SCREENED CONDUCTOR
	-W	03-02-07	DOUBLE JUNCTION OR CONDUCTOR
	-W	03-02-15	T-CONNECTOR
	-X	03-03-05	PLUG AND SOCKET (MALE AND FEMALE)
	-XW	03-03-17	CONNECTING LINK CLOSED
	-E	04-01-12	HEATING ELEMENT
M 3	-M	06-08-01	3PH INDUCTION MOTOR
M	-M	06-05-01	DC MOTOR
FORM 1	-T	06-09-01	TRANSFORMER WITH TWO WINDINGS (CONCEPTUAL DRG)
FORM 2	-T	06-09-02	TRANSFORMER WITH TWO WINDINGS (SCHEMATIC DRG)
FORM 1	-T	06-09-04	TRANSFORMER WITH THREE WINDINGS (CONCEPTUAL DRG)
FORM 2	-T	06-09-05	TRANSFORMER WITH THREE WINDINGS (SCHEMATIC DRG)
FORM 1	-TI	06-09-10	CURRENT TRANSFORMER (CONCEPTUAL DRG)
FORM 2	-TI	06-09-11	CURRENT TRANSFORMER (SCHEMATIC DRG)
FORM 1	-TU	06-13-01A	VOLTAGE TRANSFORMER (CONCEPTUAL DRG)
FORM 2	-TU	06-13-01B	VOLTAGE TRANSFORMER (SCHEMATIC DRG)

SYMBOL	LETTER CODE	IEC 60617 REF.	DESCRIPTION
	-S	07-02-02	GENERAL SYMBOL FOR A SWITCH
	-S	07-07-01	MANUALLY OPERATED SWITCH
	-S	07-07-02	PUSH BUTTON SWITCH MAKE CONTACT AUTOMATIC RETURN
	-S	07-07-02	PUSH BUTTON SWITCH BREAK CONTACT AUTOMATIC RETURN
	NIL	07-02-01	MAKE CONTACT (NORMALLY OPEN)
	NIL	07-02-03	BREAK CONTACT (NORMALLY CLOSE)
	NIL	07-02-04	CHANGE OVER BREAK BEFORE MAKE CONTACT
	-Q0	07-13-05	CIRCUIT BREAKER
	-Q8	07-15-01 07-13-06	EARTH SWITCH
	-F	07-22-03	SURGE DIVERTER
A	-P	08-01-01	AMMETER
V	-P	08-02-01	VOLTMETER
W	-P	08-01-01	WATTMETER
VAR	-P	08-02-04	VARMETER
COS j	-P	08-02-03	POWER FACTOR METER
Wh	-P	08-04-03	WATT-HOUR METER
Wh	-P	08-04-05	WATT-HOUR METER COUNTING ENERGY FLOW FROM BUSBAR
Wh	-P	08-04-06	FLOW TOWARDS THE BUSBAR

SYMBOL	LETTER CODE	IEC 60617 REF.	DESCRIPTION
	-H	08-10-06	BELL
	-H	08-10-01	SIGNAL LAMP
	-X	NIL	FIXED TYPE SECONDARY TERMINAL LOCATED AT LV COMPARTMENT
	-X	NIL	ISOLATABLE TYPE SECONDARY TERMINAL LOCATED AT LV COMPARTMENT
	-X	NIL	FIXED TYPE SECONDARY TERMINAL LOCATED AT MULTICORE CABLE
	-X	NIL	ISOLATABLE TYPE SECONDARY TERMINAL LOCATED AT MULTICORE CABLE
	-E	11-15-04	LUMINAIRE, FLUORESCENT LAMP (GENERAL SYMBOL)
1 O 2	-S	NIL	CHANGE OVER SELECTOR SWITCH WITH OFF (SPRING RETURN TO OFF)
	-XW	03-03-19	CONNECTING LINK OPEN
	-X	11-13-01	POWER SOCKET (GENERAL SYMBOL)
	-S	11-14-11	PUSH BUTTON WITH INDICATOR LAMP
1 O 2	-S	NIL	CHANGE OVER SELECTOR SWITCH WITH OFF (STAT PUT)
1 O 2	-S	NIL	CHANGE OVER SELECTOR SWITCH WITH OFF (SPRING RETURN TO OFF)
1 2	-S	NIL	CHANGE OVER SELECTOR SWITCH WITHOUT OFF (STAT PUT)
1 2	-S	NIL	CHANGE OVER SELECTOR SWITCH WITHOUT OFF (SPRING RETURN TO POSITION 1 FOR EXAMPLE
	-R	04-01-01	RESISTOR

SYMBOL	DESCRIPTION
*	MEASURING RELAY OR DEVICE RELATED TO MEASURING RELAY (ASTERRISK TO BE REPLACED BY DESIGNATION LETTER CODE, GENERAL DEVICE FUNCTION NUMBER, AND FUNC. LETTER CODE
-F26OT	TR. OIL TEMPERATURE PROTECTION/ INDICATION DEVICE
-F26WT/HV	TR. WDG. TEMPERATURE PROTECTION/ INDICATION DEVICE-HV SIDE
-F26WT/LV	TR. WDG. TEMPERATURE PROTECTION/ INDICATION DEVICE-LV SIDE
-K27UV	UNDER VOLTAGE RELAY
-F50OC	INST. OVERCURRENT-(PHASE FAULT) PROTECTION RELAY
-F51OC	TIME OVERCURRENT-(PHASE FAULT) PROTECTION RELAY
-F50EF	INST. OVERCURRENT-(EARTH FAULT) PROTECTION RELAY
-F51EF	TIME OVERCURRENT-(EARTH FAULT) PROTECTION RELAY
-F63B	BUCHHOLZ RELAY
-F63PRD	PRESSURE RELIEF PROTECTION DEVICE
-F64REF/HV	TR. RESRICTED EARTH FAULT PROTECTION HV SIDE
-F64REF/LV	TR. RESRICTED EARTH FAULT PROTECTION LV SIDE
-F67OC	DIRECTIONAL TIME OVERCURRENT - PHASE FAULT PROTECTION RELAY
-F67EF	DIRECTIONAL TIME OVERCURRENT - EARTH FAULT PROTECTION RELAY
-U77W	TRANSDUCER FOR ACTIVE POWER
-U77VAR	TRANSDUCER FOR REACTIVE POWER
-U77A	TRANSDUCER FOR AMMETER
-U77V	TRANSDUCER FOR VOLTMETER
-F86E	LOCKOUT MASTER TRIP RELAY

REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: LEGEND

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

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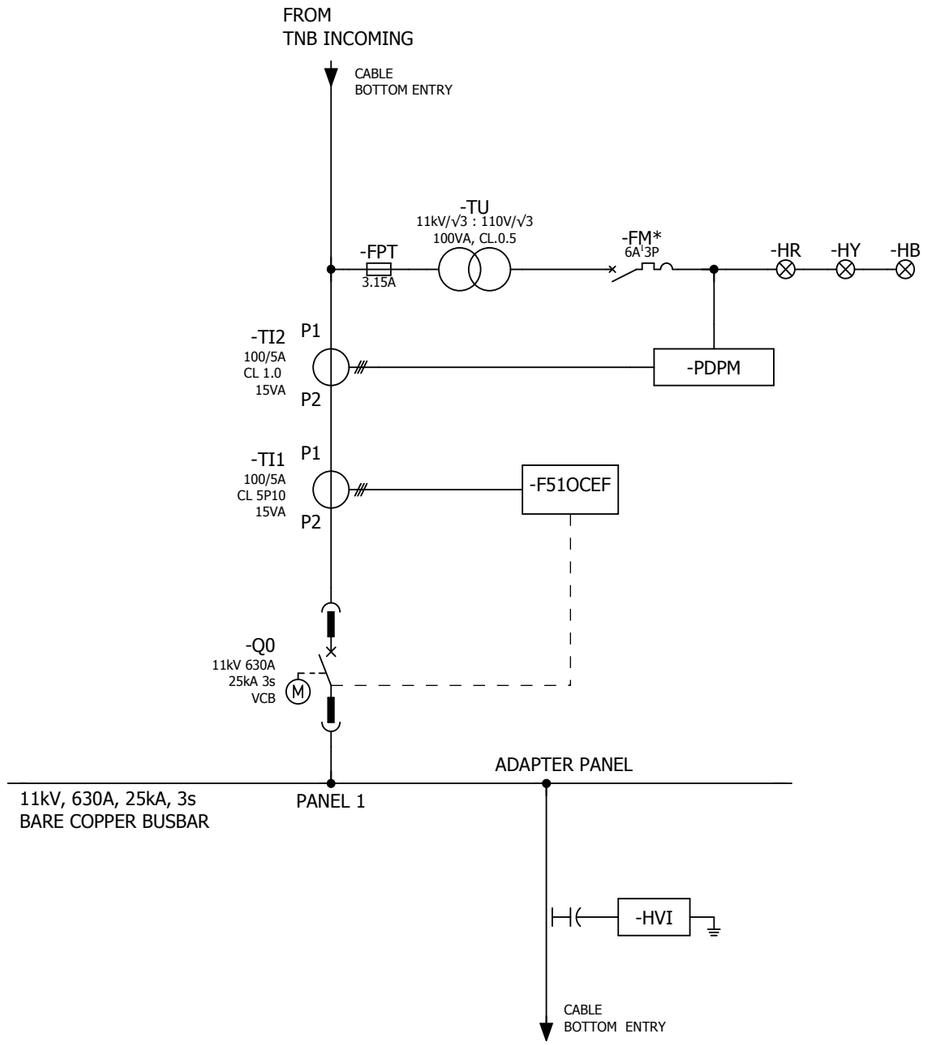
SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

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FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	4	13



CONSUMER 11kV SWITCHBOARD

REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: SINGLE LINE DIAGRAM

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

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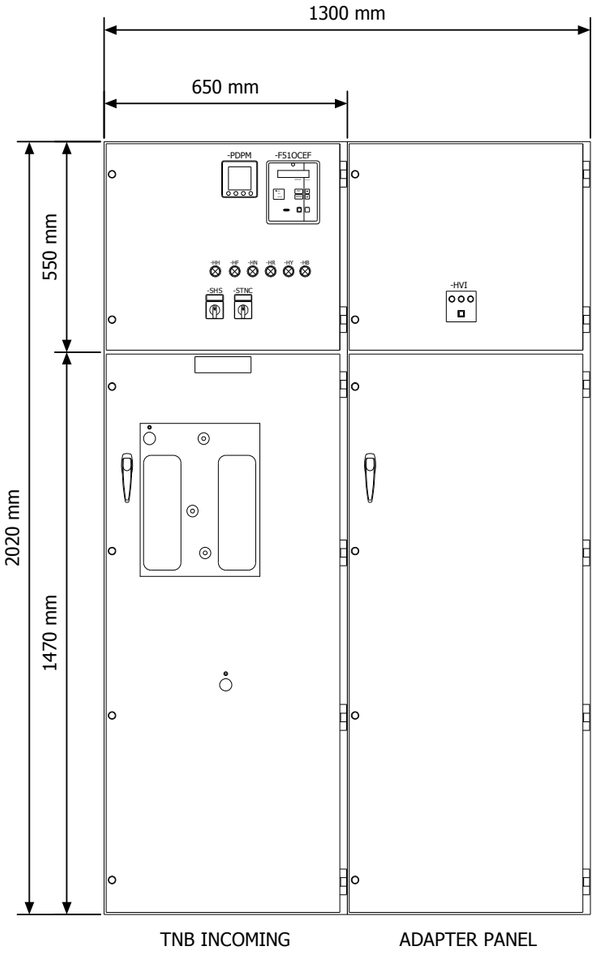
SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

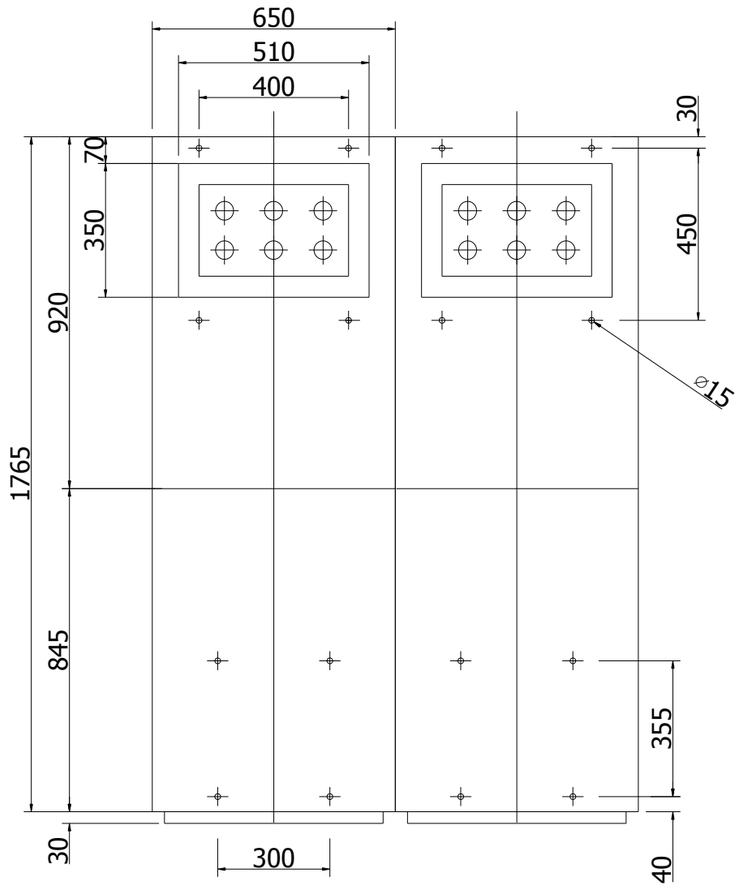
Schneider Electric

FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	5	13



PANEL FRONT VIEW & GENERAL ARRANGEMENT



FOUNDATION DETAILS

REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: GENERAL ARRANGEMENT & FOUNDATION DETAILS

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

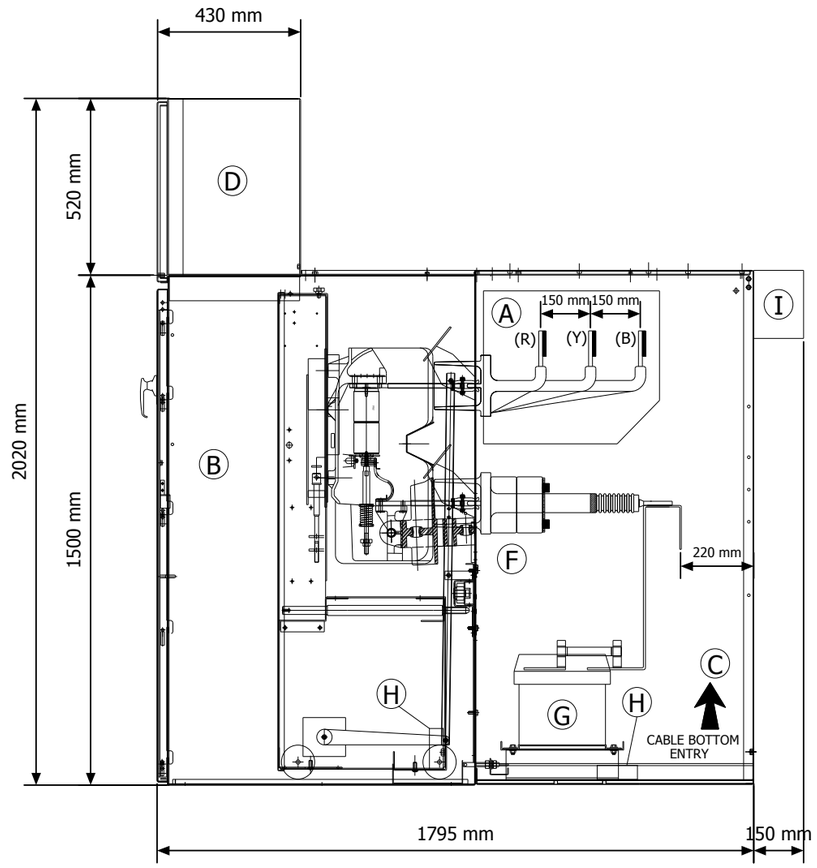
SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

Schneider Electric

FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	6	13



SECTIONAL VIEW FOR TNB INCOMING

LEGEND

Ⓐ - BUSBAR COMPARTMENT
Ⓑ - CIRCUIT BREAKER COMPARTMENT
Ⓒ - CABLE COMPARTMENT
Ⓓ - LOW VOLTAGE COMPARTMENT
Ⓔ - EARTH SWITCH
Ⓕ - CURRENT TRANSFORMER
Ⓖ - VOLTAGE TRANSFORMER
Ⓗ - HEATER
Ⓘ - MULTICORE CABLE BOX

NOTE
DEGREE OF PROTECTION : IP 3x
PANEL MATERIAL : MILD STEEL
THICKNESS : i) LV door double bendway = 2mm
ii) Body = 2mm
iii) Base panel = 3mm
PANEL FINISHING : POWDER COATED
PANEL COLOR : RAL 9422

REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: SECTIONAL VIEW

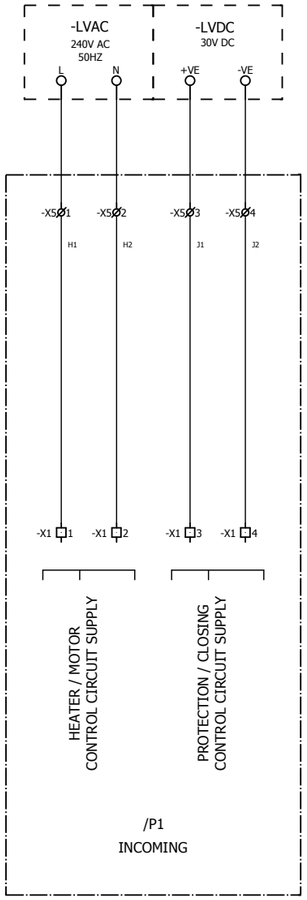
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DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)
SUBSTATION: CONSUMER 11kV SWITCHBOARD
DRAWING NO.: 17-RHB-01

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FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	7	13



REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT	RHB TRUSTEES BERHAD				
DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

TITLE: AC/DC DISTRIBUTION CIRCUIT

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

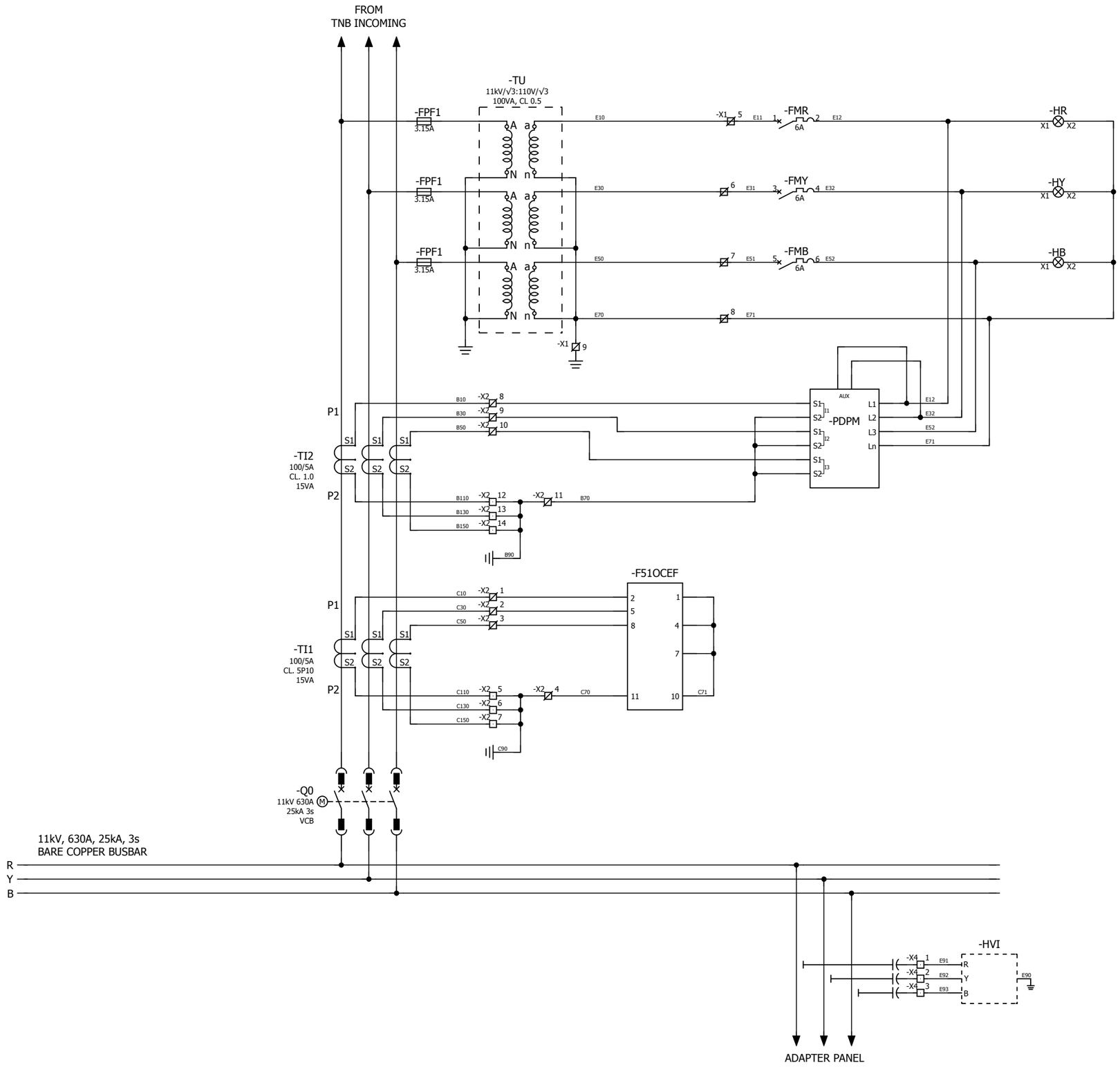
SUBSTATION: CONSUMER 11kV SWITCHBOARD

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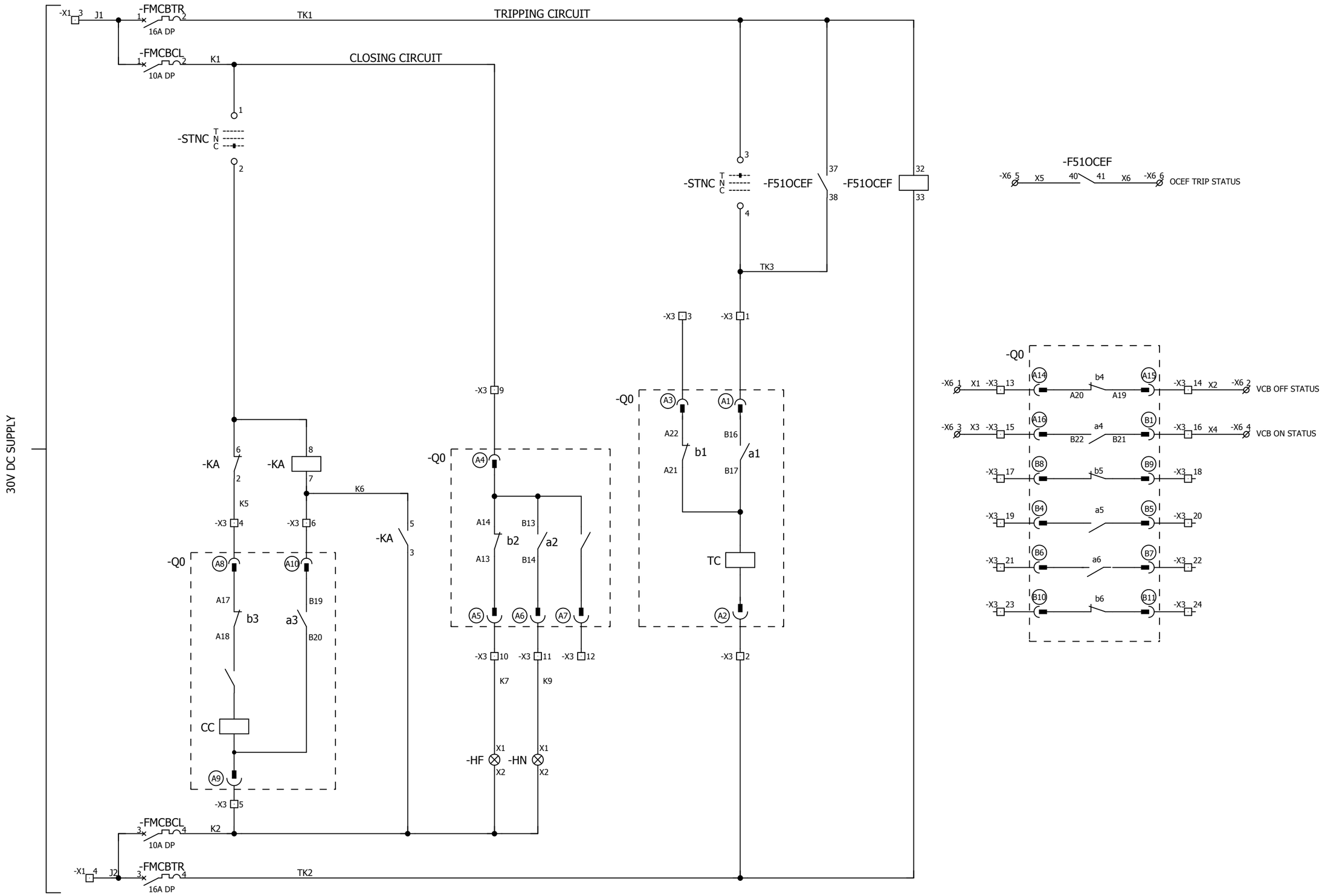
DRAWING NO.: 17-RHB-01

FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	8	13


FROM
TNB INCOMING
-TU
11kV/√3:110V/√3
100VA, CL 0.5
-FPF1
3.15A
-FPF1
3.15A
-FPF1
3.15A
-FMR
6A
-FMY
6A
-FMB
6A
-HR
-HY
-HB
-PDPM
AUX
-TI2
100/5A
CL. 1.0
15VA
-TI1
100/5A
CL. 5P10
15VA
-F51OCEF
-Q0
11kV 630A
25kA 3s
VCB
11kV, 630A, 25kA, 3s
BARE COPPER BUSBAR
R
Y
B
-HVI
ADAPTER PANEL

| | | |



REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: CONTROL CIRCUIT STANDALONE

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

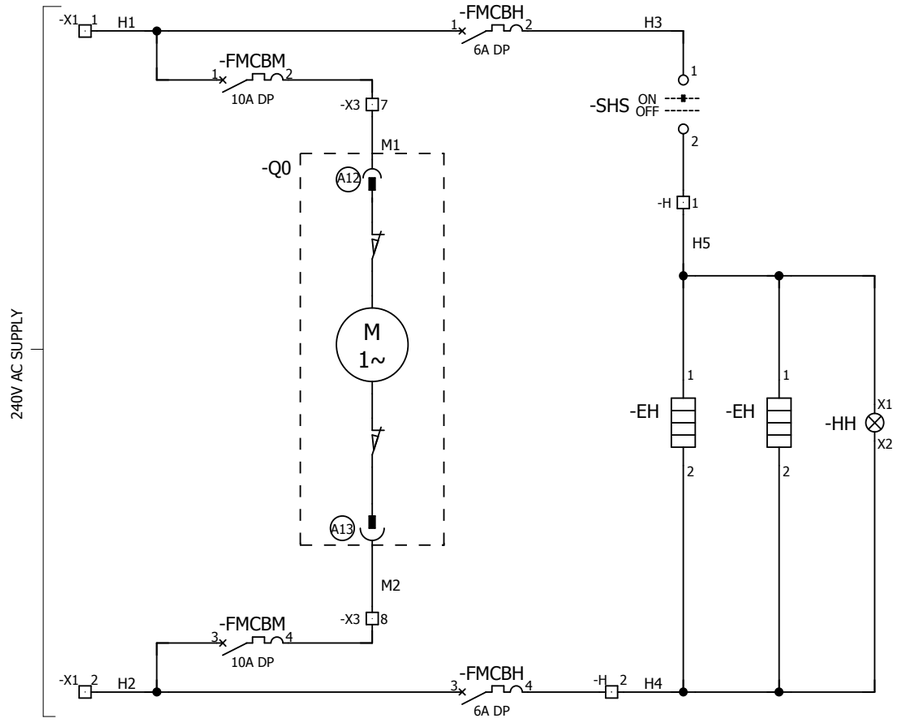
SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

Schneider Electric

FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	10	13



REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: HEATER & MOTOR CONTROL CIRCUIT

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

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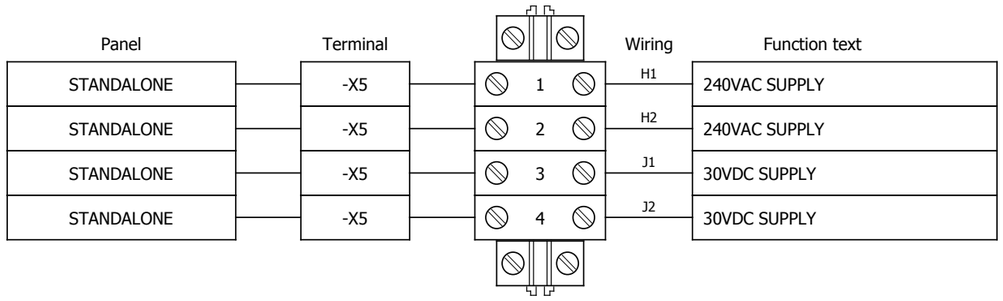
FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	11	13

Terminal diagram

Strip

=11+SWG-X5



REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: TERMINAL DIAGRAM

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

Schneider Electric

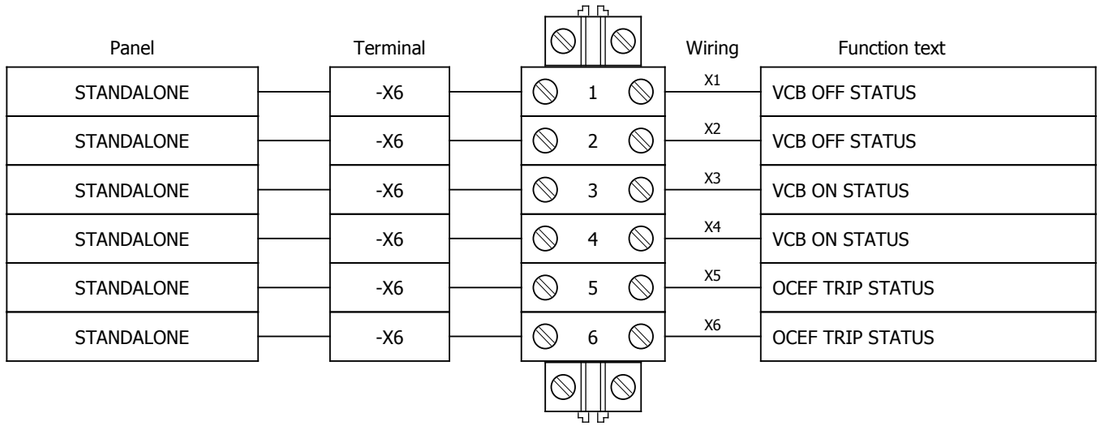
FOR APPROVAL

REV.	SHEET	TOTAL SHEET
0	12	13

Terminal diagram

Strip

=11+SWG-X6



REV	DESCRIPTION	DRAWN	APPROVED	DATE

PROJECT: RHB TRUSTEES BERHAD

TITLE: TERMINAL DIAGRAM

DRAWN	SAMILAH	CHECKED	SHAHRUL	SCALE	NTS
DATE	03/04/2017	APPROVED	KH TEE		

DRAWING: 11kV VCB SWITCHGEAR (STANDALONE)

SUBSTATION: CONSUMER 11kV SWITCHBOARD

DRAWING NO.: 17-RHB-01

Schneider Electric

FOR APPROVAL

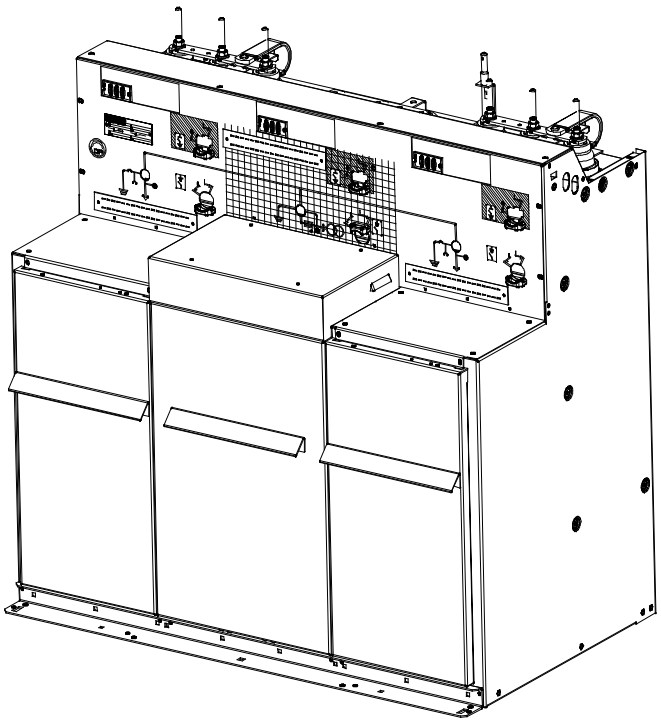
REV.	SHEET	TOTAL SHEET
0	13	13

RM6

MV distribution
factory built assemblies
at your service

ENGLISH

instructions for use



Schneider Electric

Released for Manufacturing
Printed on 2015/11/12

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maintenance rules 4

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symbols and conventions

Caution:
you will find all the symbols below throughout the document, indicating the hazard levels depending on the different types of situation.

as per iso 3864- 2



DANGER

DANGER: failure to follow this instruction will result in death or serious injury.



AVERTISSEMENT

WARNING: failure to follow this instruction may result in death or serious injury.



ATTENTION

CAUTION: failure to follow this instruction may result in injuries.
This alert signal can also be used to indicate practices that could damage the SM6 unit.



INFORMATION- ADVICE
We draw your attention to this specific point.

contact the Schneider Electric service unit for diagnosis and advice

You can log on to:

WWW.SCHNEIDER- ELECTRIC.COM

Call your sales representative who will put you in contact with the closest SCHNEIDER- ELECTRIC service centre.

distribution rules

CAUTION

The aim of this publication is to enable the **RM6** unit to be installed correctly.

CAUTION

This document is not a commercial document.It is a strictly technical document drawn up by **Schneider Electric.**

safety rules

CAUTION

All the operations described below must be performed in compliance with applicable safety standards, **under the responsibility of a competent authority.**

WARNING

The contractor must be certified and authorised to manipulate and perform work on the **RM6** unit.

WARNING

Only undertake the work after having read and understood all the explanations given in this document.

If you have any difficulty complying with these rules, please contact **Schneider Electric.**

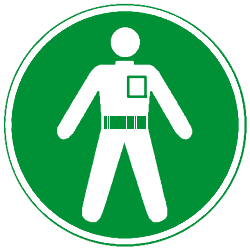
protective equipment

For each operation, it is mandatory to use safety equipment appropriate:

- **P**ersonal **P**rotective **E**quipment (**PPE**)
- **C**ollective **P**rotection **E**quipment (**CPE**)



Eye protection must be worn



Safety overalls must be worn



Safety boots must be worn



Safety gloves must be worn



Safety helmet must be worn

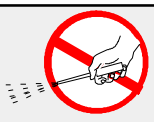


Ear protection must be worn

maintenance rules

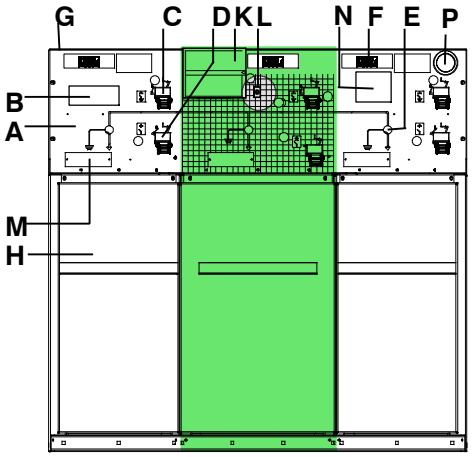


NEVER USE SOLVENTS AND ALCOHOL



WE DRAW YOUR ATTENTION TO THE RISK OF USING HIGH PRESSURE CLEANING PROCESSES

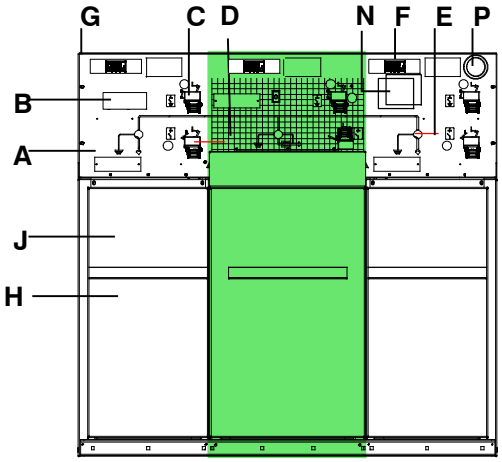
circuit breaker and switch function



IDI

A : operating mechanism front plate comprising the mimic diagram
B : information plates
C : earthing switch operating shaft
D : switch operating shaft
E : function position indicator
F : voltage indicator
G : LV connection access trunking
H : connection bushing access panel
K : **VIP30**/**35** and **VIP300** protection relays
L : **D function** opening pushbutton
M : rating plate
N : pressure switch or gauge label
P : pressure switch or gauge

fuse- switch and switch function



IQI

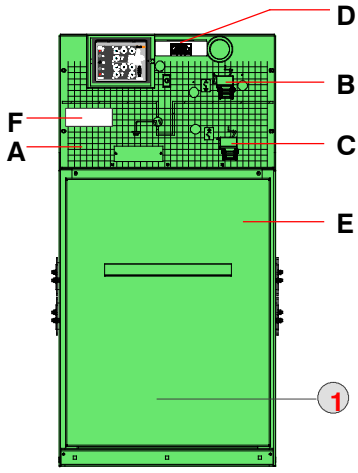
A : operating mechanism front plate comprising the mimic diagram
B : information plate
C : earthing switch operating shaft
D : switch operating shaft
E : function position indicator
F : voltage indicator
G : LV connection access trunking
H : connection bushing access panel
J : rating plate
N : pressure switch or gauge label
P : pressure switch or gauge

”switchboard coupling” switch and circuit breakers

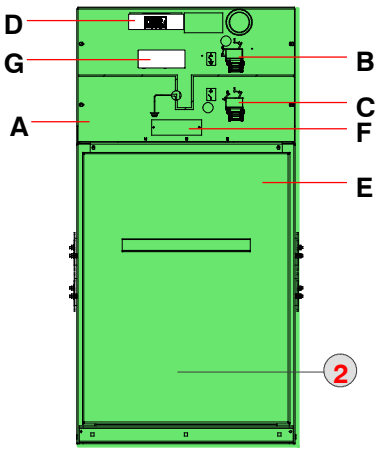
Example presented :

1: **DE- BC** station with earthing switch

2: **DE- IC** station with earthing switch



A: control panel featuring the mimic panel
B: earthing switch operating shaft
C: switch operating shaft
D: voltage indicator
E: connection bushing access panel
F: rating plate
G: characteristics plates

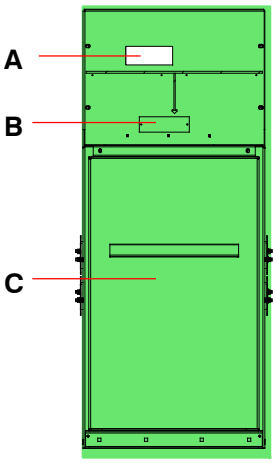


A: control panel featuring the mimic panel
B: earthing switch operating shaft
C: switch operating shaft
D: voltage indicator
E: connection bushing access panel
F: plate characteristics

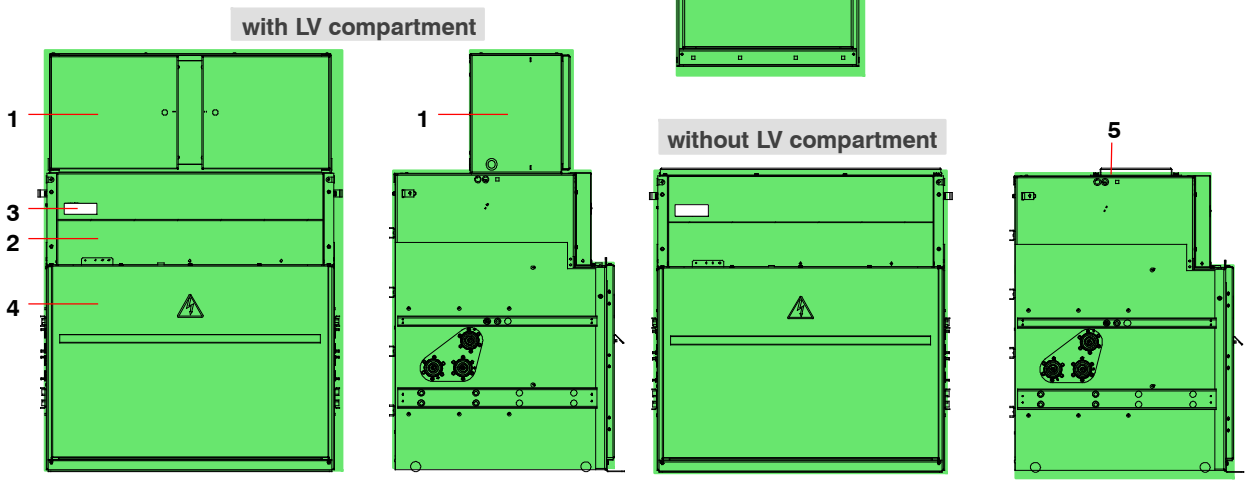
cable connection function

Exemple presented : DE- O

A: characteristics plate
B: rating plate
C: connection bushing access panel



metering cubicle

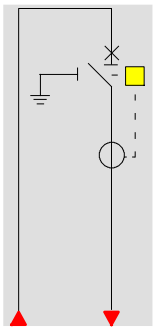


1: LV compartment
2: voltage transformer access panel
3: characteristics plate
4: access panel to current transformer
5: LV compartment

single- line diagramms

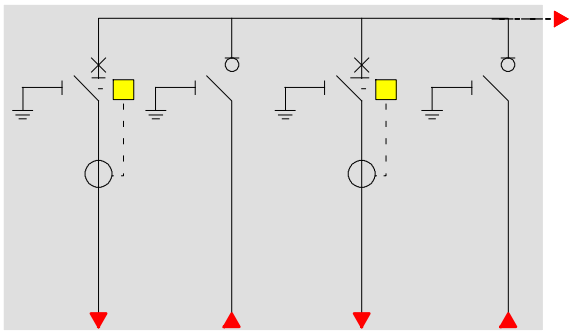
NE = No Extensible	LE = Left Extensible
DE = Double Extensible	RE = Right Extensible

NE- D



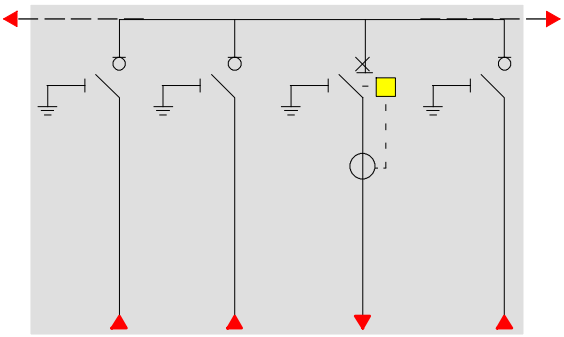
TRANSFORMER PROTECTION BY 'CIRCUIT- BREAKER'

RE- DIDI



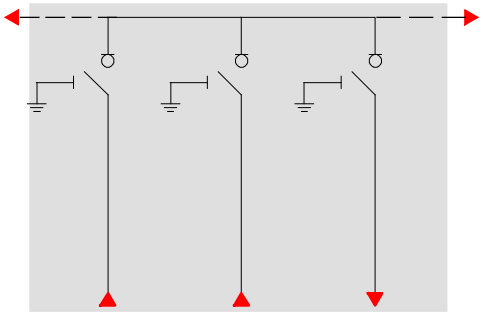
TRANSFORMER PROTECTION BY 'CIRCUIT- BREAKER'

DE- IIBI



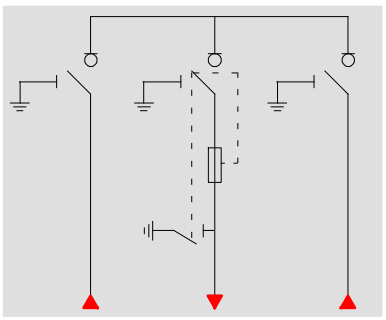
LINE PROTECTION BY 'CIRCUIT- BREAKER'

DE- III



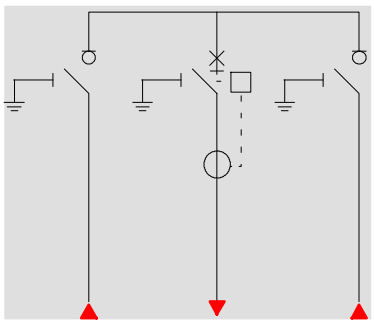
NETWORK 'SWITCH '

NE- IQI



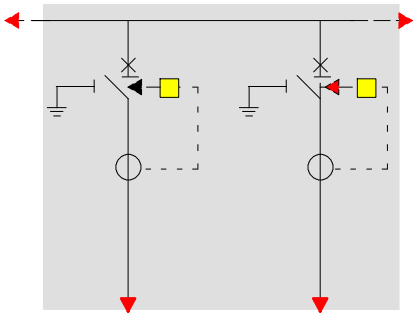
TRANSFORMER PROTECTION BY 'FUSE- SWITCH COMBINAISON'

NE- IDI



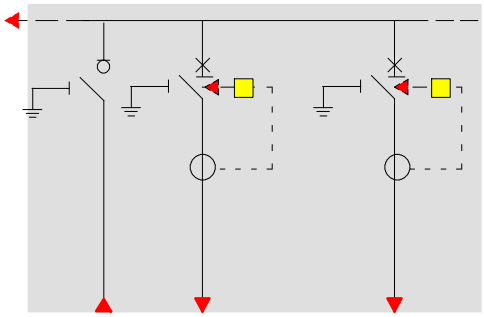
TRANSFORMER PROTECTION BY' CIRCUIT- BREAKER'

DE- DD



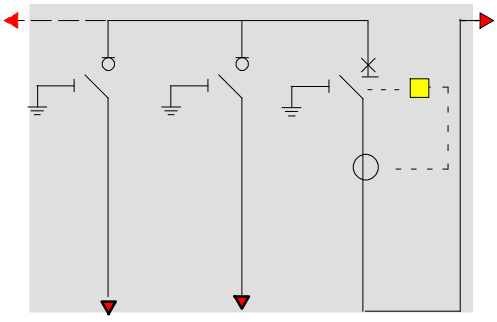
TRANSFORMER PROTECTION BY 'CIRCUIT- BREAKER '

DE- IDD



TRANSFORMER PROTECTION BY 'CIRCUIT- BREAKER'

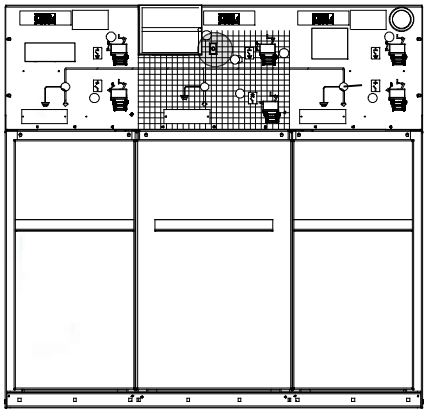
DE- IIBc



SWITCHBOARD COUPLING 'CIRCUIT- BREAKER'

prior to energising





Check that the connection bushings are fitted with connectors or with insulating caps.

Check that the **RM6** is connected to the substation earth.

pressure check of unit in operation

CAUTION → **ENERGISED RM6 UNIT**

unit with manometer

Case 1:
needle in green zone

- The **RM6** unit is operating normally.

Case 2:

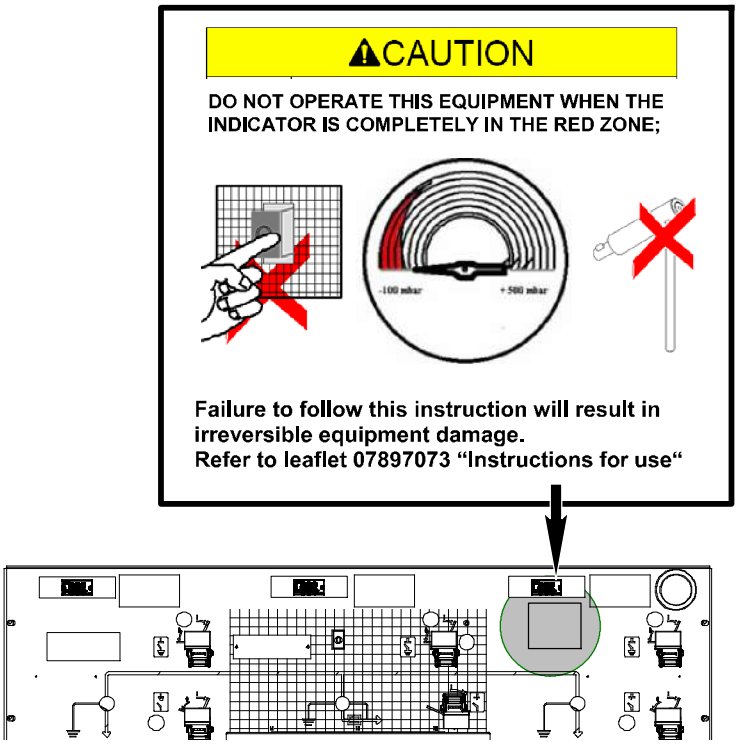
WARNING

needle in red zone

- The **RM6** unit must be replaced urgently.
- It can remain energised until replacement.
- **All opening or closing operations are forbidden.**
- To replace the RM6, power off the unit.

warning label

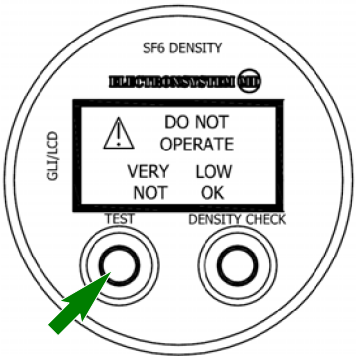
recalls the safety rules



unit with pressure switch

LCD display check

Press the "**TEST**" button. The LCD screen should display:



- If nothing is displayed, check that the 8- point connector on the pressure switch wiring harness at the rear of the LCD display is correctly connected.
- Contact the after sales service.

www.schneider- electric.com

Note: The LCD display is self-powered by piezoelectric buttons ("TEST" and "DENSITY SWITCH"). Pressing on one of these buttons will turn on the display for a few seconds.

pressure check

Press the "**DENSITY CHECK**" button. The LCD screen displays:

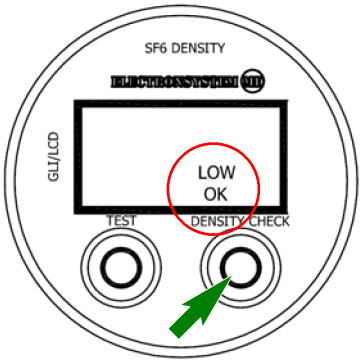
Case 1: OK



- The **RM6** unit is operating normally.

Cas n° 2 : LOW / OK

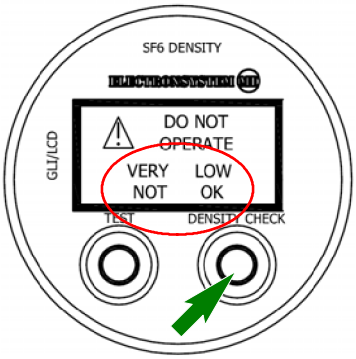
CAUTION



- The **RM6** unit must be replaced.
- It can remain energised until replacement.
- All operations can be performed while energised.

Case 3: VERY LOW / NOT OK

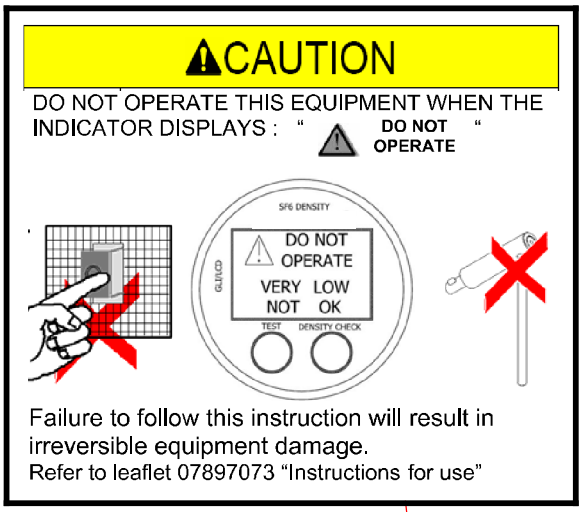
WARNING

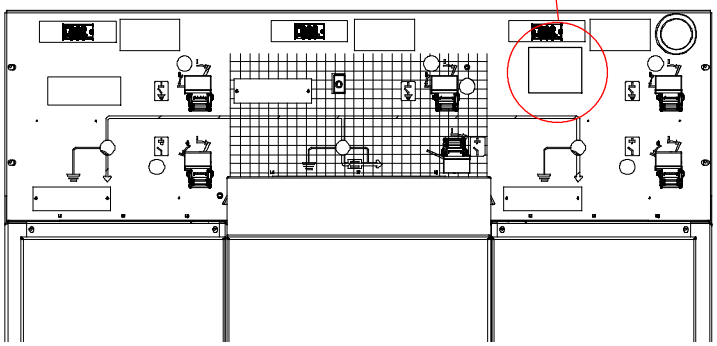


- The **RM6** unit must be replaced urgently.
- It can remain energised until replacement.
- **All opening or closing operations are forbidden.**
- To replace the RM6, power off the unit.

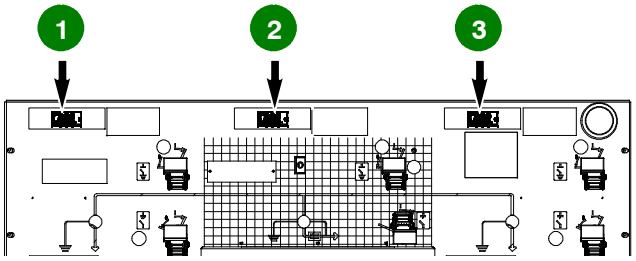
warning label

recalls the safety rules





position of the VPIS or VDS voltage indicator units (optional)



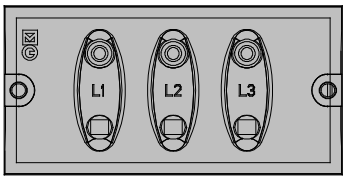
1 and 3 :voltage presence on network cables.

2 : voltage presence downstream of fuses for a switch combination or on the outgoing cable for a circuit- breaker.

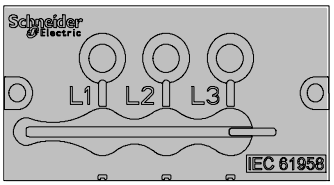
VPIS

presentation of VPIS- V1 and VPIS- V2

VPIS :**V**oltage **P**resence **I**ndicating **S**ystem, a case with 3 built- in lights.



VPIS- V1 : production until February 2009.



VPIS- V2 : production starting from March 2009.

characteristics

Conforming to **IEC 61958**, relative to voltage presence.

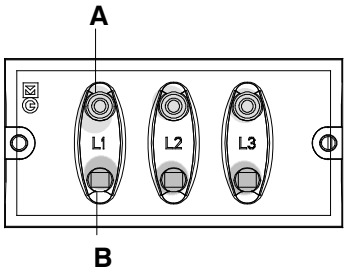
operating instructions

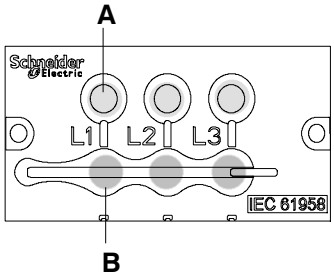
WARNING

The indication provided by a **VPIS- V1** or **V2** alone is not sufficient to ensure that the system is de- energised.

INFORMATION

When the ambient lighting is particularly bright, it may be necessary to improve visibility by protecting the indication.





A : voltage presence indicator light (one for each phase)

B : connection point designed for the connection of a phase concordance unit (one for each phase)

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Printed on 2015/11/12
07897073EN01 revision : 11

phase concordance unit

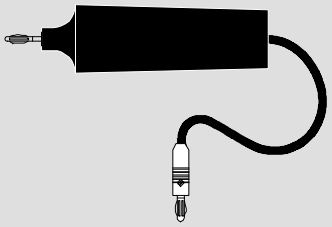
Phase concordance testing for VPIS- V1 and VPIS- V2 must be carried out each time a cable is connected to a functional unit.

It is a way of making sure that all three cables are each connected to the corresponding phase of the substation.

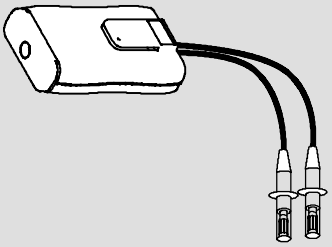
principle

The principle of the phase concordance unit is that it allows a check of the phase concordance between 2 energised functional input units on the same substation.

reminder of accessories that can be used for phase concordance test



Phase concordance unit V1.
(51191954FA)



Phase concordance unit V2.
(VPI62421

rules for the use of phase concordance unit

WARNING

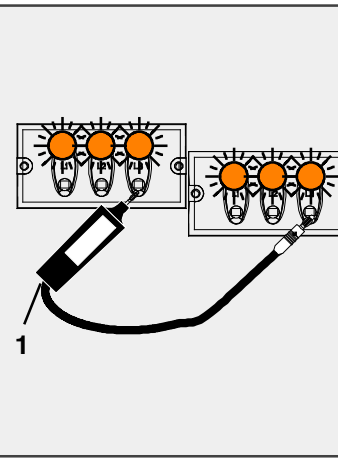
IT IS IMPOSSIBLE TO CARRY OUT A PHASE CONCORDANCE TEST WITH 2 VPIS OF DIFFERENT TYPES

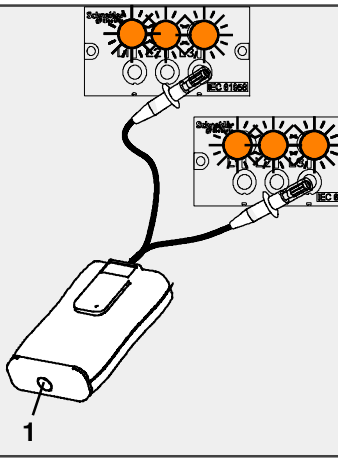
Balanced phases :

- the phase concordance unit light **(1)** is untit.

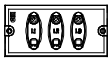
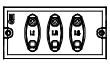
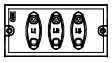
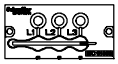
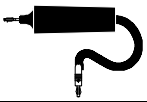
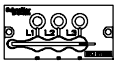
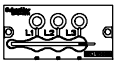
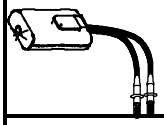
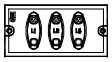
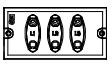
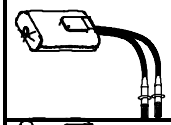
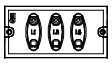
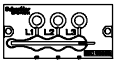
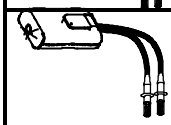
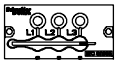
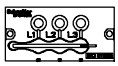
Unbalanced phases :

- the phase concordance unit light **(1)** is lit.



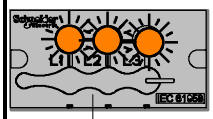
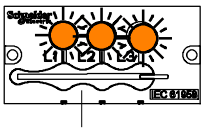
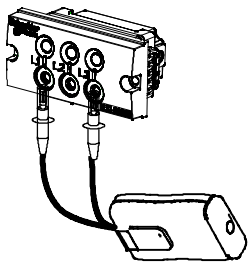
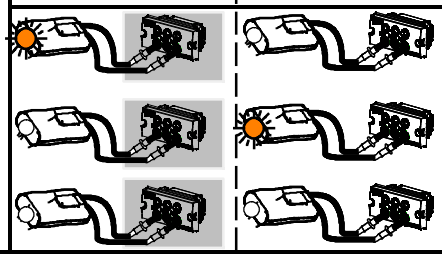


rules for choosing phase concordance unit

phase concordance unit	functional unit 1	functional unit 2	compatibility result	corrective actions
	V1 	V1 	OK	
	V1 	V2 	OK	Replace **VPIS- V1** by **VPIS- V2**. Use a phase concordance unit **V2**.
	V2 	V2 	OK	Use a phase concordance unit **V2**.
	V1 	V1 	OK	Replace **VPIS- V1** units by **VPIS- V2** units OR test with 1 phase concordance unit **V1**.
	V1 	V2 	OK	Replace **VPIS- V1** with **VPIS- V2**.
	V2 	V2 	OK	

check before phase concordance test

Please refer to the previous chapters in the event of test malfunctioning.

TEST	RESULT	ACTION
  1 2 Visual checking of the indicator lights on the **VPIS** units of functional unit **1** and of functional unit **2**	The 3 indicator lights of each VPIS are on.	The 2 functional units are energised, the VPIS units are operating and the check can continue.
	The 3 indicator lights of the VPIS are off. The functional unit is not energised or the VPIS is defective.	Apply power to the functional unit. If VPIS- V1 remains unlit, replaced it by a VPIS- V2.
	One or 2 indicator lights unlit.	The VPIS is probably defective. Replace by a VPIS- V2.
Phase concordance unit check choice  On each functional unit test phases **1** and **3.**	functional unit **1**  functional unit **2** 	You can test.
		**You cannot test them.** The choice of the phase concordance unit is wrong or it is not functionning correctly.

phase condordance test

The 3 indicator lights of the 2 VPIS are lit and the phase concordance unit is correct, meaning that phase concordance test can be performed.

lexique  *or*  **phase concordance unit** LED **lit** ○ LED **unlit**

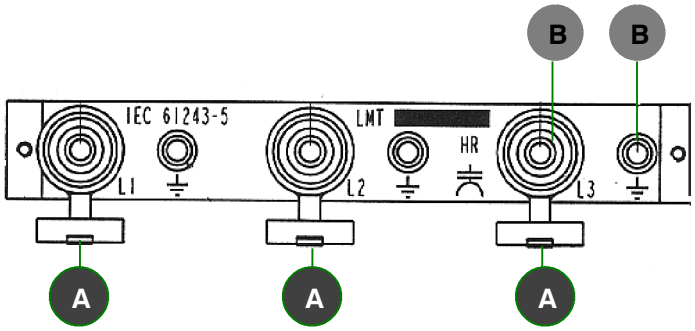
Functional unit n°2					
Functional unit n°1		L1	L2	L3	**Conclusion regarding phase concordance**
	L1	○	☀	☀	**Connection is satisfactory.**
	L2	☀	○	☀	
	L3	☀	☀	○	
	L1	☀	○	☀	**Reverse the MV cables connected to L1 and L2 on one of the 2 functional units**
	L2	○	☀	☀	
	L3	☀	☀	○	
	L1	○	☀	☀	**Reverse the MV cables connected to L2 and L3 on one of the 2 functional units**
	L2	☀	☀	○	
	L3	☀	○	☀	
	L1	☀	☀	○	**Reverse the MV cables connected to L1 and L3 on one of the 2 functional units**
	L2	☀	○	☀	
	L3	○	☀	☀	
	L1	☀	○	☀	**Change the position of each MV cable on one of the 2 functional units**
	L2	☀	☀	○	
	L3	○	☀	☀	
	L1	☀	☀	○	**Change the position of each MV cable on one of the 2 functional units**
	L2	○	☀	☀	
	L3	☀	○	☀	

RM6 equipped with VDS voltage detection units

VDS: **V**oltage **D**etecting **S**ystem, unit with connectors used to plug in individual indicators.

A: protective covers.

B: connections points used to connect an individual indicator.



characteristics

The voltage detector system equipping your **RM6** is of the separate VDS type, HR system.

It complies with standard **IEC 61243- 5.**

instructions for using the interface

Each time the interface is used, put back the protective covers.

Do not use connectors enabling short- circuiting of the interface, in networks with unearthed or earthed neutral by resonant circuit.

accessories usable at the interface

Individual voltage indicator for HR system.

Universal phase concordance unit.

CAUTION

The reliability of the information provided is guaranteed only by use of accessories conform to standard **IEC 61243- 5**: to use them, follow the instructions of the accessory manufacturer.

Other devices must only be used at the interface if they exhibit the same dielectric strength as an indicator.

Released for Manufacturing
Printed on 2015/11/12
07897073EN01 revision : 11

choosing the HV fuses

The rating of the fuses to be fitted in the **RM6** protection function depends on the following factors (among others):

- operating voltage.
- transformer rating.
- fuse technology (manufacturer).

- Various fuse types with striker with average energy can be fitted :

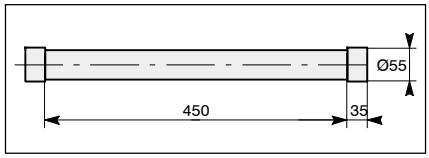
- as per standard UTE NFC 13.100, UTE NFC 64.210 of the Soléfuse type.

- as per recommendation IEC 282.1 and dimensions DIN 43.625 of the Fusarc CF type.

Example: general case for protection of a 400 kVA – 10 kV transformer, 63 A Soléfuse fuses or 50A Fusarc CF fuses will be chosen.

For installation of fuses of other manufacturers, please consult us.

Dimensions of the Soléfuse fuses (UTE)



rated voltage rating (kV)	rating to (A)
7,2 à 24	6,3 à 63

Our products are guaranteed only with the fuses mentioned in this document.

To install fuses of other brands, please ask "Schneider Electric" support.

Dimensions of the Fusarc CF fuses (DIN)



rating voltage (kV)	rating to (A)	lenght (mm)	diamater to (mm)
12	10 à 20	292	50,5
	25 à 40	292	57
	50 à 100	292	78,5
	125	442	86
24	10 à 20	442	50,5
	25 à 40	442	57
	50 à 63	442	78,5
	80 à 100	442	86

IEC & UTE standards require that all 3 fuses are to be replaced after the fusion of one fuse.

selection table

(rating in A, use without overload at –25°C < θ < 40°C).

(*)SIBA types fuses at 160A/12kV reference 30- 020- 13.

(") In the case of an external trip system (eg.:overcurrent relay).

A calculation must be carried out to guarantee coordination of fuse fuse- switches.

Please consult us.

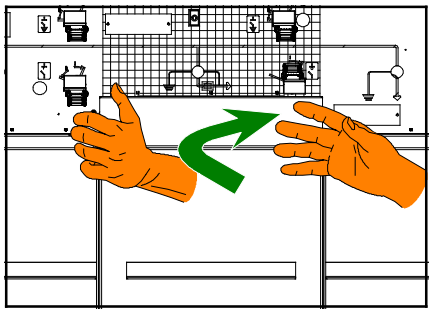
For any values inclued in the table, please consult us.
In this case of an overload beyond 40° C, please consult us.

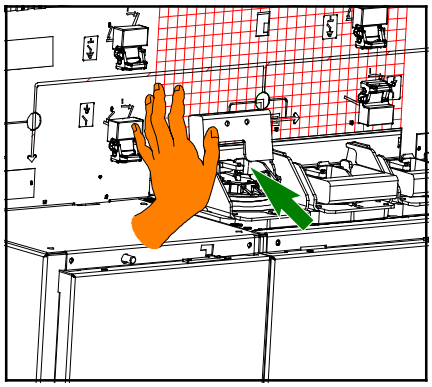
fuse type	operating voltage (kV)	Transformer rating (kvA)																Rated voltage (kV)
		50	75	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	
Solefuse (norme UTE NFC : 130.100, 64.210)																		
	5,5	16		31,5	31,5	63	63	63	63	63								7,2
	10			16	16	31,5	31,5	31,5	63	63	63	63						24
	15			16	16	16	16	16	43	43	43	43	43	63				
	20			16	16	16	16	16	16	43	43	43	43	43	63			
Fusarc CF et SIBA (*) (General case, **IEC 60282- 1, standard CEI62271- 105** (to replace **IEC 60420**) and **DIN 43625 standard**)																		
	3	20	31,5	40	50	50	63	80	100	125*	160"							
	3,3	20	25	40	40	40	63	80	80	125*	125*	160"						
	4,2	20	25	25	40	50	50	63	80	80	100	125*	160"					
	5,5	16	20	25	25	40	40	50	63	80	80	100	125*	160"				12
	6	16	20	25	25	31,5	40	50	50	63	80	100	125*	160"				
	6,6	10	20	25	25	31,5	40	50	50	63	63	80	100	125*	160"			
	10	10	10	16	20	25	25	31,5	40	50	50	63	80	100	125*			
	11	10	10	16	20	20	25	25	40	40	50	50	63	80	100	125*		
	13,8	10	10	10	16	16	20	25	31,5	40	40	50	50	63	100*			24
	15	10	10	10	10	16	20	25	31,5	31,5	40	50	50	63	80	100*		
	20	10	10	10	10	16	16	20	25	25	31,5	40	40	63	63	80	100*	
	22	10	10	10	10	10	16	16	20	25	31,5	40	40	50	63	80	100*	

fitting HV fuses

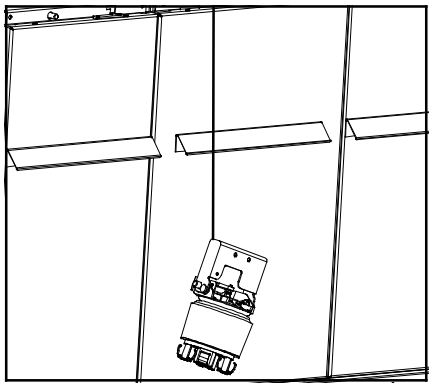
CAUTION

Before performing these operations, close the earthing switch.





Release the plug and push the extraction handle manually to release the plug (tap with the palm of your hand to detach the plug seal if necessary).

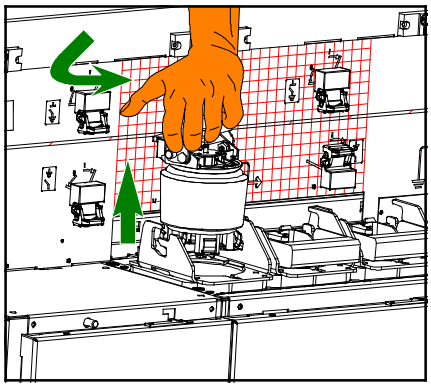


CAUTION

Repeat the operations below for all 3 fuses.

To remove the cover: lift it and pull it towards you.

The instructions are visible on the cover.



Fit the plug as far as it will go and swivel it to the left to extract it.

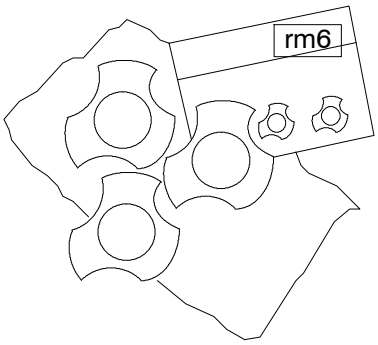
Let the plug hang.
Ensure the plugs are clean before fitting them.

To clean the plugs, consult the **preventive maintenance section.**

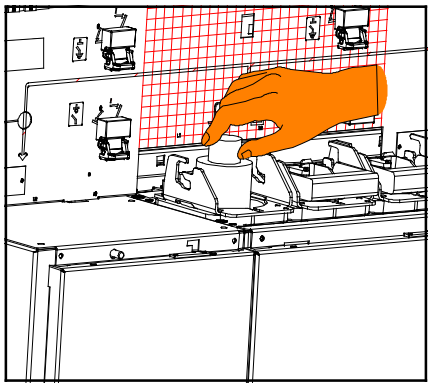
fitting a DIN fuse (Fusarc CF)

On no account must a fuse that has been knocked be installed.

A test prior to installation using a monitor is recommended.



Recover the centring devices in the bag supplied with the substation.



Insert the fuse in the compartment.Fit the centring device on the fuse.

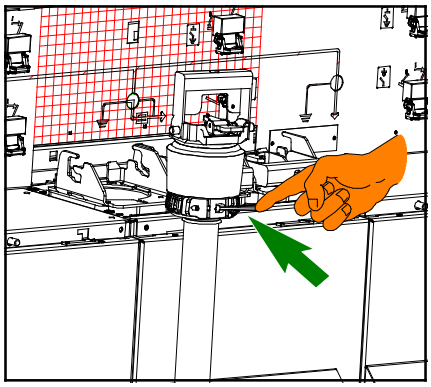
Insert the plug pins in the plinth and swivel it round to the right.

fitting an UTE fuse (Solefuse)

CAUTION

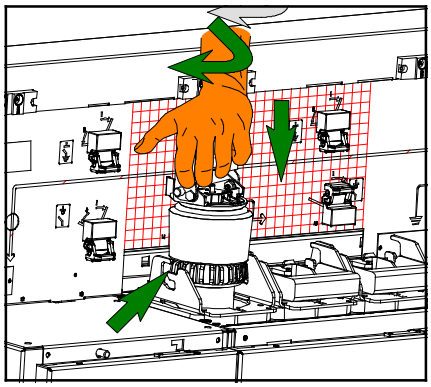
On no account must a fuse that has been knocked be installed.

A test prior to installation using a monitor is recommended.



Fix the fuse on the plug using a torque wrench with end BTR no. 5 and insert the fuse in the compartment.

Tightening torque: 15 Nm.



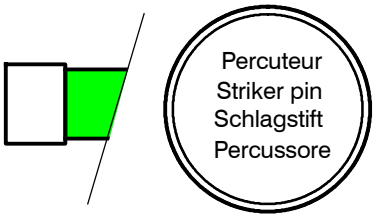
Insert the plug and fuse assembly in the compartment.Insert the plug pins in the plinth and swivel it round to the right.

Press to insert the assembly in the downstream clamp.

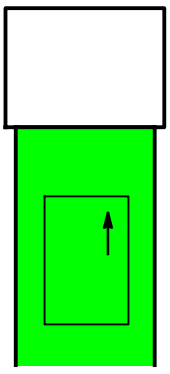
direction for mounting a fuse with striker

CAUTION

Fuse blowing releases a striker that causes three- phase opening of the switch and prevents it from reclosing.

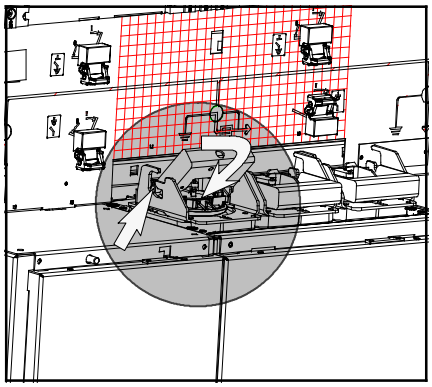


The end of the fuse equipped with the striker is marked.

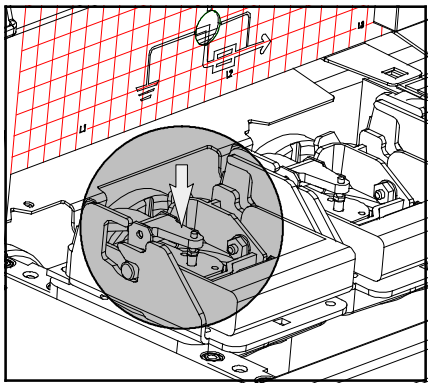


The technical data and mounting direction of the fuse are printed on the body.(striker facing upwards).

locking the plug



Make sure that the handle trunnions are inserted in the plinth slots and lock the plug manually by folding down the operating handle.



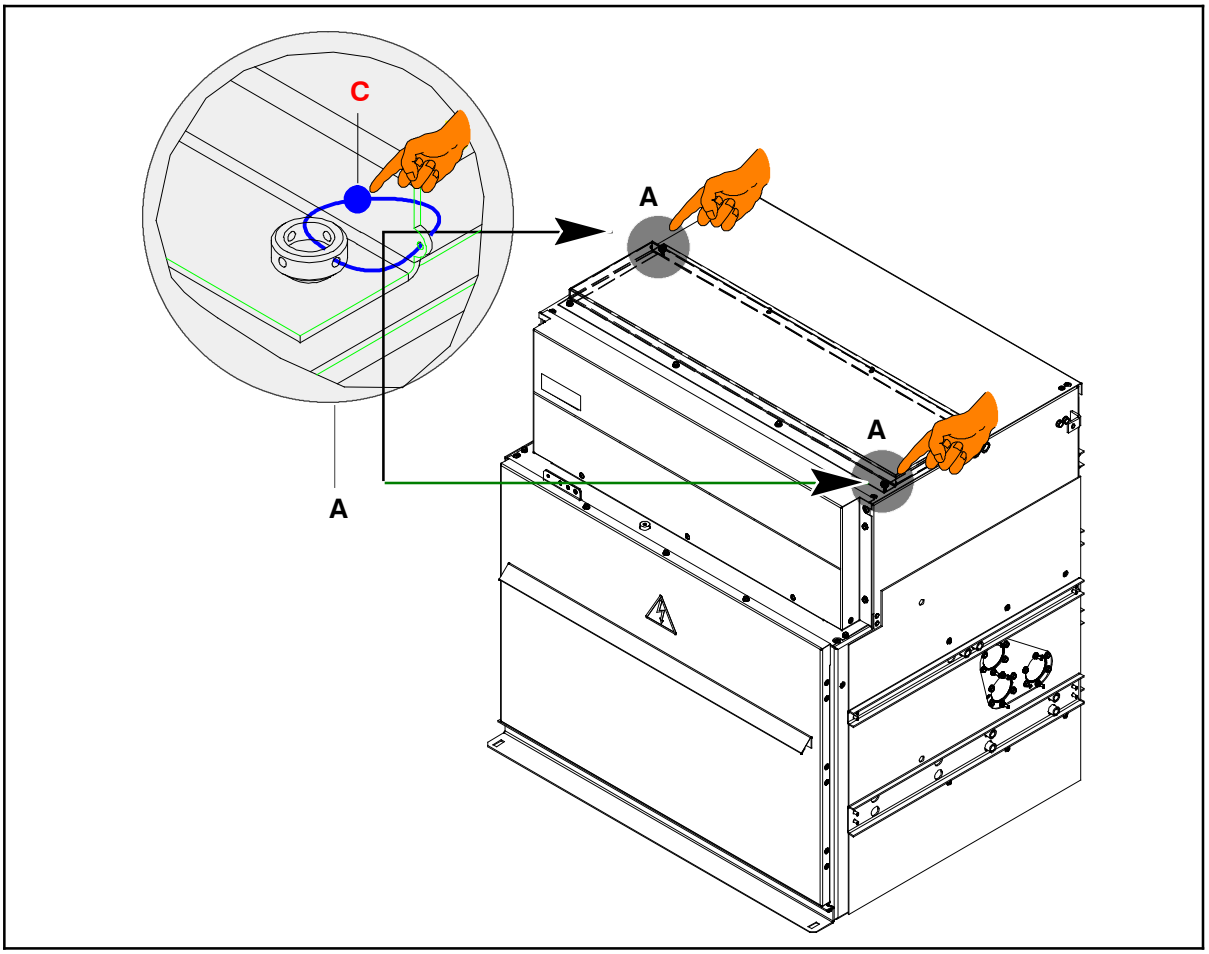
Plug with fuse blowing release, used to cause three- phase opening of the switch.

Press the switch to position it.

sealing of DE- Mt cubicle

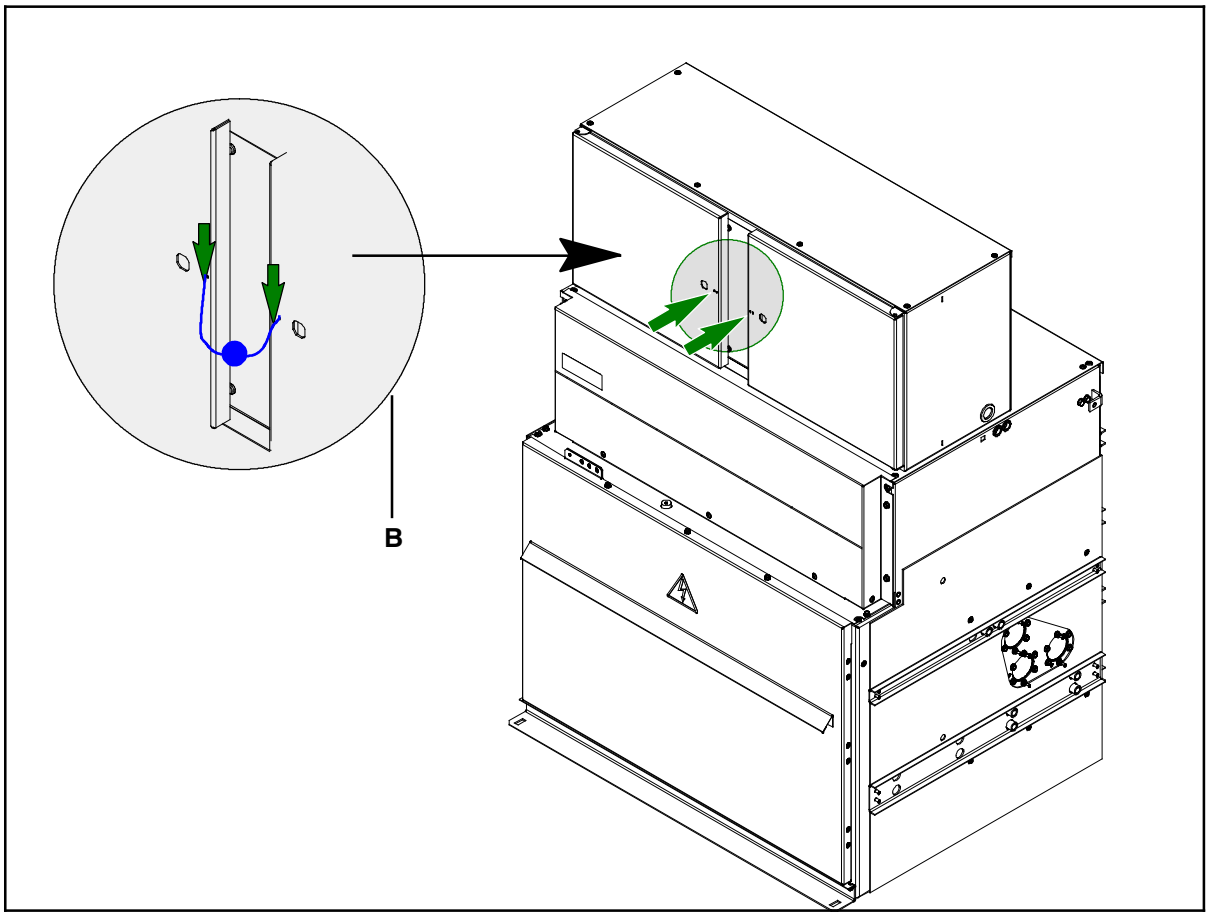
without LV compartment

A: rear sealing
B: front sealing
C: seal + wire; steel



with LV compartment

A: sealing of the LV compartment
B: seal + wire steel



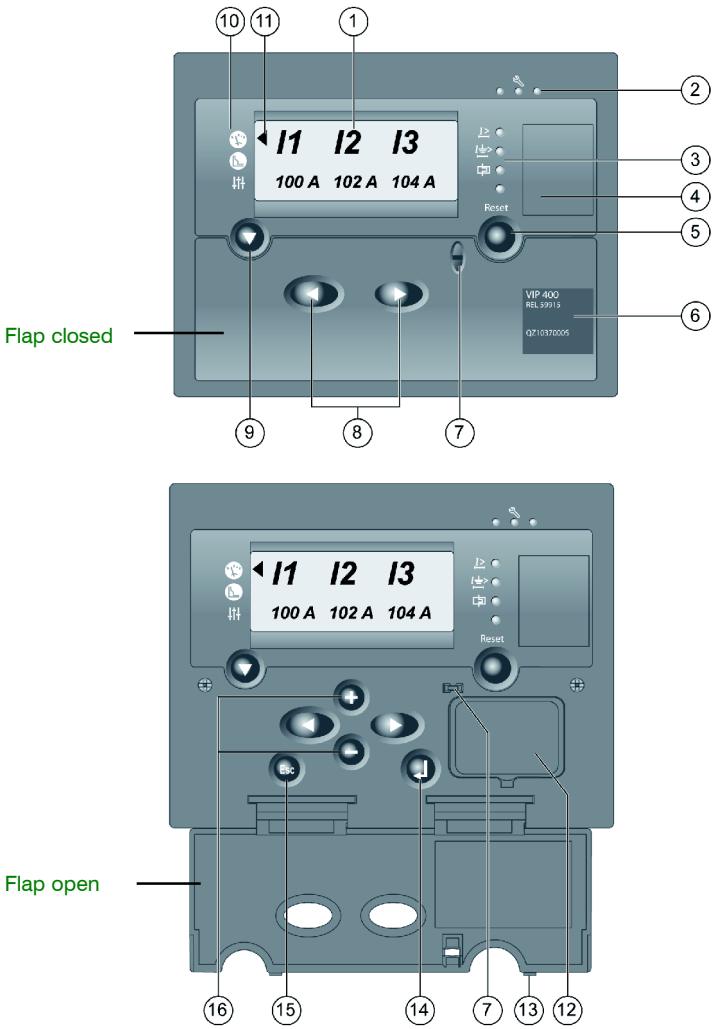
CAUTION

The VIP parameters must be set correctly in order for the circuit breaker function well.

VIP400 / VIP410
presentation

The User- Machine Interface (UMI) on the front panel of **VIP** relays consists of a display, LEDs and keys. A sealable pivoting flap can prevent access to the setting keys by unauthorized persons.

1: Display
2: Status LEDs
3: Fault indication LEDs
4: Zone for a user- customizable label with pictograms of the fault indication LEDs
5: Acknowledgement key
6: Identification label
7: Sealing ring
8: Selection keys
9: Key for selecting menus and testing LEDs. When the **VIP** is not supplied with power, this key can also be used to start the **VIP** from the battery in order to enter settings
10: Menu pictograms
11: Menu selection pointer
12: Battery compartment and socket for connecting the pocket battery module
13: Settings protective flap
14: Confirm entry key
15: Abort entry key
16: Setting keys



status LEDs

- The status LEDs provide information about the **VIP** general status:

Pictogram	Function	VIP400	VIP410
Aux. Power	**Green LED:** auxiliary power supply present	-	■
	Red LED permanently on: VIP unavailable (VIP in the fail- safe position).	■	■
	Red LED flashing: a failure has been detected but does not involve the VIP going into the fail- safe position.	■	■
	Yellow LED flashing: communication active	-	■

INFORMATION- ADVICE

NRJED311206EN : reference manual is available on : www.schneider- electric.com
or call your sales representative who will put you in contact with the closet **SCHNEIDER- ELECTRIC** service center

operation

Fault Indication LEDs

VIP relays have fault indication LEDs. They flash to indicate a fault, as shown in the **table below** :

Pictogram	Fault	VIP400	VIP410
I>	Detection of a fault by the phase overcurrent protection or in the event of tripping by the temporary test mode	■	■
Io>	Detection of a fault by the earth fault protection	■	■
θ	Detection of a fault by the thermal overload protection	■	■
Ext.	Tripping by a volt- free contact connected to the external trip input	-	■

After a trip, the fault indication LEDs are powered by the battery embedded in the VIP or by the VIP410 auxiliary power supply.

Fault indication by the LEDs can be stopped:

- by pressing the Reset key
- automatically by the reappearance of a current in the network higher than the pick- up current
- automatically after 24 hours
- by remote control order via the communication (VIP410)

For the first 3 LEDs, faster flashing may occur before the protection trips, to indicate the following information :

Pictogram	Overshoot
I>	Overshoot of the instantaneous set point for phase overcurrent protection (I> or I>> or I>>> pickup outputs
Io>	Overshoot of the instantaneous set point for earth fault protection (Io> or Io>> pick- up outputs)
θ	Overshoot of the alarm set point for thermal overload protection

note

In custom mode, the protection set points may not be assigned to the Mitop trip unit output.

In this case, the fault indication LED may be active, without being associated with the **circuit breaker** trip.

Depending on the application, this can indicate the presence of a fault without tripping the **circuit breaker**

The fault indication LED pictograms can be customized by sticking a label to the right of the LEDs.

display

The display is an LCD unit.

It is only back- lit on the VIP410, when the auxiliary power supply is present.



Each VIP function is presented in a screen consisting of the following items:

- **First line**: symbols for electrical values or function name
- **Second line**: displays the values of measurements or parameters associated with the function
- A menu pointer, on the left, it is pointing to the pictogram for the selected menu

menu organization

All the data available in the VIP relay is divided between 3 menus:

- The metering menu contains the current measurements, peak demand currents, load history, event records, fault trip counter and the breaking current history.
- The protection menu contains the essential settings for setting up the protection functions
- The parameters menu contains the parameters that are used to adapt VIP operation to particular applications.

When a **VIP** is new, all the parameters in this menu have a default value.

The protection functions are operational even with the parameters menu default values.

selecting a screen in a menu

Etape	Action
1	Press the key to select one of the 3 menus The menu pointer indicates the selected menu : : Metering menu : Protection menu : Parameters menu
2	Press the or keys to scroll through the screens in the select menu, until the desired screen diplayed

default screen

A default screen is displayed automatically 3 minutes after the last keystroke.

This default screen is the screen displaying the phase currents.

operation according to the power supply mode (VIP400)

The **VIP400** is a stand- alone protection relay powered by its current sensors.

When current is present in the medium- voltage (MV) network, the protections and the display work and it is possible to enter settings and view measurements.

The current in the MV network on which the **VIP** operates is called the 'pick- up current'.

When no current is flowing through the circuit breaker (for example circuit breaker open), or when the current in the MV network is too low, the **VIP** is off and nothing appears on its display.

If current appears, the protection functions are activated and trip the circuit breaker - or not - according to their settings.

The additional time taken by the **VIP** to start when current appears is called the 'pick- up time'.

More information on the value of the pick- up current and the pick- up time are available in the **VIP** Function Characteristics

Please consult the reference **NRJED311207EN.**

operation according to the power supply mode (VIP410)

The VIP410 is a relay with a dual power supply. It is powered both autonomously by its sensors and by the auxiliary power supply.

Like for the VIP400, the self- powered supply allow the protection functions to work even if the auxiliary power supply fails.

The auxiliary power supply is used to power functions that do not depend on the current being present in the MV network. These functions are marked in the function table (Please consult the reference **NRJED311207EN**). The auxiliary power supply must be present in order them to work.

integral battery

The VIP has an integral battery. It is used to:

- activate the user- machine interface in order to enter settings when the VIP is not supplied with power
- illuminate the fault indication LEDs when the VIP is no longer supplied with power after giving theopening order to the circuit breaker
- power the internal calendar

When the **VIP** is not supplied with power:

Pressing and holding down the key will activate battery- powered operation of the user- machine interface. It is then possible to access the menus in order to enter settings.

In this case, the display turns off automatically after 3 minutes of inactivity on the keypad.

- The protection functions are activated automatically if the current reappears.

The integral battery plays no part in operating the protection functions. The protection functions work even when there is no battery.

NOTE :

- in battery operation mode, the **VIP** processor runs with a reduced clock frequency to ensure the battery life is maintained. As a result, the user- machine interface may be slower to react.

- during a setting operation with the **VIP** powered by its internal battery alone, the clock display is not refreshed on screen. However the internal clock increments normally.

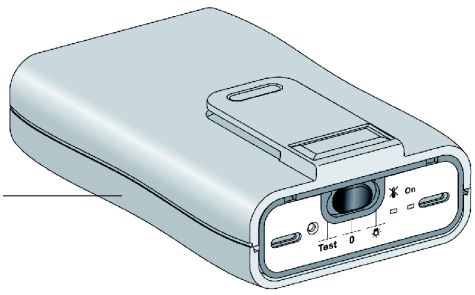
pocket battery module

The pocket battery module is an accessory that can be connected to the front panel of **VIP** relays. It contains a battery that can be used to power the **VIP** in order to:

- enter settings if the integral battery is missing and if the VIP is not powered by the current sensors
- test the **VIP**, please consult the reference **NRJED311207EN.**
- display the cause of the last trip by the VIP' please consult the reference **NRJED311207EN.**
- more information on connecting the pocket battery module to the **VIP** is available in the Connection to the **VIP** ' please consult the reference **NRJED311207EN.**

battery module

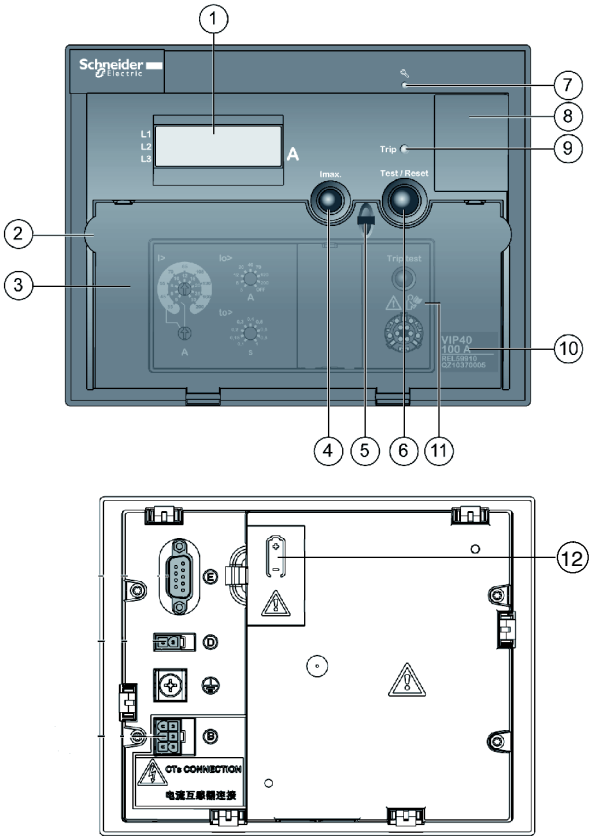
The pocket battery module should only be used during maintenance or commissioning by qualified personnel and must never be left permanently connected to a running **VIP**.



LV434206

presentation of VIP40/45

1: Display
2: Lugs for opening the transparent protective flap
3: Transparent protective flap
4: Imax. peak demand display button
5: Sealing ring
6: Test/Reset button
7: Status LED
8: Space for a user- customizable label
9: Trip fault indication LED
10: Identification label
11: Symbol indicating that it is necessary to read the manual
12: Battery



display

- The display is an LCD unit
- During operation, the display indicates the value of the current on each phase in succession

Each phase remains displayed for 3 seconds before automatically changing to the next. The display is in amps, on three digits.

The display is in amps, on three digits.

NOTE: If the phase current is less than the pick- up current (Please you consult the reference **NRJED311207EN**), the **VIP** is not activated and the display is off.

lugs for opening the transparent protective flap

To open the flap, pull both lugs simultaneously.

The flap pivots open on its 2 bottom hinges.

Imax. button: peak demand display

Pressing the **Imax.** button triggers a sequence displaying the peak demand currents for all 3 phases in succession.

After this sequence, the **VIP** automatically returns to displaying the phase currents.

INFORMATION- ADVICE

NRJED311207EN : reference manual is available on : www.schneider- electric.com
or call your sales representative who will put you in contact with the closet **SCHNEIDER- ELECTRIC** service center

Test/Reset button

After a trip, pressing this button stops the flashing trip indication.

This button can also be used to:

- test the built- in battery. When pressing the Test/Reset button, the fault indication LED lights up immediately to indicate that the battery is OK.
- perform the 'lamp test' if the relay is supplied with power. Pressing the Test/Reset button for 5 seconds causes all the display segments and the status LED to light up, and displays the software version number.

voyant d'état

Pictogram	Color	Event
	Red	■ LED permanently on: the **VIP** has gone into the fail- safe position following detection by the embedded self- tests of the failure of one of its internal components, involving a risk of nuisance tripping. In this case, the **VIP** is no longer operational ■ **NOTE**: This LED may light up briefly when the **VIP** is energized: this is normal and does not indicate a failure. ■ LED flashing: the **VIP** has detected a failure not involving a risk of nuisance tripping. In this case, the **VIP** has not gone into the fail- safe position.Intervention is required as soon as possible (Please you consult the reference **NRJED311207EN.**) The LED stops flashing as soon as the failure disappears.

space for user- customizable label

There is a special space for a user- customizable label for the **Trip** LED.

Trip LED: fault Indication

The fault indication LED flashes to indicate that the **VIP** has sent a trip order to the circuit breaker.

Aftercircuit breaker opening, when the **VIP** is no longer supplied with power by its sensor, the built- in battery makes the LED flash.

The LED stops flashing:

- automatically after 24 hours
- when the current returns, on **circuit breaker** closing (if the current is higher than the pick- up current)
- when the Test/Reset button is pressed
- when the pocket battery module is connected then disconnected

NOTE: The **VIP** built- in battery only supplies power to the fault indication LED and displays the type of fault.

It has no role in operating the protection functions.

identification Label

The identification label on the front panel is used to identify the **VIP**:

- product name
- product reference
- serial number

symbol : necessary reading of manual

The symbol indicates that it is necessary to read the **VIP** reference manual before working on the product.

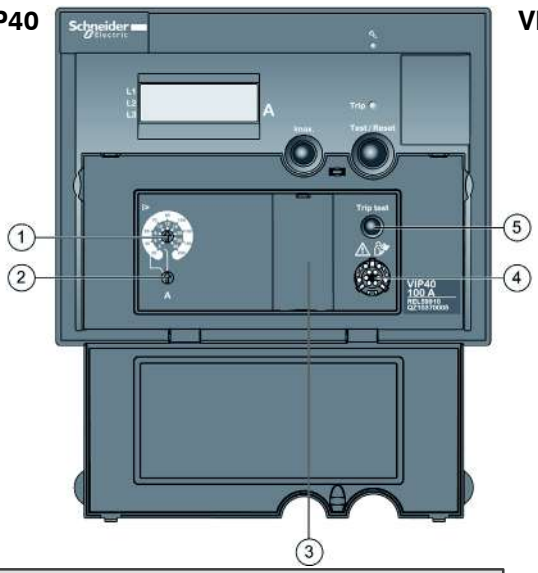
VIP40/45 settings

front panel

When the protective flap is opened, you can enter the protection settings by means of the rotary switches.

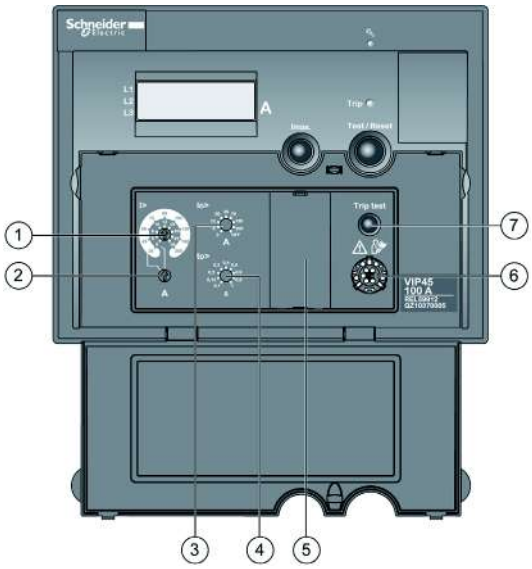
To do this, use a 3 mm flat blade screwdriver

VIP40



1 Phase overcurrent protection adjustment dial
2 Setting range selector switch
3 Advanced settings protective cover
4 Connection port for the pocket battery module
5 Trip test button

VIP45



1 Phase overcurrent protection adjustment dial
2 Setting range selector switch
3 Earth fault protection set point adjustment dial
4 Earth fault protection time delay adjustment dial
5 Advanced settings protective cover
6 Connection port for the pocket battery module
7 Trip test button

phase overcurrent protection adjustment dial

The setting is entered directly in Amps using the 9- position switch.(I>)

The selector switch has 2 graduated rings.

The range is selected using the setting range selector switch.

earth fault protection adjustment dial

The set point is set directly in Amps using the 9- position switch..(Io>)

The time delay setting is entered directly in seconds using the 9- position switch.(to>)

NOTE: the earth fault protection adjustment dials are only found on the **VIP45.**

temporary display of the changed setting

When **VIP** relays are energized, they display temporarily the value of the setting after a switch has changed position.

advanced settings

To access the advanced settings, remove the advanced settings protective cover.

Both settings can be entered using a single selector switch:

- discrimination with the LV CB
- earth fault protection inrush current delay

connection port for the pocket battery module

The connector is used to connect the pocket battery module so that the VIPs can be energized and tested.

Please consult the reference **NRJED311207EN**

NOTE:the pocket battery module should only be used during maintenance or commissioning by qualified personnel and must never be left permanently connected to a running VIP.

Trip test button

The Trip test button is used for testing VIPs.

A 5 mm diameter pointed tool is needed to activate it.

More information is available in the section describing Commissioning.

Please consult the reference **NRJED311207EN**

frequency

The network frequency **(50 Hz or 60 Hz)** is a parameter that must be known for operation of the **VIP40** and **VIP45** signal processing algorithms.

They therefore have an automatic frequency recognition system.

The recognized value

(50 Hz or 60 Hz) is stored and the VIP works permanently with this value.

This stored value will be used each time the **VIP** starts

For the **VIP** to recognize the network frequency and store it, it has to detect a current on phase 1 for a minimum period of 5 seconds in the range **50 Hz +/- 2 Hz or 60 Hz +/- 2 Hz.**

This detection happens when the **VIP** starts.

For further information on the **Sepam series10,** download the reference manual from our website:

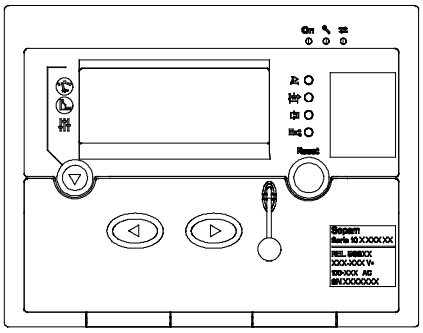
www.schneider- electric.com

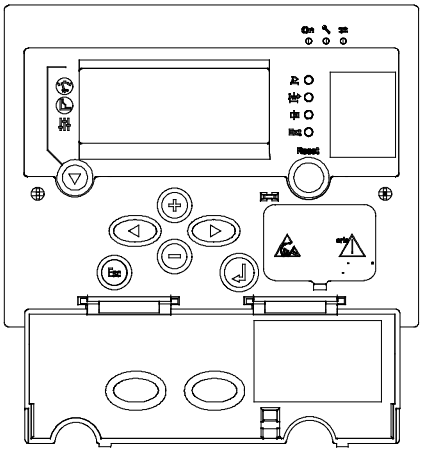
Sepam series 10

protection of HV/LV transformers

protection of HV networks

Sepam 10 relays fitted to RM6 circuit breakers require an auxiliary power supply.





Sepam 10A:
- provides protection against overloads (thermal overload protection), phase- phase faults and phase- earth faults.

It has:
- 4 logic inputs and 7 configurable relay outputs
- a communication port

Sepam 10B:
- provides protection against overloads (thermal overload protection), phase- phase faults and phase- earth faults.

It has:
- 3 configurable relay outputs

Functions		Code ANSI	Sepam série 10 B	Sepam série 10 A
Protection types				
Earth current maximum protection	Standard	50N/51N	□	□
	Very sensitive		□	□
Phase current maximum protection		50/51	■	■
Thermal overload protection		49RMS	■	■
Cold load pickup (low sensitivity of phase and earth current maximum protection settings)			■	■
Logic discrimination	Await logic emission	68	■	■
	Await logic reception			■
External tripping				■
Measurements				
Measurement of earth current			■	■
Measurement of phase currents			■	■
Phase current maximum readings			■	■
Control and monitoring				
Circuit breaker tripping and rearmament locking		86	■	■
Trip signalling			■	■
Tripping circuit monitoring				■
Circuit breaker remote control				■
Recording of last fault			■	
Recording of last 5 events				■
Communication				
Modbus				■
IEC 60870- 5- 103				■

■ *Function available*
□ *Function available depending of Sepam model*

Inputs / Outputs (Number)	B	A
Earth current inputs	1	1
Phase current inputs	3	3
Relay logic outputs	3	7
Logic inputs	-	4
RS 485 communication port	-	1

earth current (ANSI 50N- 51N)

Earth current maximum protection enables overcurrents due to phase- to- earth faults to be detected. It makes use of the measurement of the earth current's fundamental component.

2 independent thresholds (Io> and Io>>)

- the lower threshold **(**Io>**)** can be set to either a definite time **(DT)** or an inverse time **(IDMT)** curve, with the choice of standardised curve **(IEC, IEEE, RI)** and the possibility of activating an inverse time duration.
- the upper threshold **(Io>>)** has only a definite time **(DT)** setting. The minimum setting gives instantaneous operation **(ANSI 50 function)**.

Depending on the level of sensitivity required, there are 2 types of Sepam:

Sensitivity	Sensor
Standard	3 CT CRa 200/1 or CRb 1250/1
Very sensitive	CSH200 core balance CT

phase current maximum protection (ANSI 50- 51)

Phase current maximum protection enables overcurrents due to phase- to- phase faults to be detected. It makes use of the measurement of the fundamental component of the currents from the 3 phase CTs.

2 independent thresholds (I> and I>>)

- the lower threshold **(I>)** can be set to either a definite time **(DT)** or an inverse time **(IDMT)** curve, with the choice of standardised curve **(IEC, IEEE, RI)** and the possibility of activating an inverse time duration.
- the upper threshold **(I>>)** has only a definite time **(DT)** setting. The minimum setting gives instantaneous operation **(ANSI 50 function)**.

thermal overload protection (ANSI 49RMS)

This protection enables cables and HV/LV transformers to be protected against overloads based on the measurement of absorbed current.

This protection uses a thermal model based on current measurements to evaluate temperature rise. The current used for this protection is a 3- phase RMS current that takes into account up to 13th order harmonics.

This protection has 2 settings:

- maximum allowable continuous current, which corresponds to the maximum thermal withstand of the equipment to be protected (this allowable continuous current corresponds to a temperature rise of 100%)
- heating/cooling time constant of the equipment.

low sensitivity of phase and earth current maximum protection settings (Cold Load Pick- Up)

The cold load pickup function avoids nuisance tripping when the equipment is powered- up, especially after a long break in operation. It allows the protection thresholds to be temporarily increased.

High currents at cold load pickup may be due to:

- simultaneous powering- up of all the loads in an installation.
- power transformer magnetising currents.
- motor starting currents.

Protection concerned	Operating means
Phase current maximum protection	After circuit breaker closing, the tripping thresholds (I> or I>>) are increased or blocked for the set duration.
Earth current maximum protection	After circuit breaker closing, the tripping thresholds (Io> or Io>>) are increased or blocked for the set duration. Or The protection is restrained by the detection of sensor saturation (measurement of 2nd order harmonic level).

logic discrimination (ANSI 68)

This function achieves:

- tripping discrimination in the event of a short- circuit between phases, or from phase to earth, for all network types
- reduced tripping time of the circuit breaker that is closest to the source.

All Sepam series 10B and 10A are able to emit an await logic order should a fault be detected by the phase and earth current maximum protection functions.

Only the Sepam series 10A is able to receive an await logic order that blocks its tripping signal. A safety mechanism ensures the protection operates in the event of a fault with the blocking signal wiring.

external tripping

The **Sepam series 10A** enables, via a logic input, a tripping order from an external protection means to be taken into account.

earth current measurement

This measurement enables the value of the fundamental component of the earth current to be displayed.

phase current measurements

These measurements enable the RMS value of the phase currents to be displayed; it takes into account up to 13th order harmonics.

This function displays the 3 phase currents.

phase current maximum readings

This function enables the largest average current value of each of the 3 phases to be displayed, as well as giving the highest absorbed current during load peaks.

latching / resetting ANSI 86	Output relay latching can be configured. Latch tripping orders are memorised and must be reset in order to put the equipment back into service.	Resetting can be done: - by pressing the Reset button; - via the **Sepam 10A** communication port.
circuit breaker remote control - Sepam 10A	This function enables remote operation of the circuit breaker via the communication. A Sepam logic input allows the operating mode (local or remote) to be selected.	
recording of the last fault - Sepam 10B	This function enables the characteristics of the last fault to be displayed. The Sepam indicates the cause of the fault, the value of the phase currents and the earth current when the fault occurred, and the time and date of the fault. This information is memorised until the next fault occurs.	**Cause of faults recorded: I>, I>>, Io>, Io>>** and thermal protection.
recording of the last 5 events - Sepam 10A	This function enables the characteristics of the last 5 events to be displayed. For each event, the Sepam indicates its cause, the value of the 3 phase currents and the earth current when the event occurred, and the time and date of the event. Events are numbered in the order they occur and the last 5 can be displayed.	**The following events are recorded:** ■ tripping due to **I>, I>>, Io> or Io>>**, thermal protection ■ tripping by external input ■ tripping circuit fault ■ circuit breaker opening and closing via the communication ■ tripping due to logic discrimination safety protection.
communication - Sepam 10A	One RS 485 communication port. 2 protocols available, chosen by configuration: Modbus, IEC 60870- 5- 103.	Communication enables the following functions to be carried out remotely: ■ measurement readings, ■ status readings ■ event readings and time- stamped measurements (2 tables of 100 events available) ■ time setting and synchronisation ■ remote control orders.
operating language	When delivered, the default language is English. The following languages can be selected: UK English, US English, Spanish, French, Italian, German, Turkish, Portuguese.	

standard assignment of inputs/outputs and customised configuration

The configuration is customised using the **Sepam** human-machine interface, without the need for a PC.

Sepam 10A

Logic inputs	Standard assignment	Configurable
I1	Circuit breaker open	No
I2	Circuit breaker closed	No
I3	External tripping	Yes
I4	Local- Remote	Yes
Relay outputs	**Standard assignment**	**Configurable**
O1	Circuit breaker tripping	Yes
O2	Locking of circuit breaker latching	Yes
O3	Trip signalling	Yes
O4	Circuit breaker remote closing	Yes
O5	Await logic emission	Yes
O6	Trip circuit fault signalling	Yes
O7	Watchdog	No

Sepam 10B

Relay outputs	Standard assignment	Configurable
O1	Circuit breaker tripping	Yes
O2	Locking of circuit breaker latching	Yes
O3	Trip signalling	Yes

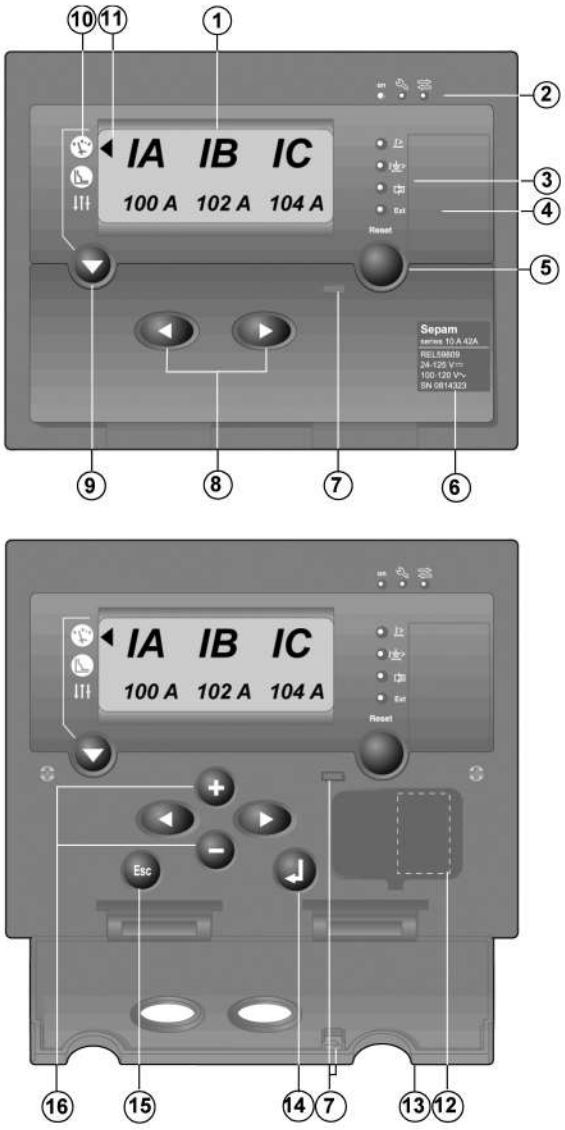
human- machine interface

front panel

The Human- Machine Interface on the **Sepam** front panel is made up of a display, indicator lamps and buttons.

Access to the setting buttons by unauthorised personnel can be prohibited using the pivoting and lead- sealable cover. The illustrations below show the 2 positions of this cover.

1: Display
2: Status indicator lamps
3: Fault indicator lamps
4: Zone for a customised pictogram label of fault indicator lamps
5: Button for resetting the Sepam and the maximum value readings
6: Identification zone
7: Lead sealing ring
8: Selection buttons
9: Menu selection and indicator lamp test button
10: Menu pictograms
11: Menu selection pointer
12: Battery compartment **(Sepam series 10A)**
13: Settings protection cover
14: Entry validation button
15: Entry abort button
16: Setting buttons



status indicator lamps

The status indicator lamps provide information on the **Sepam** status.

Pictogram	Function	Sepam series 10	
ON	Green lamp: Sepam powered- up	B	A
	Red lamp: Sepam unavailable (Sepam in fall- back position)	B	A
	Yellow lamp: communication active	–	A

fault indicator lamps

The fault indicator lamps flash as described in the table below to signal a fault:

Pictogram	FThreshold exceeded	Sepam series 10	
I>	Phase current maximum protection instantaneous threshold exceeded (I> or I>> pickup output)	B	A
Io>	Earth current maximum protection instantaneous threshold exceeded (Io> or Io>> pickup output)	B	A
	Thermal protection alarm threshold exceeded	B	A

The fault indicator lamp is latched in standard operating mode.
If, when customising the operating mode (at the time of commissioning), the latching of a fault indicator lamp has been cancelled, the fault indicator lamp goes out as soon as the fault is no longer present.

For the first 3 lamps, they may flash at a faster rate before the protection trips to signal the following information:

Pictogram	Fault	Sepam series 10	
I>	Detection of a fault by the phase current maximum protection	B	A
Io>	Detection of a fault by the earth current maximum protection	B	A
	Detection of a fault by the thermal protection	B	A
Ext	External tripping	–	A

identification zone

The identification zone on the front panel enables a Sepam to be identified:

1 : Identification code
2 : Reference
3 : Supply voltage
4 : Serial number

VIP400



VIP410

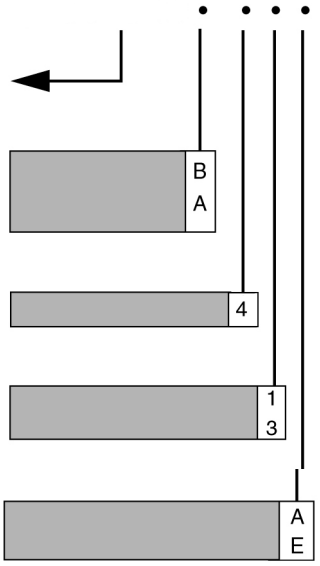


Refer to the Identification section for the **identification** code key.

identification

identification code

The identification code of a **Sepam series10** is an alphanumeric code that defines the main functions of the Sepam. It is made up of several fields:



Sepam 10 family

Model

B: phase and earth current maximum protection settings

A: phase and earth current maximum protection settings, logic inputs and communication port

Number of current inputs

4: 3 phase current inputs + 1 earth current input

Sensitivity of earth current maximum protection

1: standard (0.1...24 In) CT
3: very sensitive (0.2...24 A and 2...240 A) CSH200

Supply voltage
A: 24...125 V DC and 100...120 V AC
E: 110...250 V DC and 100...240 V AC

operating instructions

accessing information

During operation, when the settings protection cover is closed, the user has access to the following:

- reading of measurements, settings, protection types and parameters.
- local fault signalling.
- last fault resetting.
- reading of last recorded faults.
- resetting of maximum values.
- testing of indicator lamps and the display.

display



1. Press ▼ to select one of the 3 menus.
2. The pointer ◀ shows the selected menu:



Measurements
Protection types
Parameters

3. Press ◀▶ and ◀▶ to select the information to be displayed.

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resetting



1. A fault detected by the Sepam is signalled by:
   - a message on the display
   - a flashing indicator lamp
2. Press Reset to reset the fault.
3. The indicator lamp goes out and the message disappears

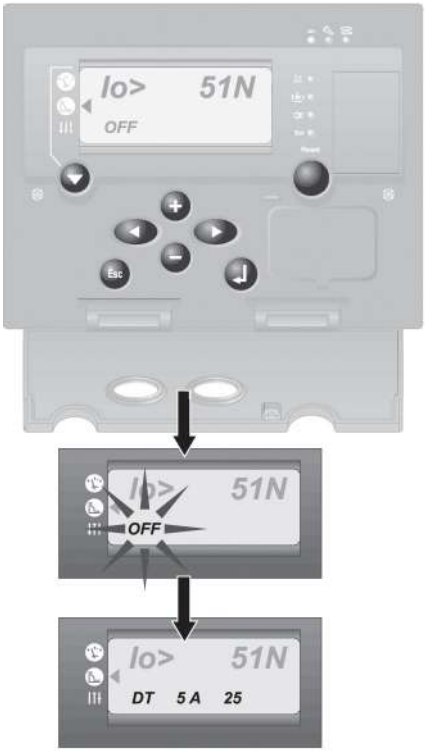
setting instructions

CAUTION

Knowledge of electrical network protection is required for choosing appropriate settings.
Only those people with the required skills are authorised to set the Sepam.
Not abiding by this instruction may cause injury and damage to equipment and property.

All protection is inhibited by default. To make the protection operational, it must be activated and set- up when commissioning the RM6.

accessing parameters and settings



1. Open the settings protection cover.
2. Press ▼ to select the protection or parameter menu.
3. Select the protection type or parameter to be set using ◀ and ▶ .
4. Enter the password if requested.
5. Press ↵ to select the value to be modified.
6. The selected value flashes.
7. Press ⊕ or ⊖ to increment or decrement the value.
8. Press ↵ to validate the new value or press Esc to cancel.
9. The value stops flashing.

setting ranges

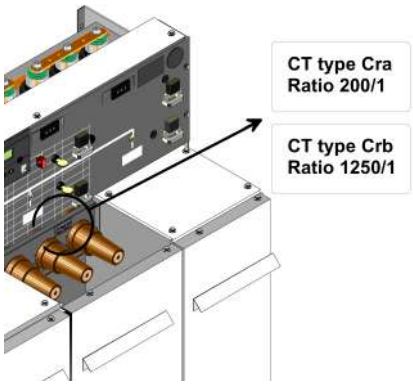
The setting ranges that can be used for the lower threshold depend on the circuit breaker type: **D** or **B**, and the type of sensors fitted to the RM6.

Circuit breaker type		**D**	**B**
Type of sensors		Cra 200/1	CRb 1250/1
Functions	Code **ANSI**		
Phase current	50- 51	20- 200A	125- 630A
Earth current	50N- 51N	20- 200A	125- 630A
Very sensitive earth current	50G- 51G	2- 240A 0,2- 24A	2- 240A 0,2- 24A

factory set parameters

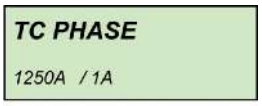
Sepam 10A and 10B standard earth

The transformer ratios of the phase and earth CTs (Io by summing) are factory set. If by error you have deleted the settings, you can find the type of CT fitted to your RM6 in the inspection report supplied with the equipment and on the CT support, where a label with the information can be found (see image aside).











Sepam 10A and 10B very sensitive earth

The factory set measurement range is 2- 240A; this can be changed.

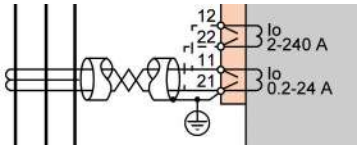


To change to the 0.2- 24A range, you should:

1- Bring up Io 0.2- 24A in the RATING screen.



2- Change the wiring at the CSH input, terminals 11- 21 on the Sepam connector marked B.



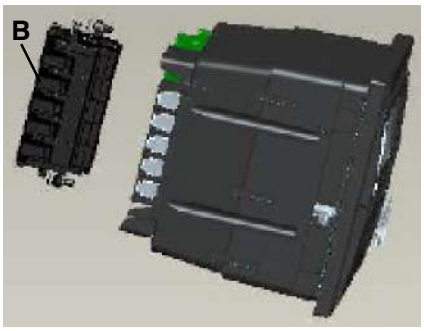
configuring the logic inputs

For the Sepam series10 A, logic input operation must be adapted to the type of voltage: **AC** or **DC**. The type of voltage must be configured in the **LOG INPUTS** screen of the parameter menu. The default value is **DC**.



accessing phase current inputs

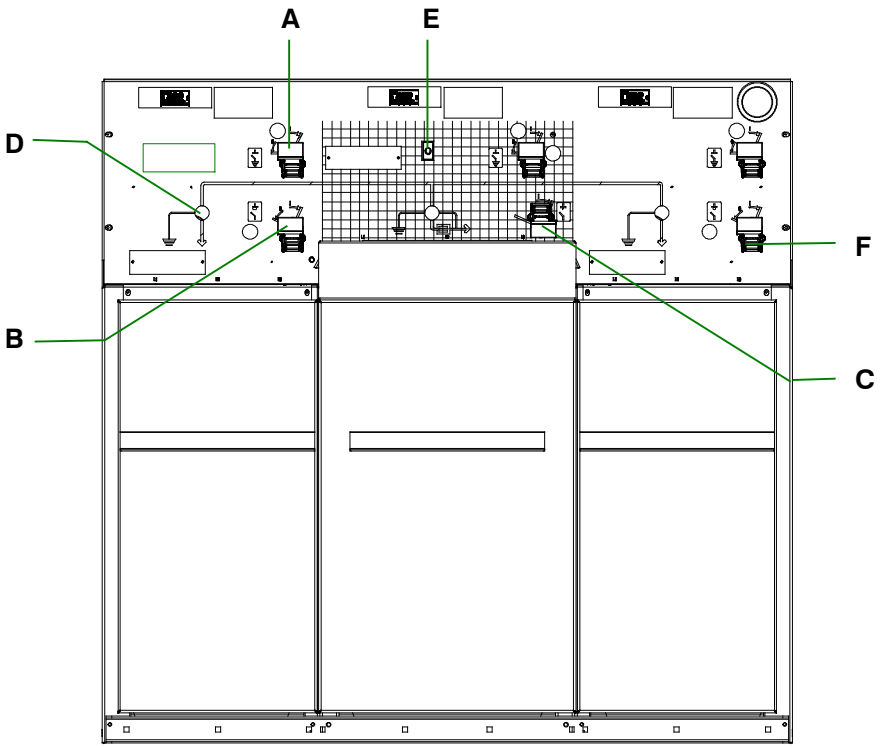
Connector **B** for connecting the current sensors is a short- circuiting connector. It can be disconnected on- load; disconnecting it does not open the sensors' secondary circuit. Remove the short- circuiting connector without disconnecting the wires connected to it. Use another connector to connect your generator.



operating and viewing substation condition

description

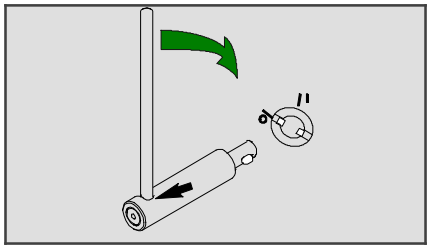
A: earthing switch operating shaft
B: switch function operating shaft
C: fuse- switch combination function operating shaft
D: position indicator
E: fuse- switch combination function opening pushbutton
F: padlocking handle



closing a switch

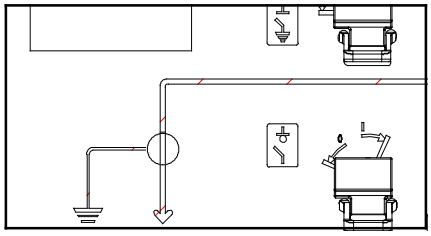
Initial state:

- switch open
- earthing switch open



Left the operating shaft protective cover.

Activate the switch operating mechanism to the right.

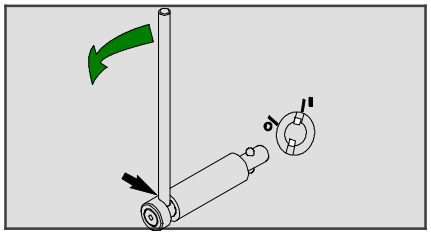


The indicator moves to the closed position, and access to the earthing switch operating shaft is blocked.

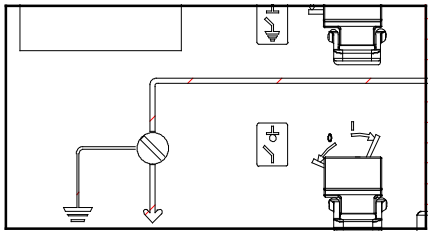
opening a switch

Initial state

- switch closed
- earthing switch open



Activate the switch operating mechanism to the left.



The indicator moves to the open position, and access to the earthing switch operating shaft is freed.

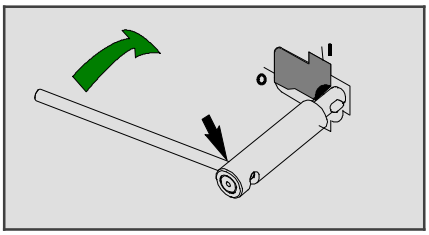
closing an earthing switch

Initial state:

- earthing switch open
- switch or circuit- breaker open

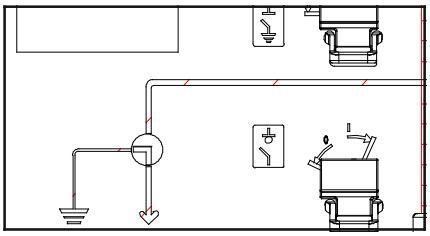
DANGER

If the incoming line is powered on, do not close the earthing switch.



Lift the operating shaft protective cover.

Separate the pallet with the end of the lever, then activate the **earthing switch operating mechanism to the right.**

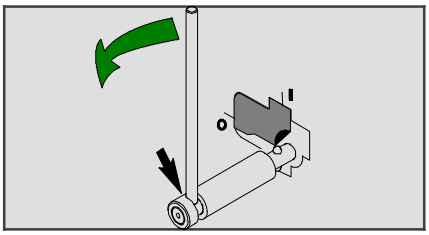


The indicator moves to the earth position and access to the earthing switch **operating shaft is blocked.**

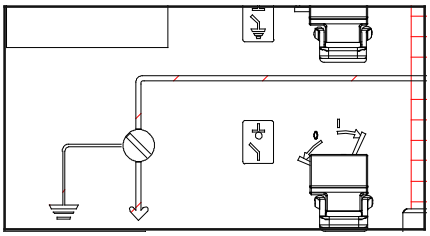
opening an earthing switch

Initial state :

- earthing switch closed
- switch or circuit- breaker open



Separate the pallet with the end of the lever, then activate the switch operating mechanism **to the left.**

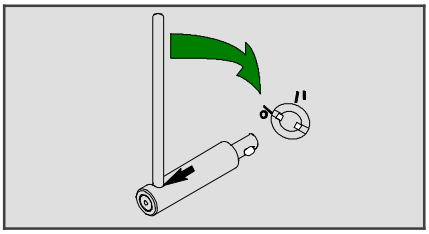


The indicator moves to the **open position**, and access to the switch or circuit- breaker operating shaft is freed.

closing a circuit- breaker or fuse- switch combination

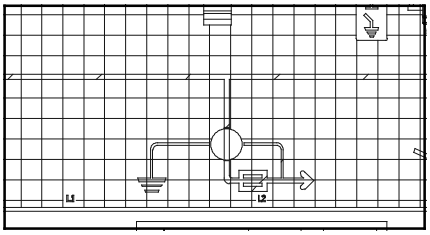
Initial state :

- circuit- breaker or fuse- switch open
- earthing switch open



Lift the operating shaft protective cover.

Activate the switch operating mechanism to the right.

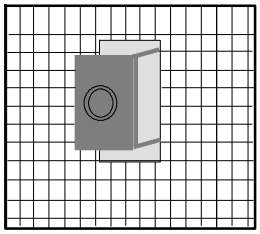


The indicator moves to the closed position, and access to the **earthing switch is blocked.**

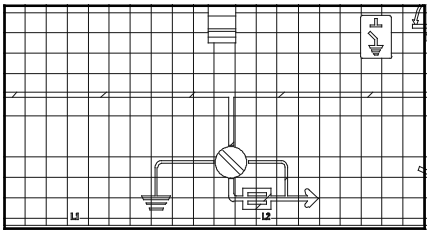
opening a circuit- breaker or fuse- switch combination

Initial state :

- circuit- breaker or fuse- switch open
- earthing switch open

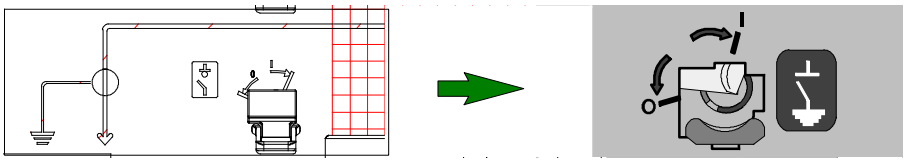


Press the opening pushbutton of the circuit- breaker or fuse- switch combination.



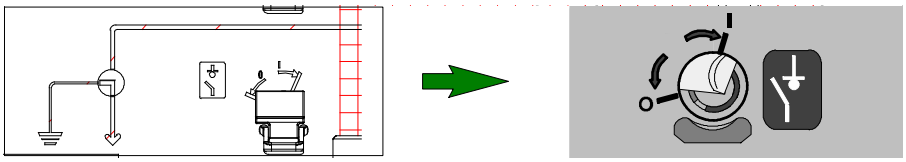
The indicator moves to the **open position**, and access to the earthing switch is freed.

operating safety



Switch or circuit- breaker closed...

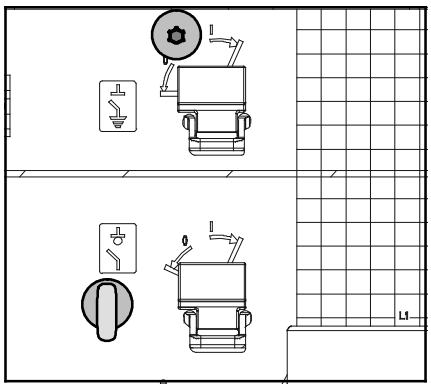
...the earthing switch is blocked.



Earthing switch closed...

...the switch or circuit- breaker is blocked.

key- locking (optional)



The switches and the circuit- breaker are locked in the open position. The earthing switches are locked in position :

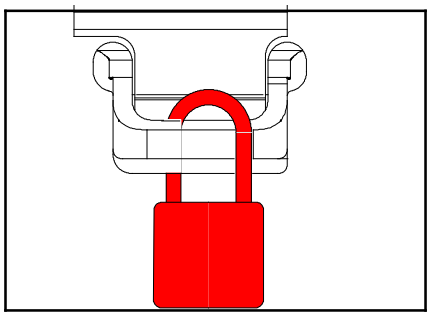
- open
- open/closed

There are various possible locking diagrams.

- network switch and network outgoing circuit- breaker
  - semi- crossed locking
  - crossed locking
- Transformer outgoer :
  - **RM6**/ transformer
  - **RM6**/ low voltage
  - **RM6**/ ransformer/low voltage

padlocking

operating shaft padlocking handle

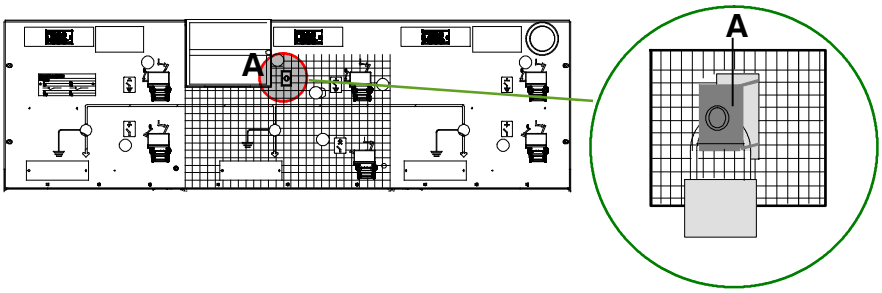


Switch and earthing switch with a degree of protection IP3X, fit a padlock
6mm < handle diameter < 8 mm.

padlocking the opening pushbutton

Fit the padlock on the opening pushbutton
6mm < handle diameter < 8 mm.

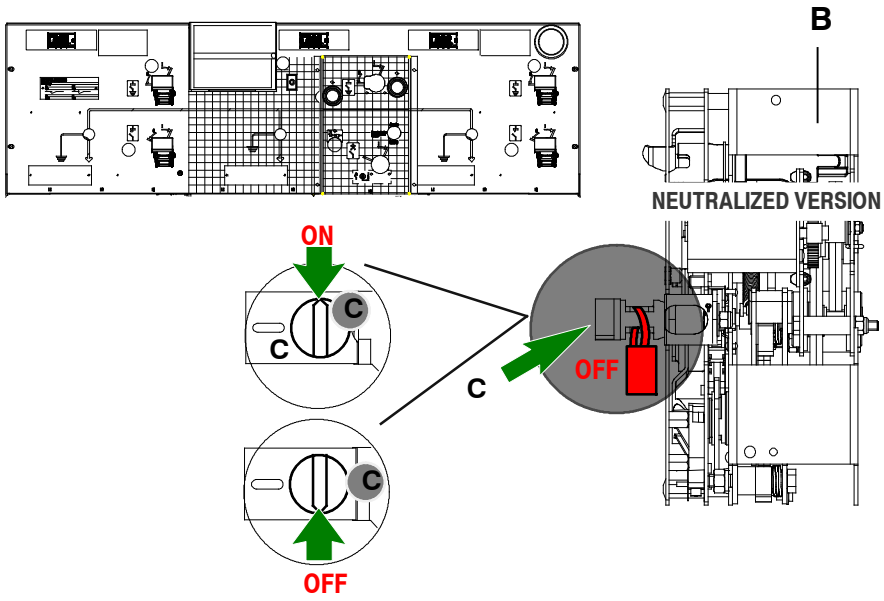
A: fuse- switch combined function or circuit breaker opening push botton.



with motorization lock option

B: circuit- breaker motorized
C: position of the switch

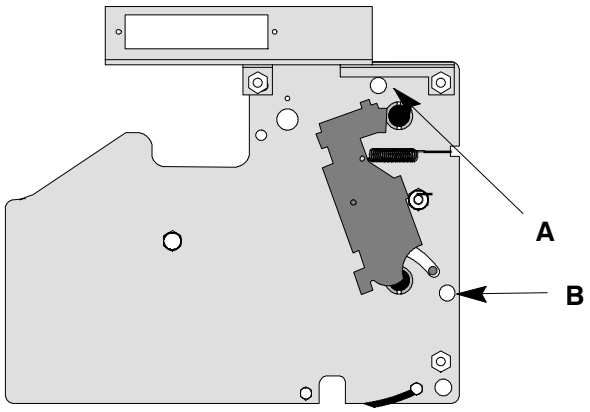
ON : AUTHORIZED ENGINE
OFF : LOCKED ENGINE



padlocking the operating shafts of the switch with the operating mechanism front plate removed

fit a padlock
6mm < handle diameter < 8 mm.
in one of the 2 marked holes.

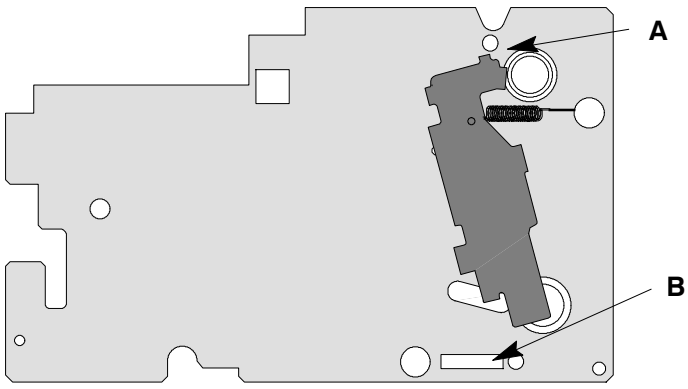
A: padlocking the earthing switch in the open or closed position
B: padlocking the switch in the open or closed position



padlocking the operating shafts of the circuit- breaker with the operating mechanism front plate removed

fit a padlock
6mm < handle diameter < 8 mm.
in one of the 2 marked holes.

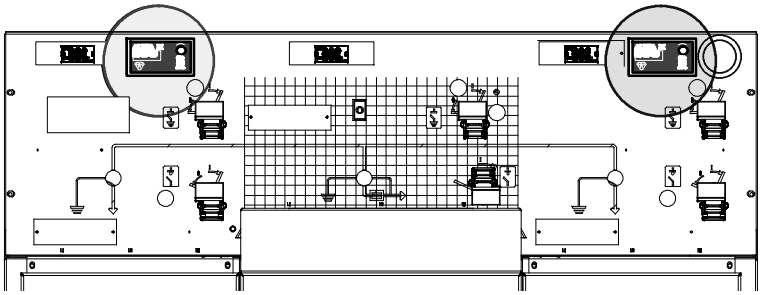
A: padlocking the earthing switch in the open or closed position
B: padlocking the switch in the open or closed position



overcurrent indicator

An overcurrent indicator of the **Alpha M** or **Alpha E** type can be optionally fitted one of the line switch.

4 detection thresholds are possible – 400 A, 600 A, 800 A, 1000 A.



Alpha M type indicator



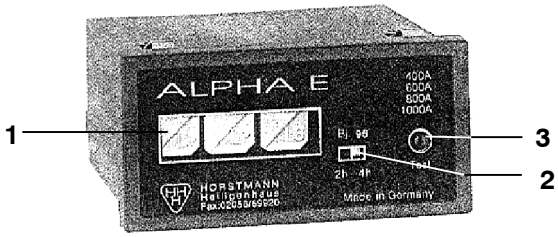
operation

If the reaction current exceeds the pre- set threshold, the indicator will send an optical signal on the faulty phase. The signal will remain visible until it is manually reset.

1) Threshold overshoot optical signal, one for each phase.

2) Rotary resetting and operating test button (turn quickly).

Alpha E type indicator



operation

If the reaction current exceeds the pre- set threshold, the indicator will send an optical signal on the faulty phase. The signal will remain visible for a time that can be pre- set.

2 hours or 4 hours.

Manual resetting is possible.

1) Threshold overshoot optical signal, one for each phase.

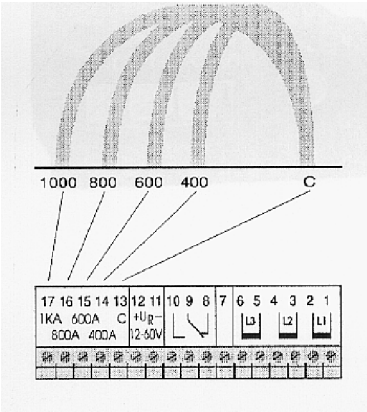
2) Time during which the signal remains visible.
Resetting is automatic.

3) Resetting and operating test pushbutton.

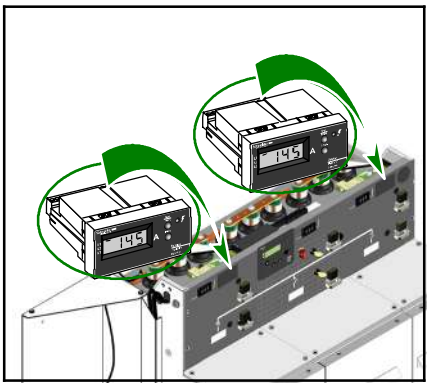
threshold change for Alpha M and Alpha E type indicator

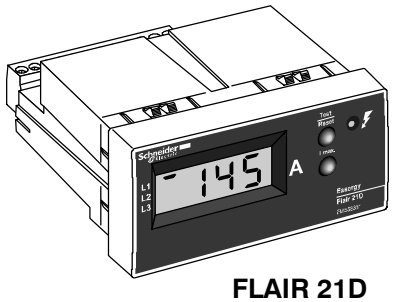
CAUTION

To change threshold, cable appropriately according to the diagram opposite. The terminal block is placed behind the device.

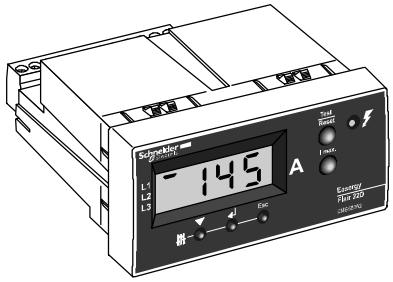


LV connection indicator Flair 2xD





FLAIR 21D



FLAIR 22D, et 23DV

The **Flair 21D**, **22D and 23DV** fault passage indicator is self- powered by the measurement sensors.

A minimum 2A current is required in the MV cable to start up the **Flair 21D** display, an energy storage guarantees a 4 hours minimum autonomy.

The Flair devices have an output contact for interfacing with a SCADA system.

Flair 22D/**23DV** can be connected to a voltage presence indicating system (VPIS) provided with a voltage output (VPIS- VO). In this case, for greater reliability, fault detection is confirmed by voltage absence without taking into account the current.

Flair 23DV has to be supplied from 24Vdc to 48 Vdc for a permanent display operating and for the outdoor lamp supply.(With a single zero sequence CT, self powering is not possible).

detector pending fault

ammeter mode

In the absence of a fault, a load current indication is displayed.

The amperage of each phase L1 - L2 - L3 is displayed in succession with its reference on the left of the display.

Example,
For a load current of 80 A : 80 for L1
then 80 for L2
and 80 for L3

When Flair 22D/23DV is provided with an earth CT (B type mounting), display of M2 and M3 only.

For each phase: if I>720A display: 888
if I≤2A display: L. P. (Low Power).

maximeter mode

To access the maximeter function, press once the “Imax.” button.

For each phase, an indication of the maximum load currents since the last reset is displayed.

Example:
for a max. current of 500 A in phase 1: M1 then 500 ,
followed by M2 and M3.

The maximeters scroll only once.

All the maximeter values are reset by simultaneous actuation of the “Test/Reset” and “Imax.” buttons during scrolling.

When Flair 22D is provided with an earth CT (B type mounting), display of M2 and M3 only.

detector in fault indication

Event **A** :
the current exceeds one of the thresholds set for
a period $\geq$ acknowledge time.

Event **B** :
the line current disappears (or absence of U with VPIS- VO option, on Flair 22D/23DV)

Fault indication is active when **A** is followed by **B** within a lapse of time of less than 70 s.

- **Phase- to- earth fault detected :**

display of L1 or L2 or L3, (or Io if earth CT).
the indicator lamp flashes (1 flash every 3 s) and the output contact is activated.

- **Phase- to- phase fault detected:**

display of OC (Over current),
the indicator lamp flashes (2 flashes every 6 s) and the output contact is activated.

For these 2 types of faults, the indicator lamp remains flashing until it is reset (Reset), which can be achieved by:

- current recovery > 70 s, configurable time delay on Flair 22D/23DV (Reset active if “Automatic reset” is not on “OFF”)
- U recovery, if VPIS- VO option on Flair 22D/23DV (Reset active if “Automatic reset” is not on “OFF”)
- end of the time delay, (4 hours on Flair 21D, configurable on Flair 22D/23DV)
- a press on external Reset
- manual actuation of the “Test/Reset” button.

maintenance

- The Flair 21D fault passage indicator requires no maintenance (no electric cells or batteries to be changed regularly)
- The lithium battery of the Flair 22D indicator should be changed about every 15 years. **(for the battery replacement process, call your sales representative who will put you in contact with the closest : SCHNEIDER- ELECTRIC group service centre. You can log on to : www.schneider- electric.com)**
- The lithium battery of the BVP option (external indicator unit with incorporated battery) is to be changed every 15 years.

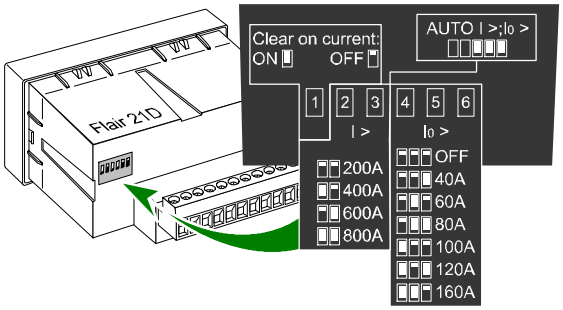
settings

The Flair devices (>2010) are a fault passage indicator without settings (automatic mode).

However, it is possible to perform specific override settings.

In manual mode, settings are made :

- using the 3 buttons located under the display, (Flair 22D/23DV).
- by micro- switches (drawing opposite).(Flair 21D) The changes are taken into account after a press on the “Test/Reset” button.

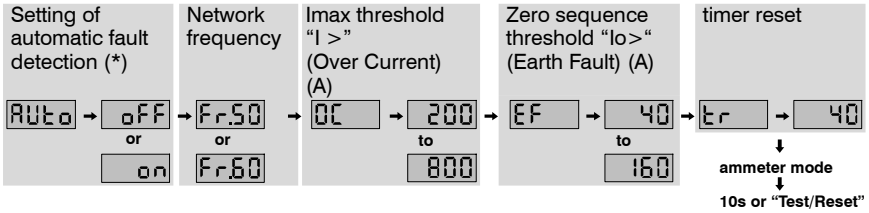


In AUTO mode I>; I0>, the manual settings are not active.

Test mode

- A press on the “Test/Reset” button activates Test mode.
- The indicator lamp flashes, and the BVP and the “OUT” output are activated until the end of the test.
- The display successively shows tESt an F21d an u 1.00 (software version)

setting parameter scrolling sequence in Test mode for Flair 21D (automatic on test mode)



When ”Auto” is ”ON”:
Flair 21D uses the following values for fault detection:

- frequency = self- detection
- zero sequence threshold = automatic fault detection for any fault > 20 A
- Imax threshold = automatic fault detection for any fault > 200 A
- acknowledge time = 40 ms
- Inrush= 3s
- CT type = CT1 (can be changed to CT2 by actualing the buttoms)
- Automatic reset = 70s (if automatic reset =on)
- Timer reset= 4h

settings mode (Flair 22D and Flair 23DV)

During the Test mode, a press on the ▼ button provides access to Settings mode (display SEt).

1) A press on the ↵ button displays the first parameter to be set

2) Several presses on the ▼ button scroll the parameters in a loop.
At this stage, with no actuation of ▼ or ↵ during 10 s, the indicator returns to ammeter mode.

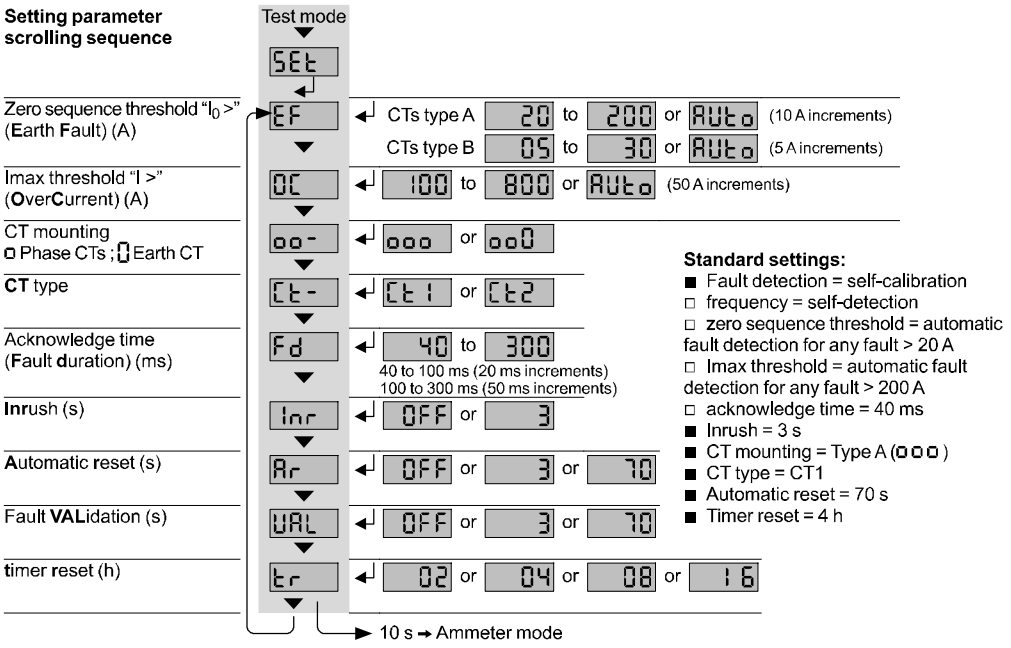
3) Press the ↵ button to display the current value of the selected parameter

4) Press the ↵ button again to activate setting of this value: the display flashes for 5 s

5) During flashing, press ▼ successively to display the desired value

6) Confirm by pressing the ↵ button; without confirmation within a period of 15 s, return to display of the parameters without change in the value.

Each press on the “Esc“ (Return) button takes you back to the preceding stage.



connection

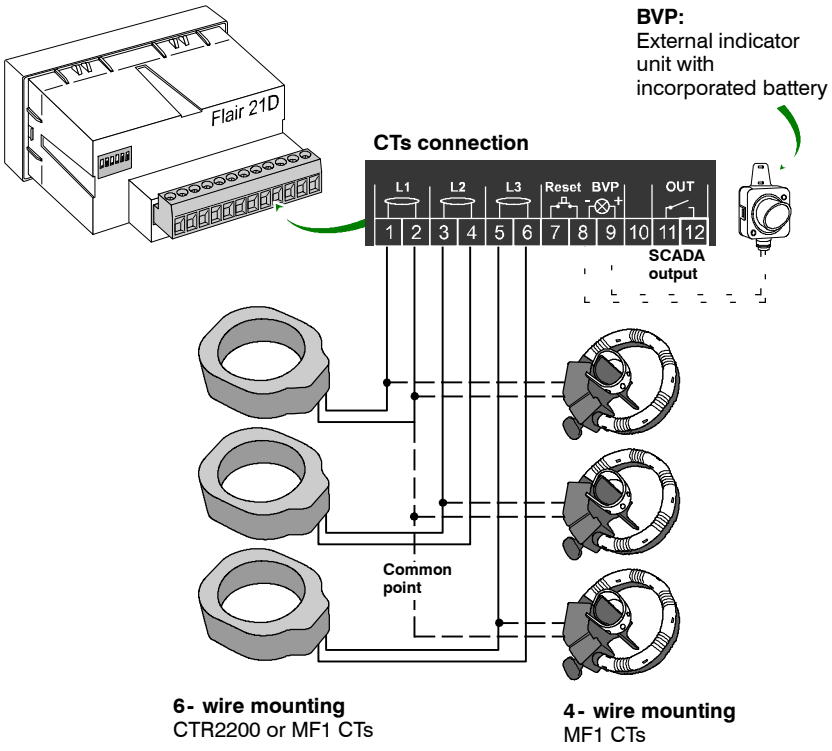
Connection of CTs to the 3 MV cables

- Cable Length : 3 m max.
- Cross section: max. 1.5 mm^2
- CTR2200 : mounting without common point (6 wires)
- MF1 : mounting with or without common point (4 or 6 wires)

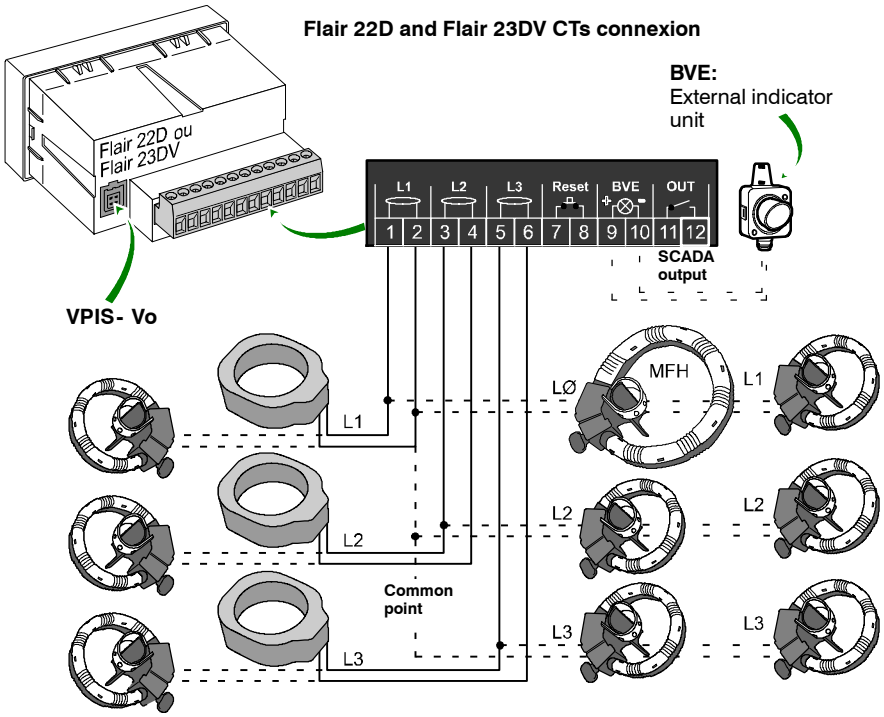
⚠ Important note
(for MF1 split core CTs):

- Mount the 3 CTs facing in the same direction
- Run the screen earth braid of the MV cable back inside the CT.

Type	Réf.	Product	Description
	EMS58351 EMS58352 EMS58353	Flair 21D Flair 22D Flair 23DV	Fault passage indicator
CT1	59925	CTR2200	Phase CT for RM6 cubicle bushing
CT2	59963	MF1	Phase CT for cable (split toroidal core)
	59928	MFC3 (pour MF1)	3 crimp- on connectors for 6- wire mounting (wires not supplied)
	59962	Faisceau MF1 or MFH	CT connector cable for 4- wires mounting (A or B type)
	59922 59988	Flair 21D BVP Flair 22D BVE	External indicator unit
	59927	MFH2200	Earth CT (split toroidal core)



Flair 22D and Flair 23DV CTs connexion

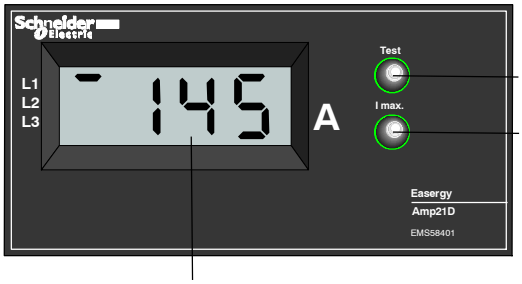


Type C mouting 'single zero sequence CT'possible only with flair 23DV

ammeter

The **Amp 21D** is an ammeter, for cubicle, **automatic** and **self-powered**.

The Amp 21D comes into operation whenever the current is greater than 3 A on the network.



Test button

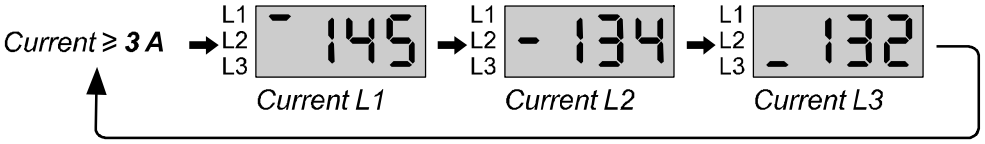
I max. button

Load current indication

standard operating

measuring mode

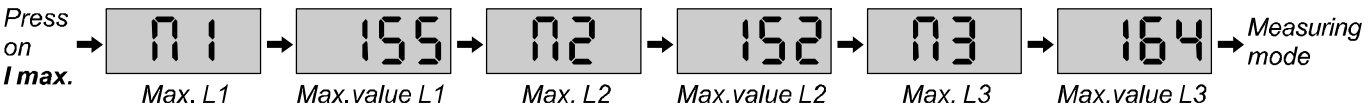
Equipment's standard operating mode.
The AMP 21D ammeter displays in succession, by scrolling, the currents on phases L1,
L2 and L3, and saves to memory the maximum values.



maximeter mode

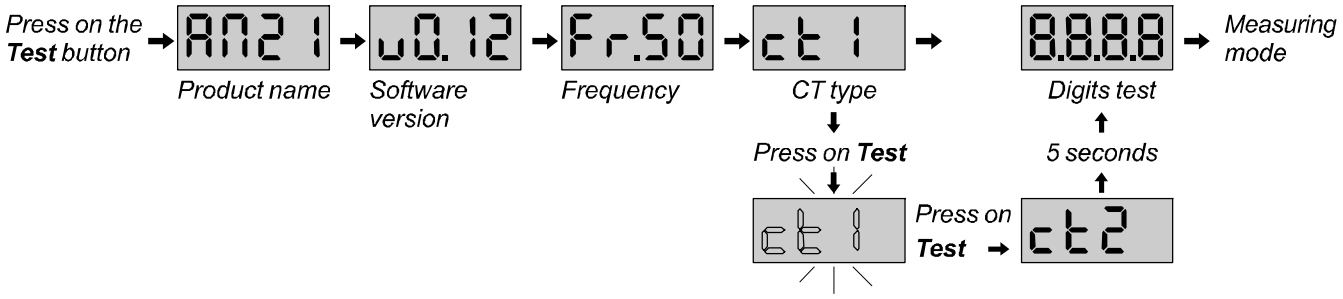
Maximeter mode (I max.) A press on the "I max." button activates the Maximeter mode.

This mode allows display of the I maximum values occurring on the three network phases since the previous initialization.



At the end of the maximeters' display cycle, the Amp 21D automatically returns to Measuring mode.
The maximeter is reset by simultaneously pressing the "Test" and "I max." buttons.

Test mode



Choice of CT type:

- The CT1 option corresponds to **(ref.59925)** phase CTs
- The CT2 option corresponds to **(ref.59963)** phase CTs
- Factory setting: CT1.

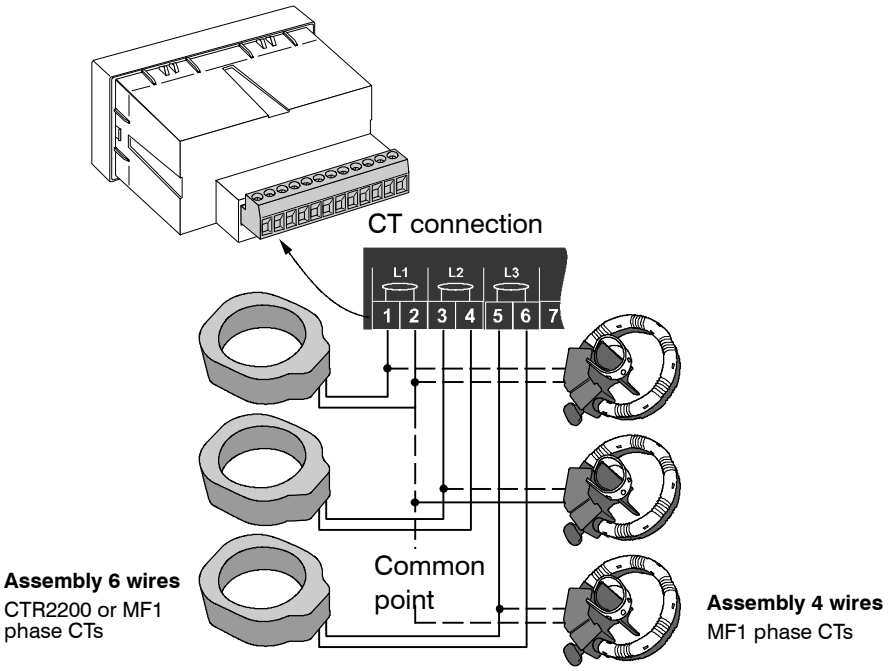
connection of CTs to the 3 MV cables

- Cable length: max. 3 m
- Cross section: max. 1.5 mm^2
- 3 phase CTs without common point on a screw- on terminal block (6 wires)
- MF1: mounting with or without common point (4 or 6 wires)

IMPORTANT

(for MF1 split core CTs)

- Mount the 3 CTs facing in the same direction
- Run the earth braid of the MV cable screen back inside the CT.



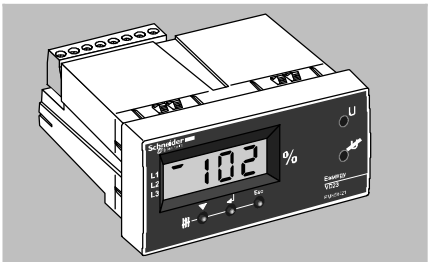
references

Type Ref.		Product	Description
	EMS58401	Amp21D	MV ammeter
CT1	**59925**	CTR2200	Phase CT for RM6 cubicle
CT2	**59963**	MF1	Phase CT for cable (split toroid)
	59928	Set of 3 connectors for MF1	3 crimp- on connectors (wires not supplied)
	59962	CONNECTING HARNESS FOR MF1	Connecting harness for MF1 for assembly 4 wires (A or B type)

voltage detection relay

The **VD23** is a voltage presence and absence detection relay.

It uses the **VPIS V2- V0** as sensor, and operates with a **24 or 48 Vdc** external power supply.



operation

Calibration:

At power up, the **VD23** automatically detects voltage presence and the network frequency, and then performs self- calibration.

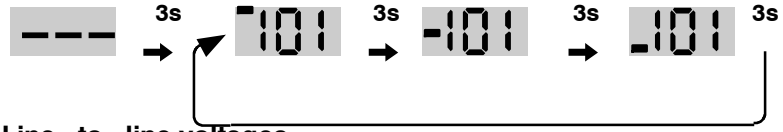
: automatic frequency detection

: calibration performed

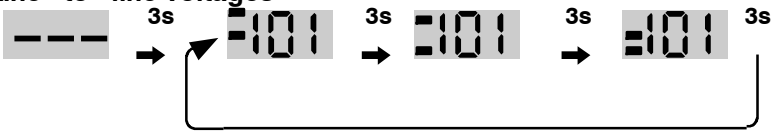
Measuring mode:

3 seconds after calibration, the **VD23** displays, by scrolling, the percentages of the nominal voltage detected on each phase

Line- to- neutral voltages



Line- to- line voltages



Detection of Voltage presence:

When the voltage percentage becomes greater than the set threshold for all the configured phases, then the **VD23** lights the voltage presence indicator and activates (or releases in inverted mode) **relay R1.**

Detection of Voltage absence:

When the voltage percentage becomes less than the set threshold for all the configured phases, then the **VD23** lights the voltage absence indicator and activates (or releases in inverted mode) **relay R2.**

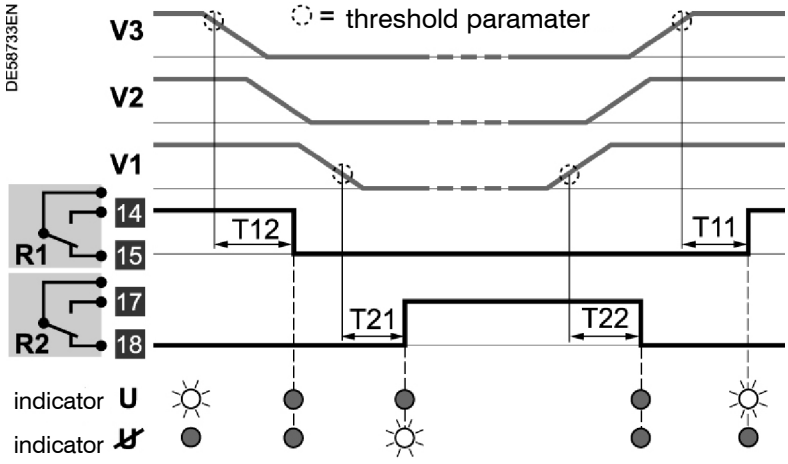
detection sequence

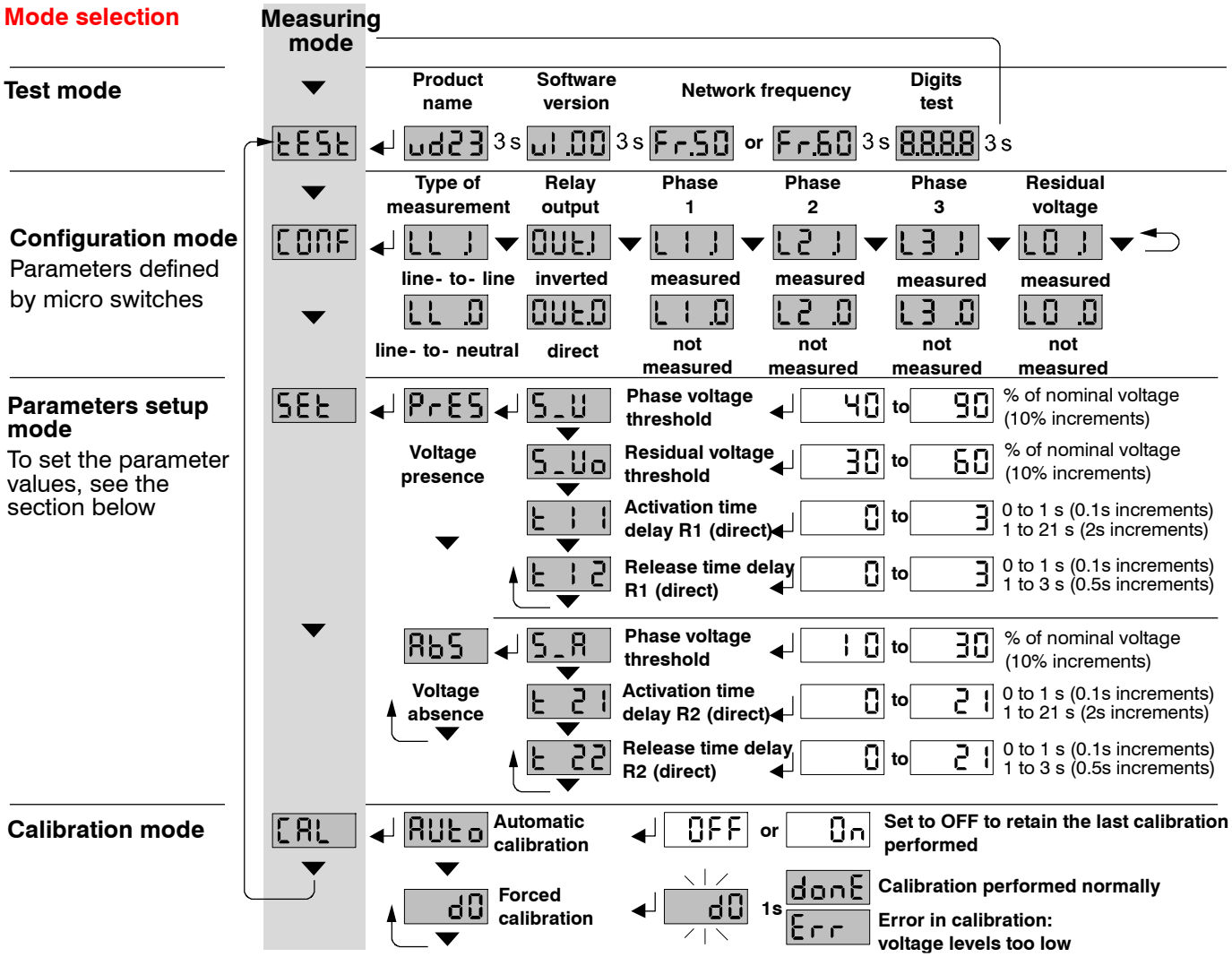
Configuration: voltages V1,V2,V3, direct mode

R1: terminal 15 = relay rest position: voltage loss on at least one of the phases

R2: terminal 18 = relay rest position: voltage presence on at least one of the phases

A configurable time delay is applied for control of R1 and R2:T12 = time delay for R1 changeover upon voltage loss
T11 = time delay for R1 changeover upon voltage recovery
T21 = time delay for R2 changeover upon voltage lossT22 = time delay for R2 changeover upon voltage recovery





configuration of thresholds and time delays

The parameter values (white screen in the above diagram) can be modified as follows:

- when the value of the parameter is displayed, a press on the ↵ key causes the display to flash for 5 s
- during flashing, press successively ▼ to display the desired value
- confirm this value by pressing the ↵ button; without confirmation within a period of 15 s, return to display of the parameters without change in the value. **Each press on the "Esc" button takes you back to the preceding stage.**

suggested choice for VD23 settings

VOLTAGE DETECTOR	EARTHED OR IMPEDANT GROUNDING	ISOLATED NEUTRAL	COMPENSATED NEUTRAL
VD23 SW 1 / SW 2	3 4 5 6 — $\overline{V1}+\overline{V2}+\overline{V3}+V0$ / $V1.V2.V3.\overline{V0}$ — R1		
VD23 SW 1 / SW 2		3 4 5 6 — $\overline{U12}+\overline{U13}+\overline{U23}$ / $U12.U13.U23.$ — R1	3 4 5 6 — $\overline{U12}+\overline{U13}+\overline{U23}$ / $U12.U13.U23.$

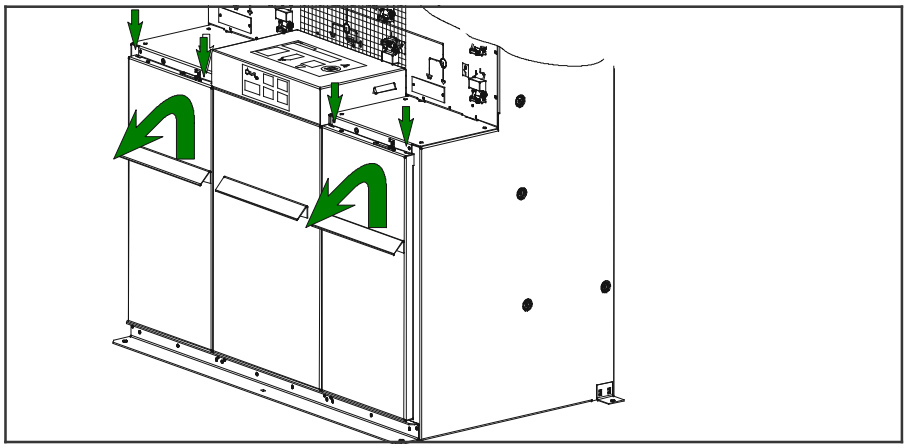
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access to the cable compartments

access to the cable connection compartments without interlocking

CAUTION

The HV cables must be de- energised for access to the compartments.



Open the switch and **close the earthing switch**.

To remove an access panel, remove the 2 upper screws, lift and pull towards you.

connection on busbar (O function and T function)

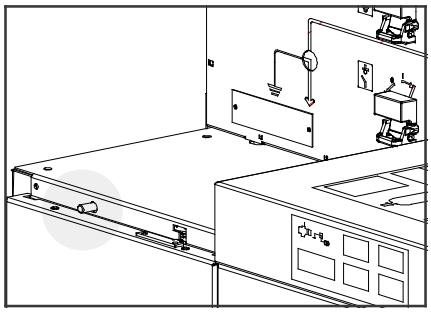
WARNING

THE COMPETE SWITCHBOARD (ALL THE RM6 CONNECTED TOGETHER) MUST BE DE- ENERGISED

OPEN ALL SWITCHES CONNECTED TO THE BUSBAR

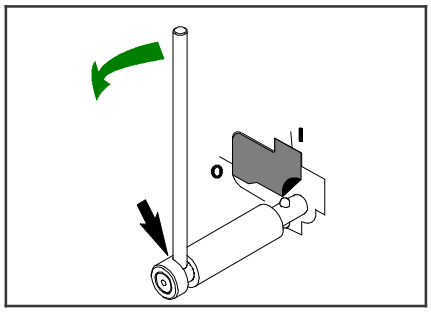
CLOSE ALL ASSOCIATED EARTHING SWITCHES

access to the cable connection compartments with interlocking (optional)



Functional unit in operation, switch closed.

The access panel is locked.

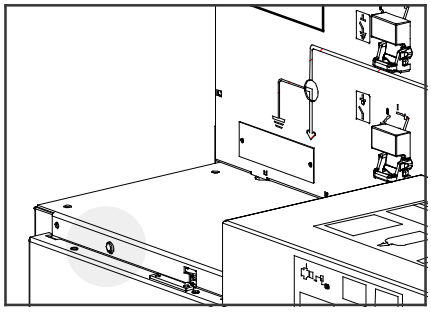


Open the switch.

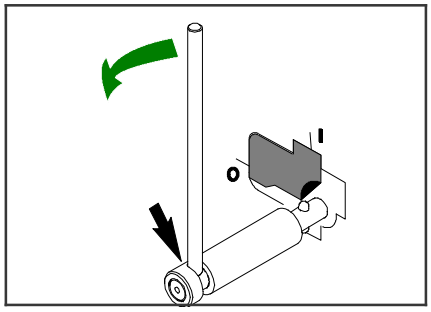
The access panel remains locked.

Optionally

Switch and circuit- breaker closing is inhibited if the access panel is removed.



Close the earthing switch.
The access panel is released.

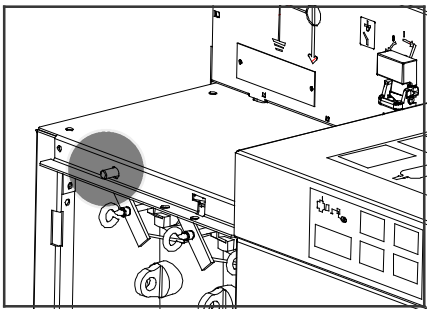


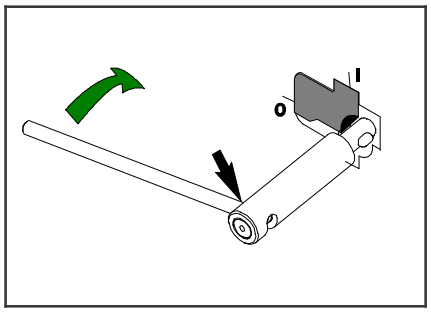
Access panel removed, the earthing switch can now be re- opened.

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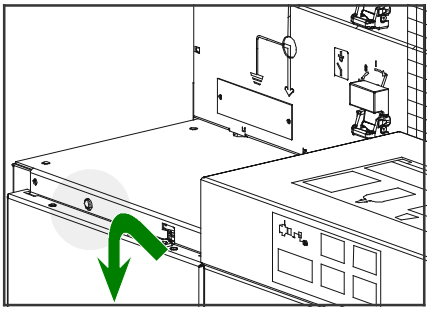
Earthing switch open: the access panel cannot be put back.

If the connectors so allow, DC current can be injected to monitor cable insulation or search for faults.

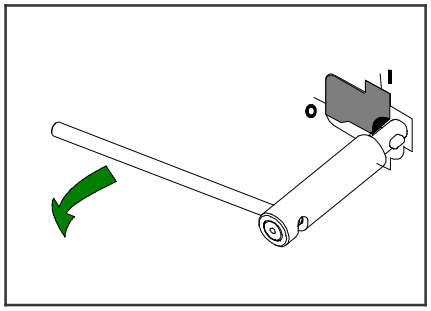




Close the earthing switch.



Put back the access panel.



Open the earthing switch.

access to the MV compartment of the DE- Mt cubicle

DANGER

- Opening of panel **(A)** authorized only if :

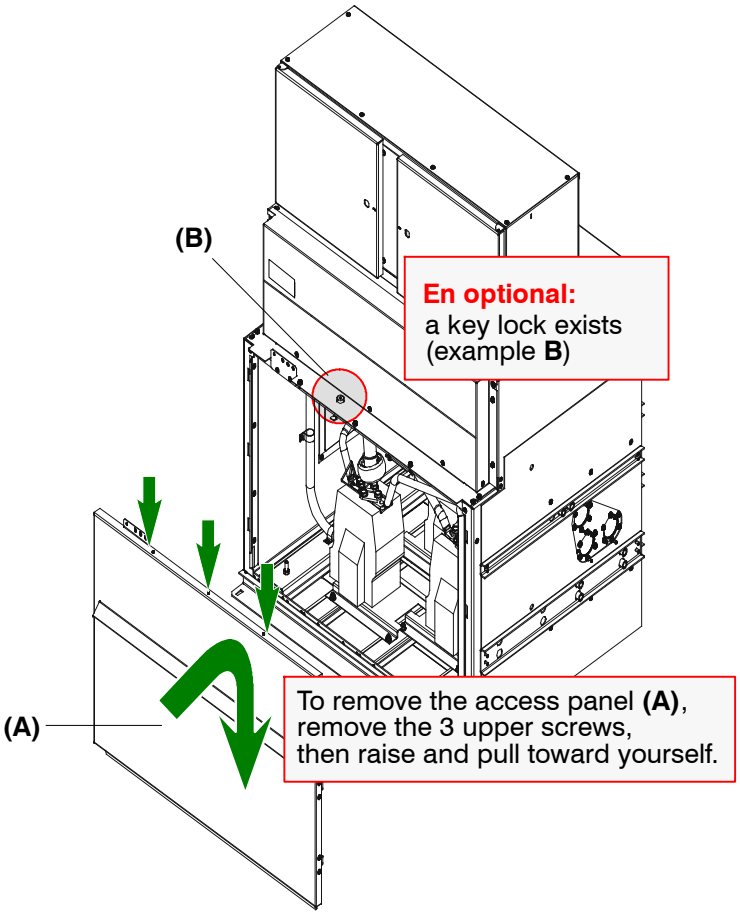
- all upstream connection(s) locked- out in OPEN position

- all downstream connection(s) locked- out in OPEN position.

DANGER

Intervention inside the DE- Mt cubicle is authorised only if:

the 3 busbars are grounded, via a temporary connection or via an earthing switch (upstream or downstream).



standard operating conditions

maintenance summarising table

CAUTION

description	operation	material
panelling		
	cleaning	cloth
earthing covers		
	cleaning	sponge, clear water

device panelling

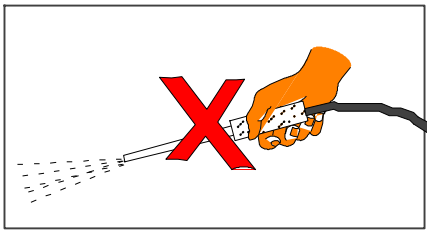
CAUTION

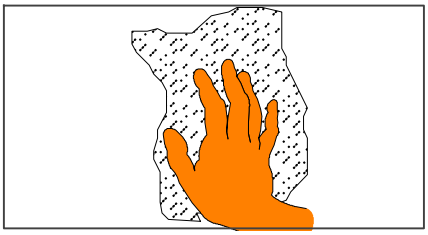
We draw your attention to the risk of using high pressure cleaning processes.

Schneider Electric cannot therefore guarantee the reliability of equipment that have been cleaned in this manner, even if cleaning was followed by lubrication.

The main drawbacks of this process are:

- deterioration due to jet pressure and impossibility of relubricating the inaccessible fixing points
- risk of overheating due to presence of solvent on the contact zones.
- elimination of special protections.





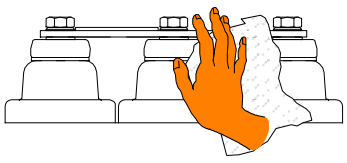
Clean using a dry cloth.

earthing covers

CAUTION

This operation can be performed in event of excessive soiling.

Clean using a sponge and clear water. Do not use alcohol or other solvents to clean.



maintenance cycle and operations

This device is designed to operate for 30 years or for 1000 operations in normal conditions of use as per **standard IEC 62271- 1.**

The following are recommended:

- an O/C operation every 6 years for motorised functional units and/or functional units with a latching mechanism (Q and D/B function)
- replacement of batteries is recommended every 4 years
- inspection every 5 years of the condition of the mechanisms (pollution, corossion) and the cleanliness of the earthing covers (pollution).

harsh operating conditions

To ensure proper operation of the RM6 in harsh operating conditions, we strongly recommend regular maintenance of the cubicle and its installation.

Recommended inspection frequency: at least once a year

During the inspection, check the 6 following points:

1 LV compartment

symptoms: condensation, presence of humidity

check: for rust on the LV electric and electronic parts

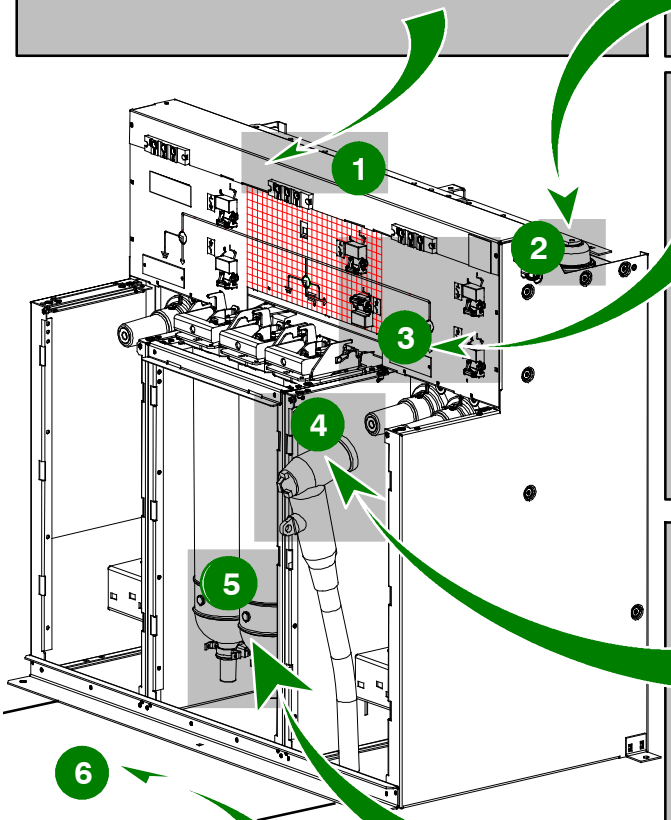
solutions:
- dry the environment
- replace the damaged parts
- fit heating resistances (optional)

2 earthing covers

symptoms: humidity, dust

check: surface cleanliness

solutions:
- dry the environment
- clean using a clean cloth and water (no alcohol or solvent)



3 mechanical operating mechanisms

symptoms: humidity, condensation on live parts

check: for red rust on moving parts

solutions:
- find and treat the origin of condensation phenomena
- follow up the damage
- replace the operating mechanism if required *(refer to reference: 07897270)*

4 MV socket and cable

symptoms: presence of corona discharge or odours

check: connections (may be damaged)

solutions:
- fit new sockets

6 trench

symptoms: humidity

check: for presence of water in the trench

solutions:
- pump out water
- drain the trench

(if necessary add sand)

In case sand is added in the trench, take care that the cables are still fixed correctly and that no additional stress is added to the bushings

5 fuse compartments

symptoms: humidity + dust

check: proper operation of the VPIS

solutions:
- clean the outside surface of the fuse compartments using a cloth and clear water

foreword

The corrective maintenance operations enable replacement of subassemblies.

The operations quoted in the following summarising table can be performed by the customer or by **Schneider Electric's** after- sales representatives.

For any other maintenance operations, contact the representatives of your nearest Groupe Schneider.

After each operation, perform the electrical tests according to current standards.

CAUTION

On replacement, all the accessories below must be replaced with new equipment.

- **Nylstop (self- locking nut)**
- **Contact washer**
- **Locking rings**
- **Mechanical pin**

To access the various devices:

- open the switches
- close the earthing switches
- cut the supply to the LV circuits

maintenance summarising table

description	réalisation
replacing a voltage indicator	**SCHNEIDER ELECTRIC** or Customer
replacing a fuse (MV)	**SCHNEIDER ELECTRIC** or Customer
replacing the charging motor	**SCHNEIDER ELECTRIC** or Customer
replacing a printed circuit	**SCHNEIDER ELECTRIC** or Customer
replacing the indicating contact	**SCHNEIDER ELECTRIC** or Customer

replacement of the voltage presence unit (VPIS) type VPIS- V1 by type VPIS- V2

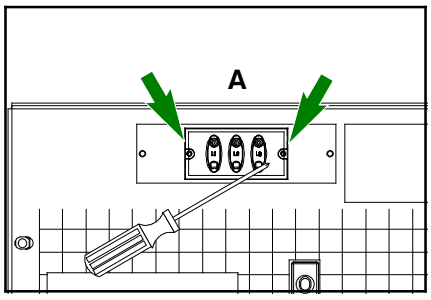
VPIS- V1: production until February 2009

VPIS- V2: production from March 2009 onwards

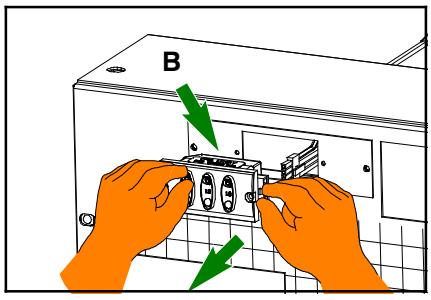
removing the VPIS- V1 voltage presence unit

CAUTION

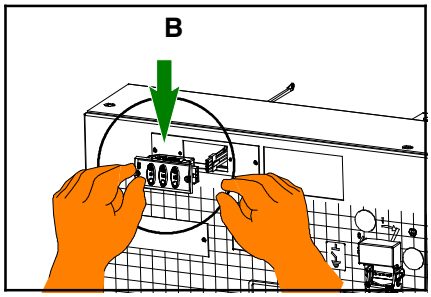
The screws (**A**) must be retained.



Unscrew the 2 self- tapping screws (**A**).



Remove the **VPIS 1** voltage presence box (**B**).

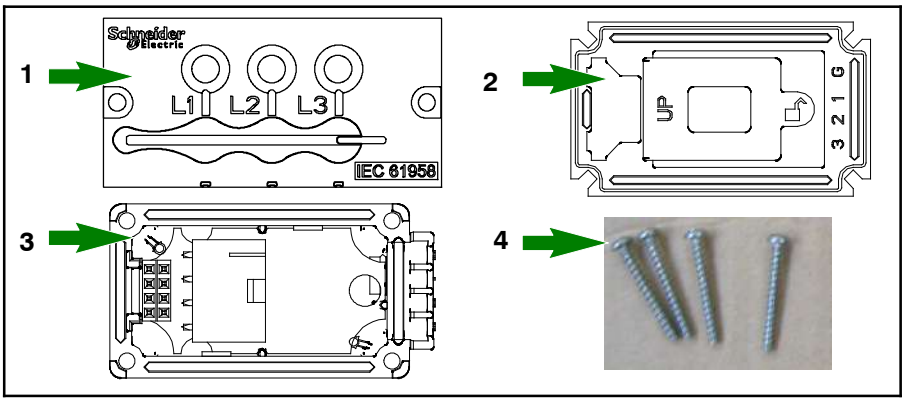


Disconnect the **VPIS1** voltage presence unit (**B**).

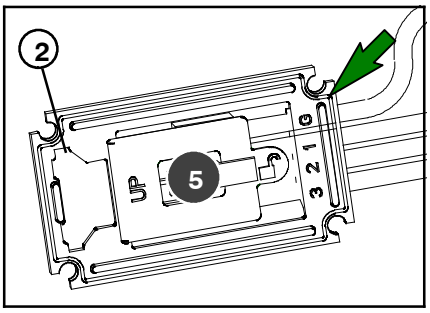
contents of the kit VPIS- V2

1: indicator unit
2: cable gland seals
3: surge arrestor
4: screws (x4)

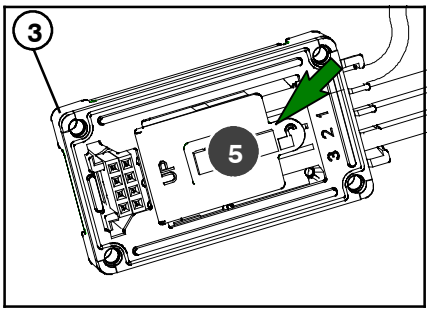
The screws removed earlier are reused. (2 self- tapping screws)



mounting the voltage presence unit (VPIS- V2)



Position the cable gland seal (**2**) on the voltage presence connection (**5**). Check that the seal is in the correct position.



Clip the cable harness connector (**5**) onto the **VPIS** protection (**3**) and fit the seal

checks to be made before continuing with the operation

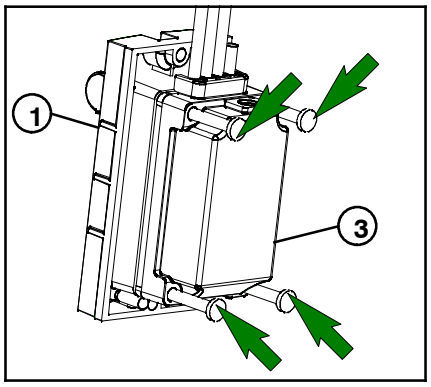
Check the condition of the wiring harness (**5**) and the **VPIS 2** rating using the **optional** diagnostic tool **(VPI62420) (not included in the kit)** or see correspondence table below.

RM6		VPI62403 7,4 µA		VPI62404 10,7 µA		VPI62406 22,4 µA		VPI62408 47,2 µA	
		Min	Max	Min	Max	Min	Max	Min	Max
RM6 50- 60Hz standard	Un : network voltage	2,5 kV	3,2 kV	3,3 kV	7,7 kV	8,8 kV	16,0 kV	16,1 kV	23,0 kV
RM6 50- 60Hz BUSHING WELL only		5.3 kV	10.6 kV	7.6 kV	15.4 kV	16 kV	32.5 kV		

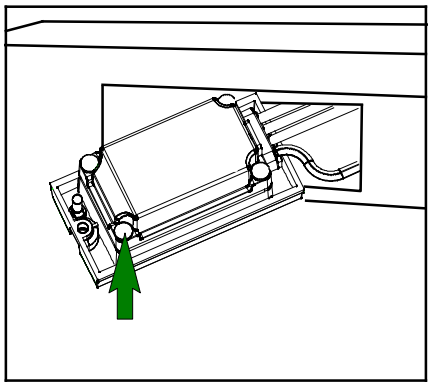
Key

Minimum and maximum network voltage in 50Hz and 60Hz.

Please refer to the chapter entitled ”contents of the kit”

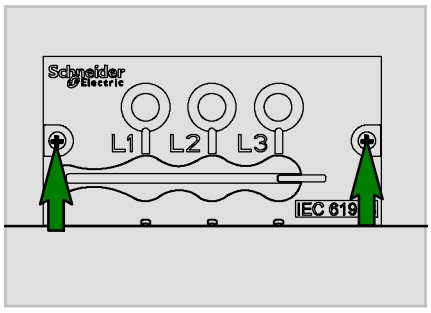


Screw the indicator unit (**1**) onto the **VPIS** surge arrestor (**3**) using the 4 screws.



CAUTION

Tighten the screws to exert slight pressure on the cable gland seal without distorting it.



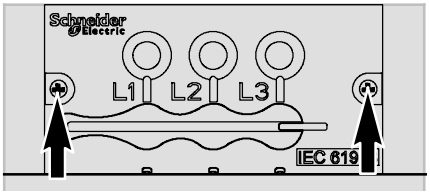
Install the voltage presence unit in the correct position using the 2 self- tapping screws removed earlier.

ATTENTION

The screws removed earlier are reused.

replacement of the voltage presence unit (VPIS) type VPIS- V2 by type VPIS- V2

removing the VPIS 2 voltage presence unit



Remove the 2 screws from the front panel.

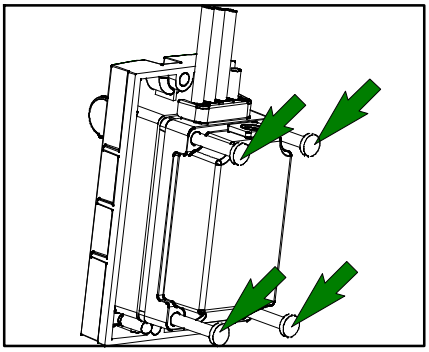
CAUTION

The screws must be retained.

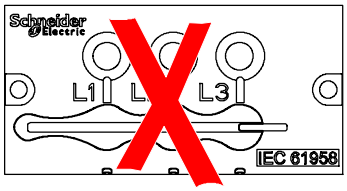
mounting the new VPIS 2 voltage presence unit

ATTENTION

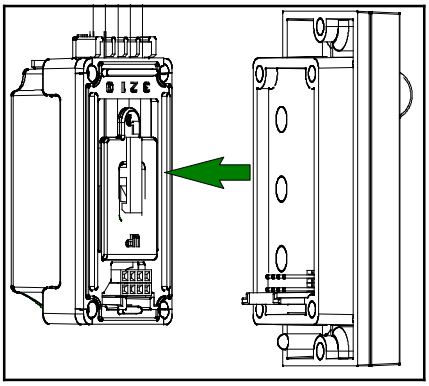
Only the indicator unit is to be changed.
Contact the **Schneider Electric** administration for recycling products at the end of their service life.



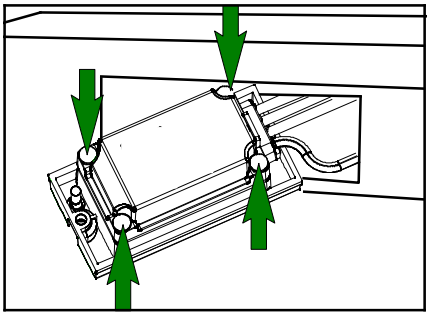
Remove the unit.
Remove the 4 screws from the indicator unit.



Discard the faulty indicator unit. Leave the existing surge arrestor and seal.



Install the new voltage presence indicator unit.

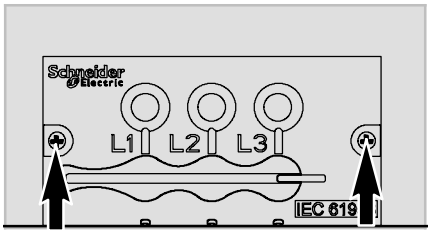


Screw up the 4 screws.

Tighten the screws to exert slight pressure on the cable gland seal without distorting it.

CAUTION

The screws removed earlier are reused.



Install the voltage presence unit in the correct position using the 2 self- tapping screws removed earlier.

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Printed on 2015/11/12
07897073EN01 revision : 11

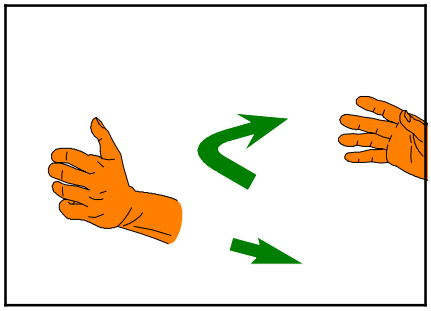
replacing a fuse

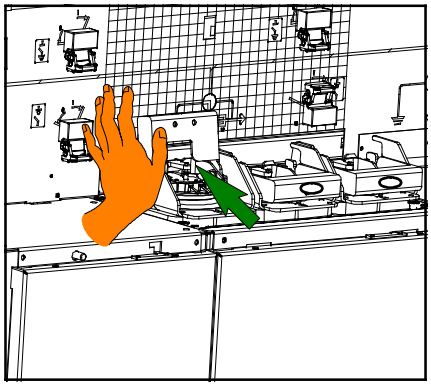
Standard **IEC 252 paragraph 23.2** recommends replacement of the 3 HV fuses after blowing of one of the fuses.

removal

CAUTION

Before performing these operations, remember that you close the earthing switch.





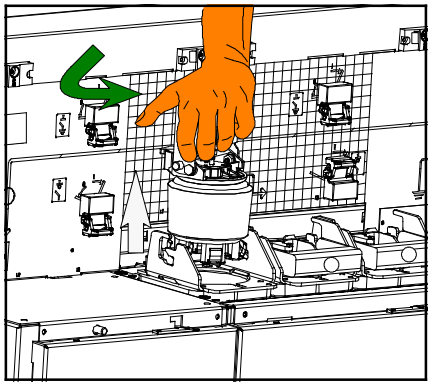
Release the plug and push the extraction handle manually to unlock the plug (tap with the palm of your hand to separate the seal from the plug if necessary).

CAUTION

Repeat the following operations for all 3 fuses.

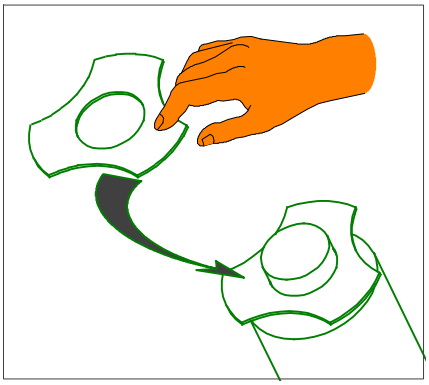
To remove the cover: lift it and pull it towards you.

The instructions are visible on the cover.

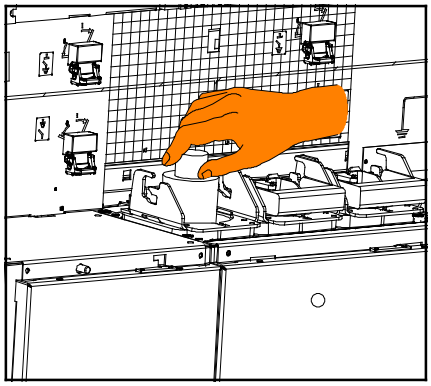


Move the plug up to the limit stop, swivel it towards the left to remove it.

removing a DIN fuse (Fusarc CF)

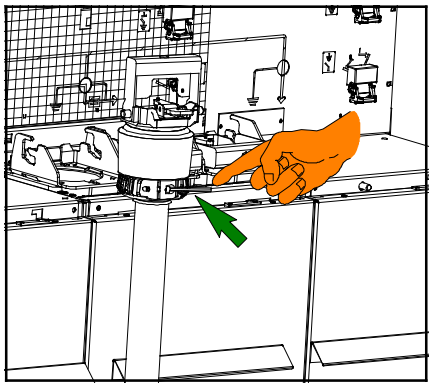


Recover the centring device at the top of the fuse.

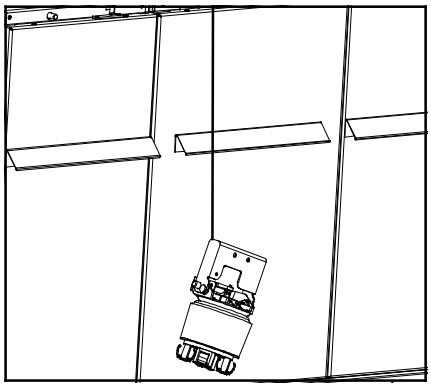


Extract the fuse.

removing a UTE fuse (Solefuse)

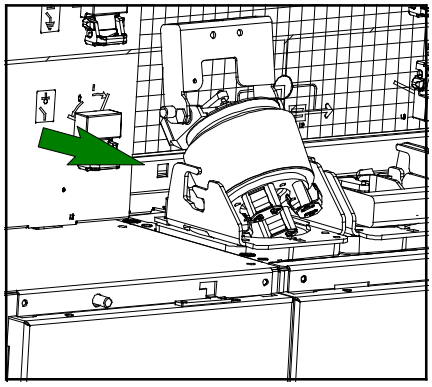


Loosen the fuse using a wrench with end BTR n° . 5.



Let the plug hang down from its supporting string.

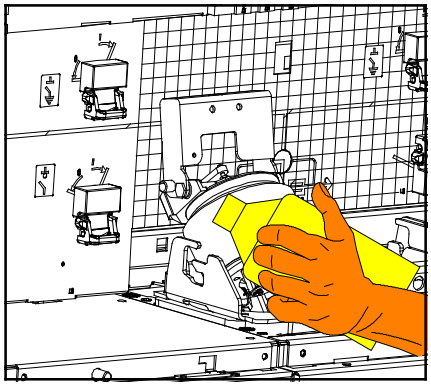
cleaning the plugs



If the fuse plugs are dirty, clean the conical surface using silicon oil.

Then wipe it down with a clean cloth to dry it.

Huile Rhodorsil 47V50.
Distributed by Rhone Poulenc (chimie Lyon) **FRANCE**



Talc the clean surface with natural talc to avoid clinging between the plug and fuse compartment.

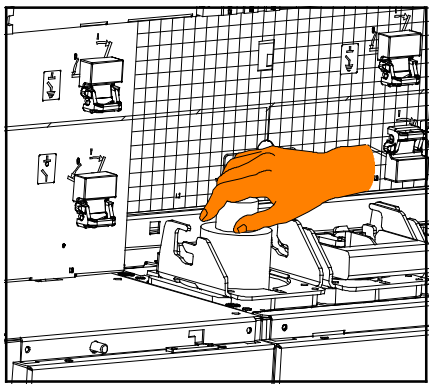
The surface must appear smooth without lumps.

TALC : westmin 8.
Distributed by Ets Ledoux Bordeaux **FRANCE**

fitting a DIN fuse

CAUTION

On no account must a fuse that has been knocked be installed. A test prior to installation using a monitor is recommended.

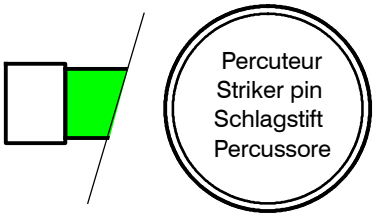


Insert the fuse in the compartment. Fit the centring device on the fuse.

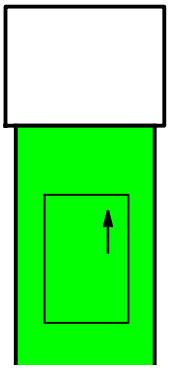
Insert the plug pins in the plinth and swivel it round to the right.

fitting a fuse with striker

Fuse blowing releases a striker that causes three- phase opening of the switch and prevents it from reclosing.



The end of the fuse equipped with the striker is marked.



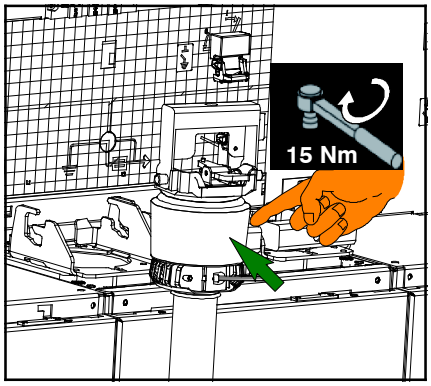
The technical data and mounting direction of the fuse are printed on the body.

(striker facing upwards).

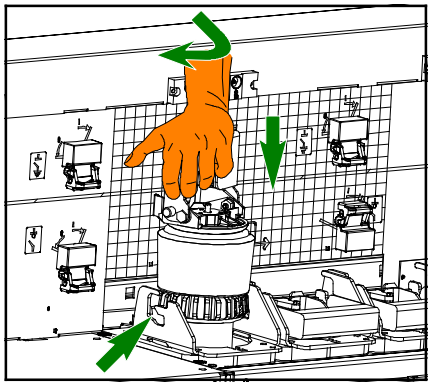
fitting a UTE fuse

CAUTION

On no account must a fuse that has been knocked be installed. A test prior to installation using a monitor is recommended.

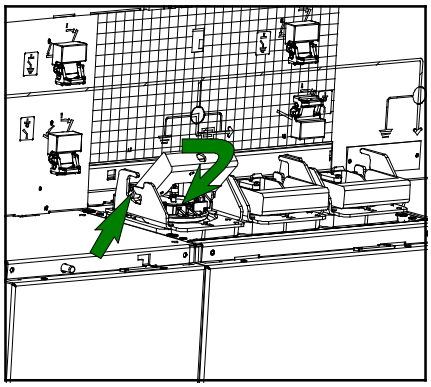


Fix the fuse on the plug using a torque wrench with end BTR n° . 5 and insert the fuse in the compartment.



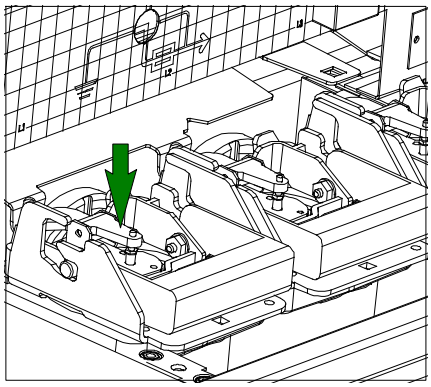
Insert the plug and fuse assembly in the compartment.
Insert the plug pins in the plinth and swivel it round to the right.

locking the plug



Make sure that the handle trunnions are inserted in the plinth slots and lock the plug.

Never use the operating lever to lock the plug.



For replacement of a fuse that has struck, press the switch to put it back in position.

access to the LV compartment

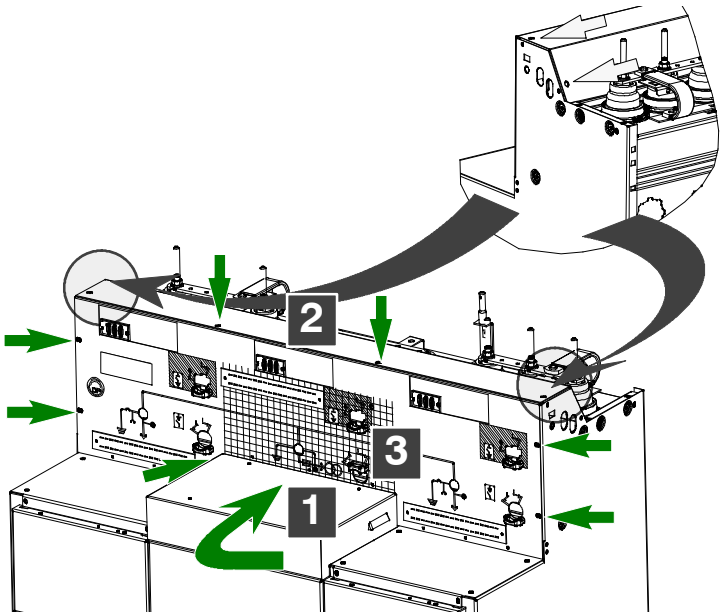
dismantling



1 - Remove the fuse compartment cover
(pull towards you)

2 - Remove the LV cable trough 6 screws (HM6x16)

3 - Remove the self - cutting screws



reassembling

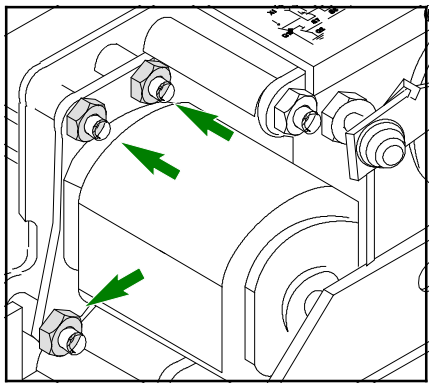
- **Reassemble in opposite order to disassembly.**

replacing a motor

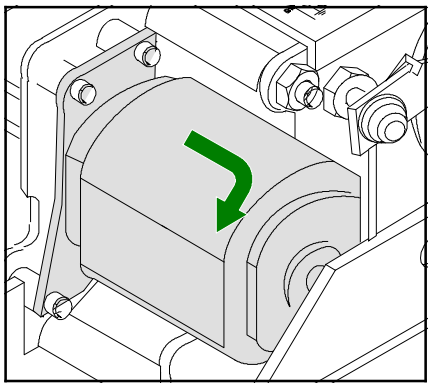
removal

CAUTION

LV circuit de - energized.



Remove the 3 nuts fixing the motor support.
Disconnect the motor supply wiring.



Remove the motor support by pulling it backwards.

fitting

Fit the new motor in the opposite order to removal.

Tightening torque: 28 Nm.

Fit the trunking and the cover.

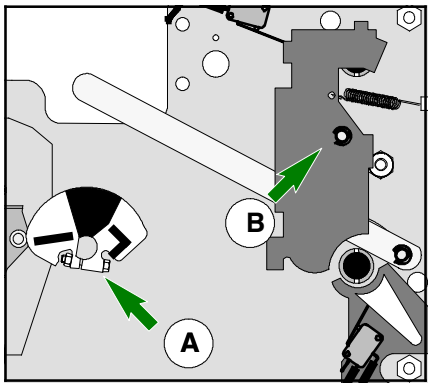
replacing the LV contacts

Disassemble the pilot light support.

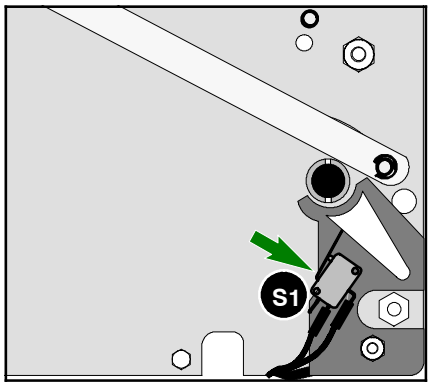
removal

CAUTION

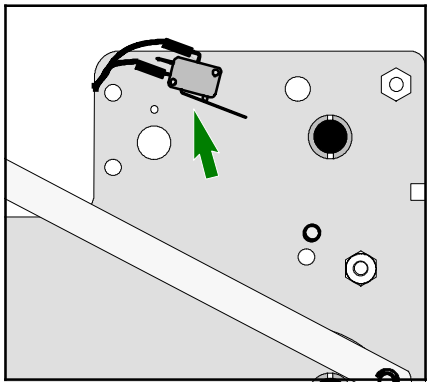
LV circuit de- energized



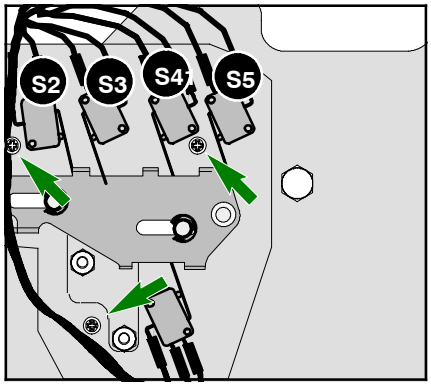
Remove the position indicator **A**.
Remove interlocking **B**.
(elastic ring and spring)



Remove contact support **S1** without disconnecting the wiring.

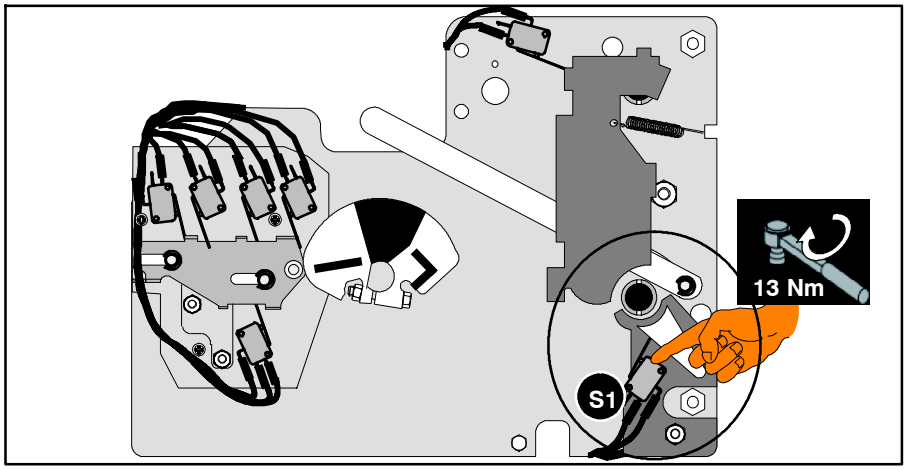


Remove contact S3 without disconnecting the wiring.



Remove the contact support **S2, S4, S5, S6** and **S7** without disconnecting the wiring.

fitting the contacts and wiring connection



Fit contacts S1 to S7 to replace the former contacts.

Fit the position indicator and interlocking.

Disconnect the contact wiring S1 disassembled, and connect it to the new contact.

Repeat this operation for all the contacts (S2 to S7).

processing of SF6 gas when dismantling the equipment

conformity rules

The SF6 gas must be removed before any dismantling operation can be carried out, according to the procedures described in **IEC 61634** and according to the following instructions. The removed gas must be processed in compliance with **IEC 60480**.

The after sales of **SCHNEIDER ELECTRIC** can propose a complete offer.

- dismantling and recycling of the **RM6 units**
- treatment of the SF6 gas.

Finally a certificate will be provied to you.

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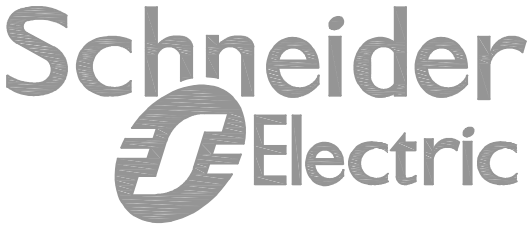
07897073EN01 revision : 11

As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

Conception, rédaction: Service Documentation Technique T&D

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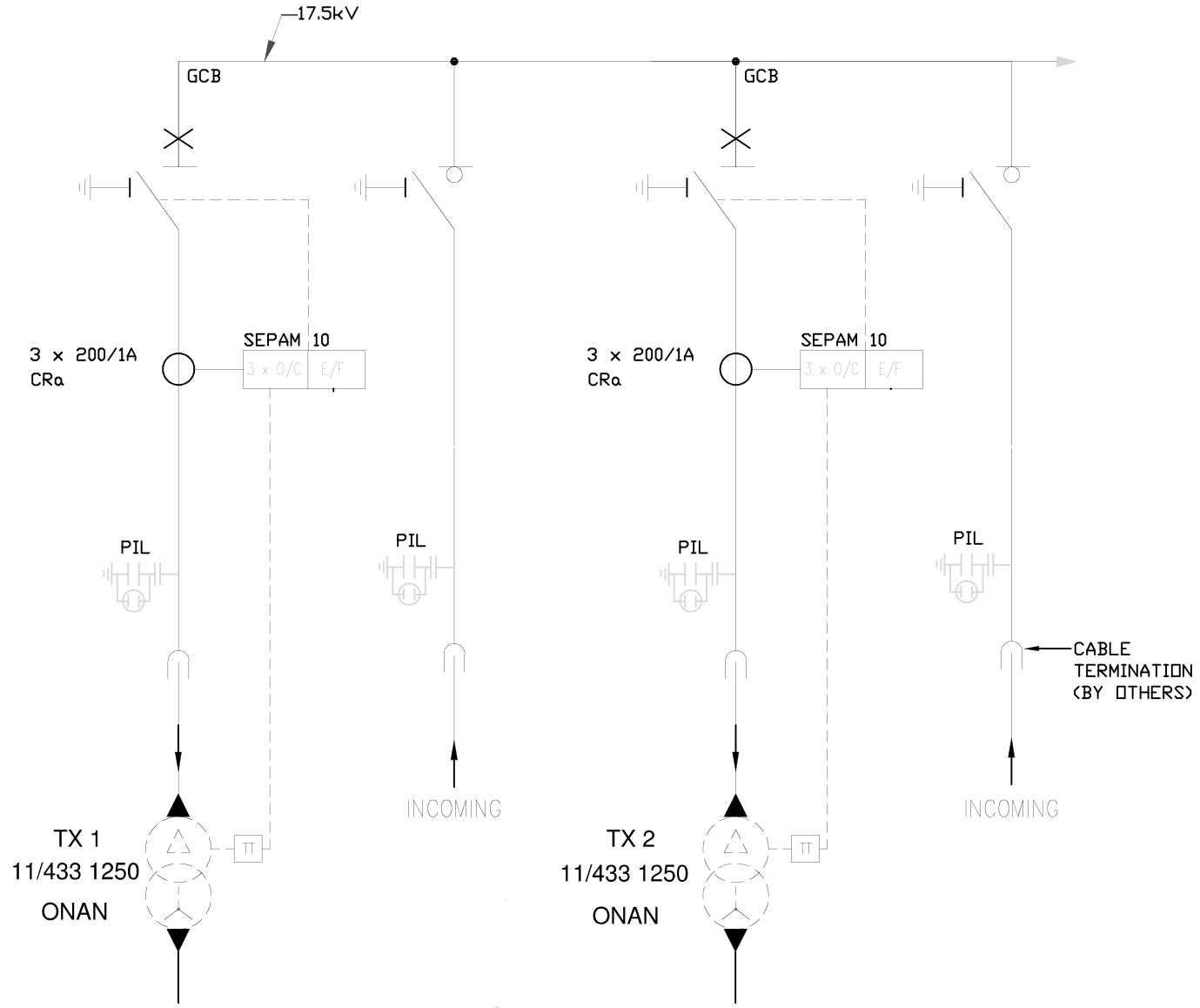
PROJECT :

RHB TRUSTEES BERHAD

ELECTRICAL CONTRACTOR :

KEJURUTERAAN BROAD-WAY SDN BHD

DRAWING NO.	SHEET NO.	DESCRIPTION
-	01	COVER PAGE
SW-100	02	CONTENTS
SW-101	03	SINGLE LINE DIAGRAM
SW-102	04	TYPICAL ARRAGEMENT
SW-103	05	POWER CIRCUIT
SW-104	06	SCHEMATIC DIAGRAM (CB)
SW-105	07	SEPAM 10A RELAY SCHEMATIC DIAGRAM



SINGLE LINE DIAGRAM

FOR APPROVAL

REV	SUBMISSION	DATE	BY
1	AMENDMENT		SAN

DRAWN	SAN
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APPROV.	K.H. TEE
DATE	

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Schneider Electric

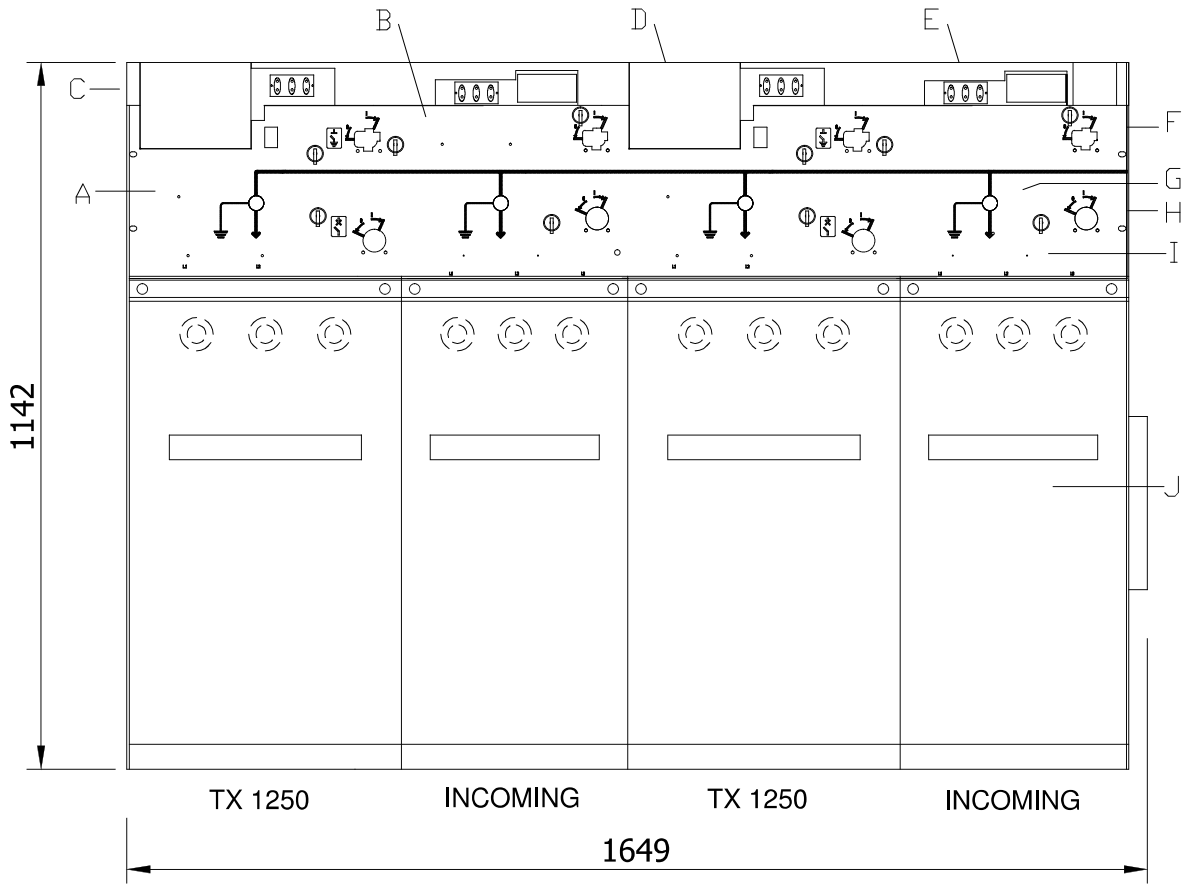
TITLE : RM-6

SINGLE LINE DIAGRAM

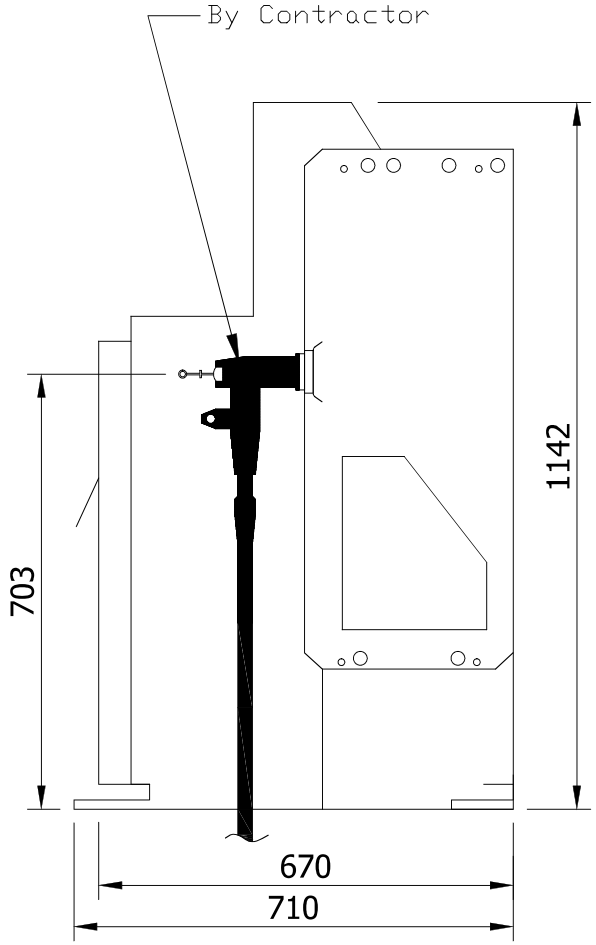
DWG NO	SW-101	SCALE	NTS
		SHEET	03

LEGENDS:-

A : operating mechanism front plate comprising the mimic diagram.
B : information plate
C : LV connection access trunking
D : SEPAM 10A relay
E : voltage indicator
F : earthing switch operating shaft
G : function position indicator
H : switch operating shaft
I : rating plate
J : connecton bushing access panel



FRONT VIEW



SIDE VIEW

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REV	AMENDMENT	DATE	BY
1	SUBMISSION	(	SAN

DRAWN	SAN	
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APPROV.	K.H. TEE	
DATE		

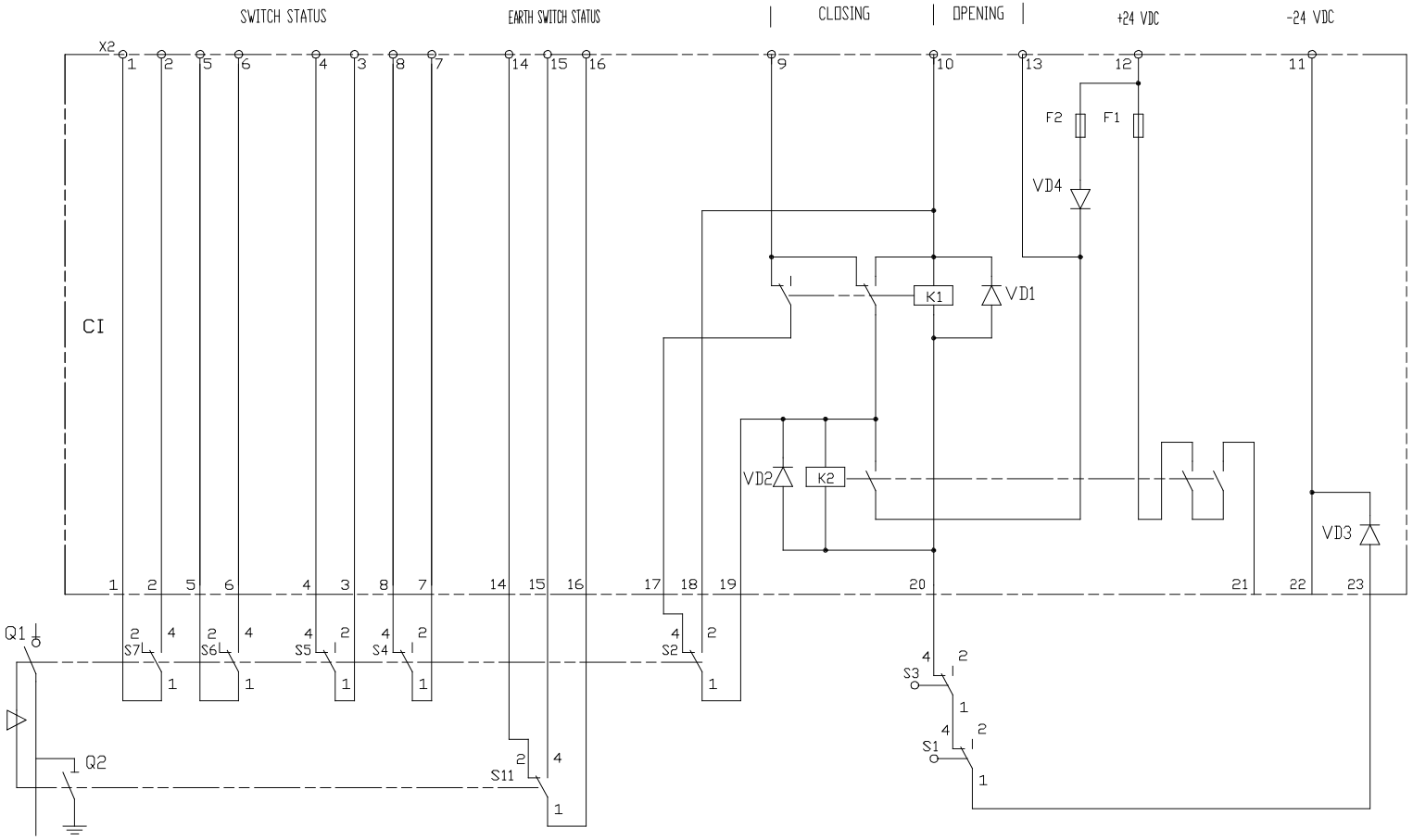
PROJECT :

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TITLE : RM-6
TYPICAL ARRAGEMENT

DWG NO	SW-102	SCALE	NTS
		SHEET	04



MARK	EQUIPMENT DESIGNATION
CI	PRINTED CIRCUIT CONTROL
F1,F2	FUSES CARTRIDGES 5x20 TYPE HA21
K1	ANTIPUMPING RELAY TYPE 5A
K2	CONTROL RELAY TYPE 5A
Q1	HV LOAD BREAK SWITCH
Q2	EARTHING SWITCH INTO LOAD BREAK SWITCH
S2,S6,S7	SWITCH POSITION CONTACTS OPERATION END CLOSING
S4,S5	SWITCH POSITION CONTACTS OPERATION END OPENING
S11	EARTHING SWITCH POSITION CONTACT
S1	CONTACT ACTED BY OPERATING LEVER OF LOAD BREAK SWITCH
S3	CONTACT ACTED BY OPERATING LEVER OF EARTHING SWITCH
X2	TERMINAL CONTROL BLOCK
VD1,2,3,4	DIODE 400V, 1A

FOR APPROVAL

REV	AMENDMENT	DATE	BY
1	SUBMISSION		SAN

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DATE		

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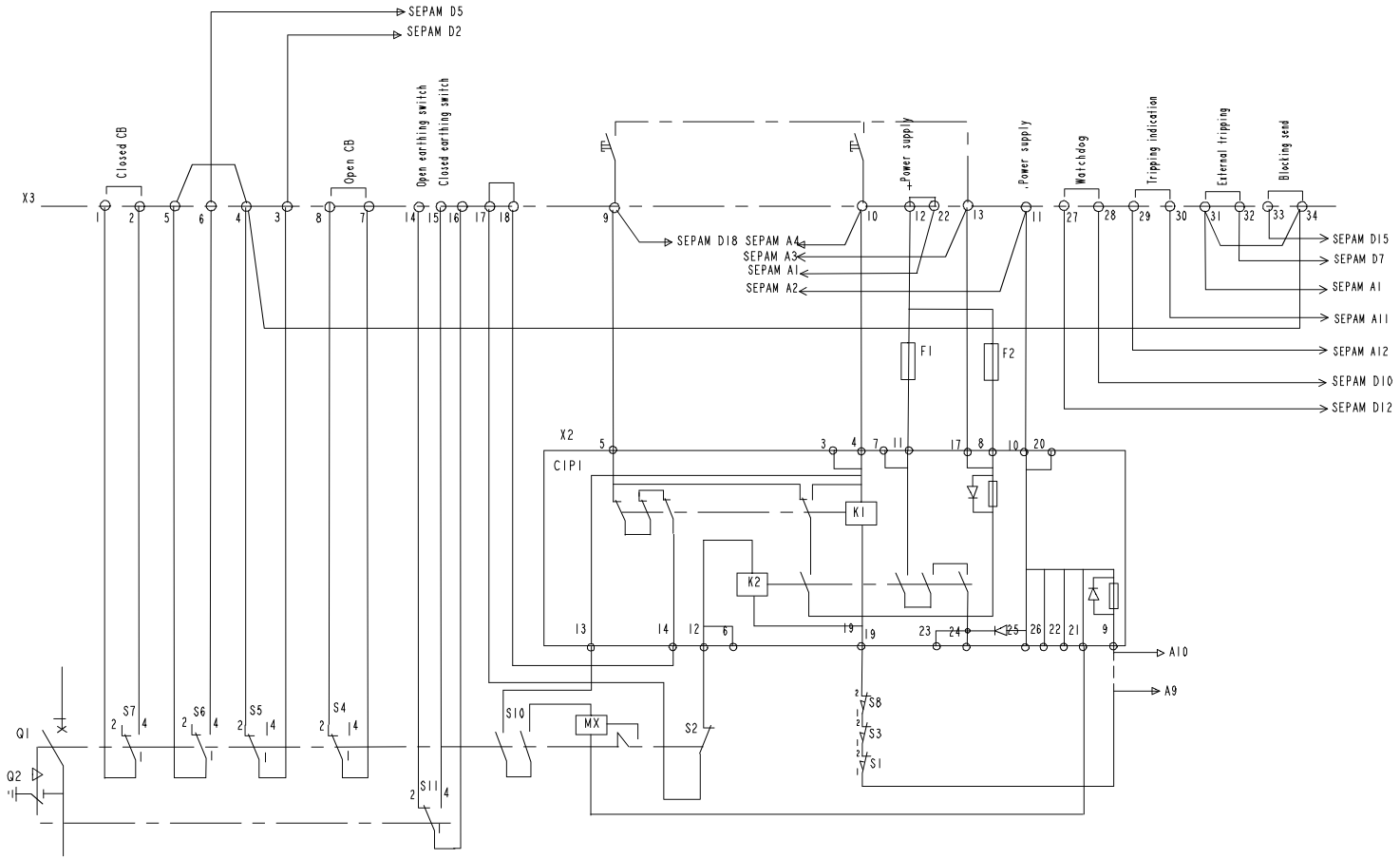
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TITLE : RM-6

POWER CIRCUIT

DWG NO	SW-103	SCALE	NTS
		SHEET	05



MARK	EQUIPMENT DESIGNATION
CIP1	PRINTED CIRCUIT BOARD
F1, F2	FUSES CARTRIDGES 5x20 TYPE HA21
K1	ANTIPUMPING RELAY TYPE 5A
K2	CONTROL RELAY TYPE 5A
Q1	HV CIRCUIT BREAKER
Q2	EARTHING SWITCH
S2, S4, S5, S10	SWITCH POSITION CONTACTS OPERATION END CLOSING
S6, S7	SWITCH POSITION CONTACTS OPERATION END OPENING
S11	EARTHING SWITCH POSITION CONTACT (OPTION)
S1	CONTACT ACTED BY OPERATION LEVER OF LOAD CIRCUIT BREAKER
S3	CONTACT ACTED BY OPERATING LEVER OF EARTHING SWITCH
S8	INTERLOCKING SWITCH BY LOCK
X2	TERMINAL CONTROL
X3	CONNECTION BLOCK
MX	SHUNT TRIP RELEASE

FOR APPROVAL

REV	AMENDMENT	DATE	BY
1	SUBMISSION		SAN

DRAWN	SAN
CHECK	-
APPROV.	K.H. TEE
DATE	

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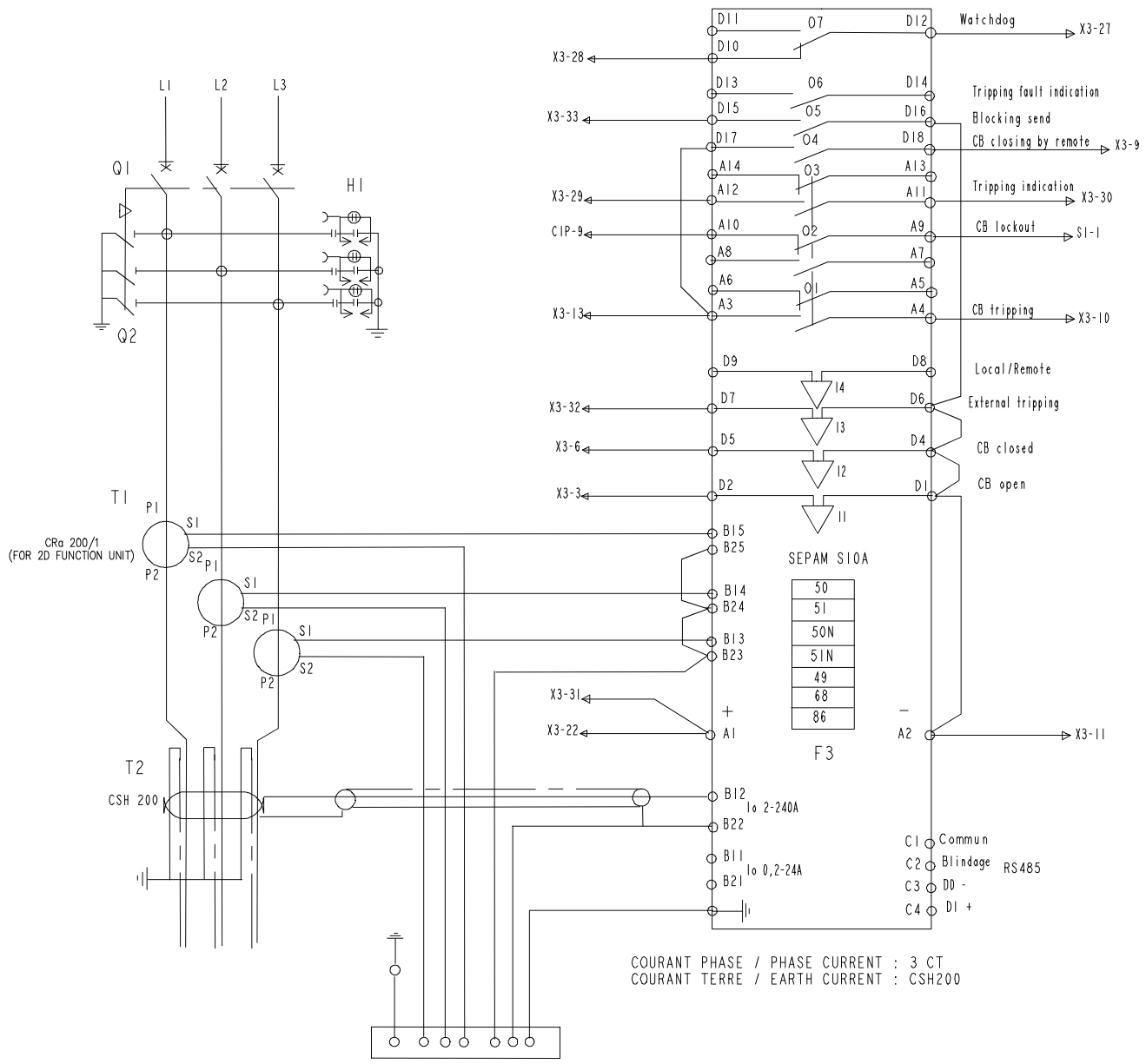
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TITLE : RM-6

MOTOR SCHEMATIC DIAGRAM (CB)

DWG NO	SW-104	SCALE	NTS
		SHEET	06



MARK	EQUIPMENT DESIGNATION
D10, D11, D12	O7 : WATCHDOG
D13, D14	O6 : TRIPPING FAULT INDICATOR
D15, D16	O5 : BLOCKING SEND
D17, D18	O4 : CB CLOSING
A11 TO A14	O3 : TRIPPING INDICATION
A7 TO A10	O2 : CB LOCKOUT
A3 TO A6	O1 : CB TRIPPING
D6, D7	I3 : EXTERNAL TRIPPING
D4, D5	I2 : CB CLOSED STATUS
D1, D2	I1 : CB OPENED STATUS
A1, A2	24VDC SUPPLY
B15 TO B23	PHASE CT
B12, B22	EARTH FAULT CURRENT INPUT
C1 TO C4	RS 485 COMMUNICATION

FOR APPROVAL

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Schneider Electric

TITLE : RM-6

SEPAM 10A RELAY SCHEMATIC DIAGRAM

DWG NO	SW-105	SCALE	NTS
		SHEET	07





TRANSFORMING THE FUTURE

MTM

MALAYSIA TRANSFORMER

One Stop Solution Provider

Wholly Owned Subsidiary of

TENAGA NASIONAL

Company Background

Malaysia Transformer Manufacturing Sdn Bhd (MTM) was established since 1977 and became a wholly owned subsidiary of Tenaga Nasional Berhad (TNB) in 2007. MTM has positioned itself as **One Stop Solution Provider** for the country's electrical transformer market. As the biggest transformer manufacturer in Malaysia, MTM has continued to maintain its identity to leverage on its long history in the country, while strengthening its corporate governance and improving its business orientation.



MTM provides the most comprehensive range of products and services with high quality Transformers ranging from 100kVA up to 100MVA, with maximum voltage of 150kV to meet clients' needs and specifications. MTM also produces Generator Transformers, Earthing Transformers and Compact Substation Unit (CSU).

In addition, MTM offers wide and full range of services to its clients which include Remanufacturing, Retrofit & Refurbishment, Repair & Service (In House & On Site), Installation, Testing & Commissioning, Transformer Recycling Management and Diagnostic & Troubleshooting of Transformers.

Company Values

Vision
To Become a Leader In Transformer Business Regionally

Mission
We Provide Total Transformer Solution To Help Energizing The Industry

Shared Value:
Integrity
Customer Focus
Business Excellence
Caring



Our Business

As a **One Stop Solution Provider**, MTM is a complete manufacturing outfit with capabilities to design, manufacture and test its products in complying with all relevant international standards. To serve our clients in more inclusive manner we also offer customized products to meet their specific requirements.

MTM also offer efficient after sales services that include Installation, Testing, Commissioning as well as Servicing, Repair, Retrofit, Remanufacturing and Refurbishment of Transformers. We also have 24-hours on site service teams to assure our clients of comfort and reliability in supporting their needs.



MANUFACTURING

Design & Engineering





Production





Quality Assurance





Testing





SERVICES

Installation, Testing & Commissioning





Service





Remanufacturing





Transformer Recycling Management





Our Products

MTM production lines offer full range of transformers including:

- Oil Immersed Transformers
- Dry Type Transformers
- Power Transformers
- Earthing Transformers
- Generator Transformers
- Customised Design Transformers
- Compact Substation Unit (CSU)

Distribution Transformer (100kVA to 3000kVA up to 33kV)



Power Transformer (5MVA to 90MVA up to 150kV)



Dry Type Transformer



Earthing Transformer



3D Wound Core Transformer



Compact Substation Unit (CSU)



Our Services

MTM offers the following services on all distribution and power transformers:

- Remanufacturing, Retrofit & Refurbishment
- Repair & Service (In House & On Site)
- Installation, Testing and Commissioning
- Transformer Recycling Management
- Testing

MTM provides full range of services to its clients which include Repair, Retrofit, Remanufacturing & Refurbishment, Installation, Testing & Commissioning and Transformer Recycling Management.

a. Remanufacturing & Refurbishment of Transformers
We carry out remanufacturing & refurbishment of transformers in house. Our capabilities include:

i. Replacement of Active Parts
ii. Drying of Active Parts
iii. Modification of Main Tank, Cable Box, Conservator and Piping
iv. Diagnostic, Investigation, Troubleshooting and Internal Inspection of Transformers







b. Services

We are expert in:

i. Replacement/Service of On-Load Tap Changer (OLTC)
ii. Un-Tanking of Active Part for Inspection
iii. Winding of Main Tank Top Cover
iv. Diagnostic, Investigation, Troubleshooting and Internal Inspection of Transformer
v. Modification of Conservator and Installation of Air Bag
vi. Replacement, Modification and Fitting of Transformer Accessories
vii. Supply of Transformer Parts and Accessories
viii. Replacement of Gasket
ix. Electrical Test – Insulation Resistance, Ratio, Winding Resistance, Tangent Delta, Polarization Index and Frequency Response Analysis (FRA)
x. Transformer Guard Test

c. Erection of Power Transformers

We provide erection service for Power Transformer up to 500kV. Our expertise includes:

i. Installation
ii. Testing and Commissioning
iii. Dismantling of Transformer
iv. Laying & Termination of Control Cable
v. Laying & Termination of Power Cable



d. Testing

The transformers are individually tested in accordance with ISO 17025 standards and routine tests including:

i. Diagnostic, Investigation & Troubleshooting
ii. Routine Test and Type Test

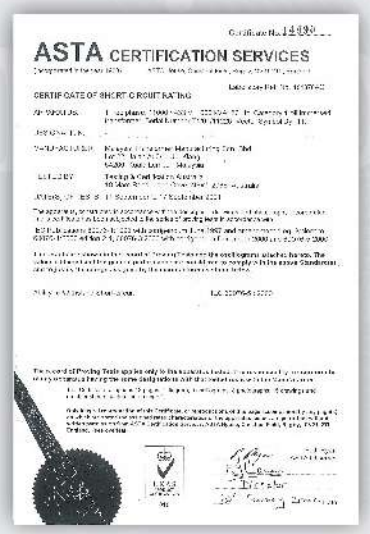




All aspects of product quality are ensured by our Integrated Management Systems. To ensure minimum carbon footprint, we execute environmental-friendly processes in our production lines. Gaining a firm foothold in the competitive global market, our products have been successfully accredited by internationally certified testing bodies such as ASTA, CESI and CPRI. Our management system is also certified under Integrated Quality, Environment, Occupational Health & Safety Assessment Systems and Accredited Laboratory Certificates complying with ISO 9001:2008, ISO 14001:2004, and OHSAS 18001:2007 and MS ISO/IEC 17025.

MTM's Quality, Safety And Environment

ASTA Certificates


ASTA CERTIFICATION SERVICES

CERTIFICATE OF SHORT CIRCUIT RATING


Certificate No. 18788
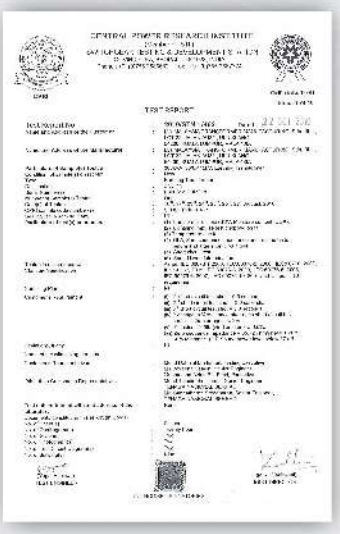
ASTA Certificate

OF SELECTED TYPE TESTS

CPRI Certificates

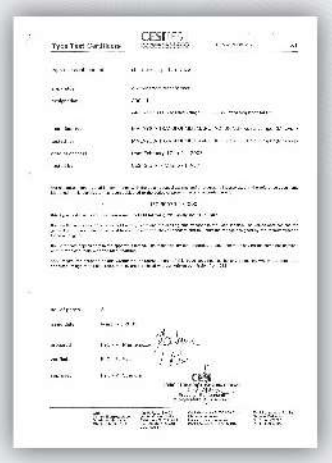

CENTRAL POWER RESEARCH INSTITUTE

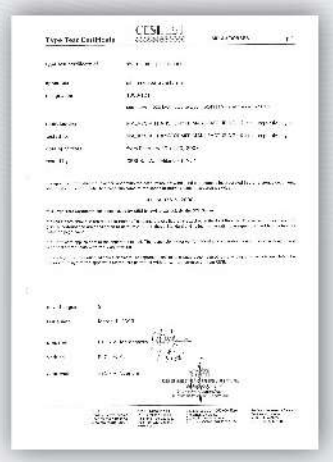
TEST REPORT


CENTRAL POWER RESEARCH INSTITUTE

TEST REPORT

CESI Certificates







ISO 9001:2008





ISO 14001:2004





OHSAS 18001:2007





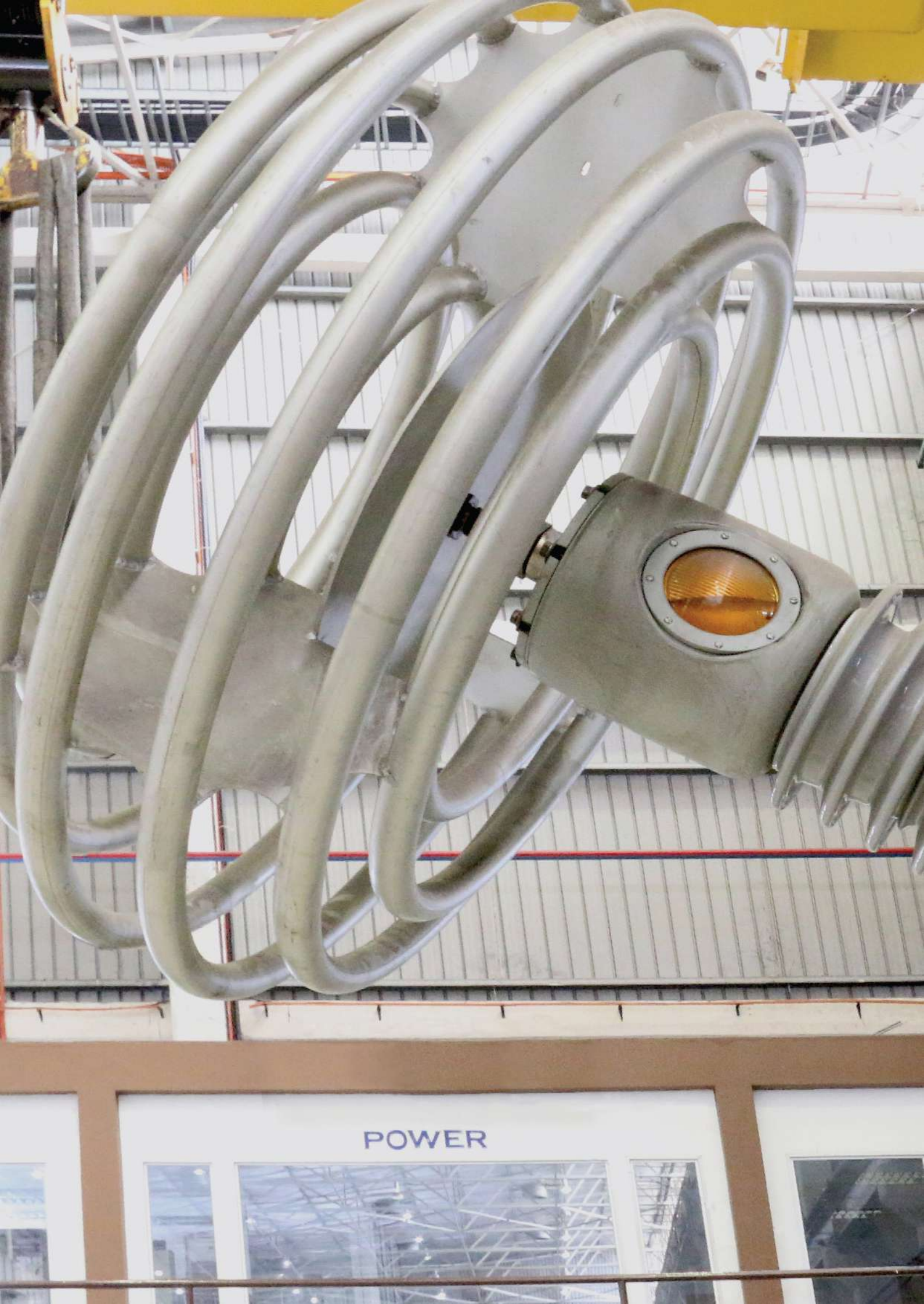
MS ISO/IEC 17025





Contact Us

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(Wholly Owned Subsidiary of Tenaga Nasional Berhad)
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POWER

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TECHNICAL DATA FOR STACKED CORE DISTRIBUTION TRANSFORMERS

OIL-IMMERSED TRANSFORMER

RATED VOLTAGE : 11/0.433 kV

RATED (kVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (W)		IMPEDANCE (%)	TOTAL WEIGHT (KG)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
100	Dyn11	ONAN	60	300	1500	4.75	846	244	1052	857	1188
300	Dyn11	ONAN	60	600	2800	4.75	1409	320	1242	843	1239
500	Dyn11	ONAN	60	1000	4100	4.75	2003	377	1365	921	1270
750	Dyn11	ONAN	60	1200	5600	4.75	2455	453	1563	893	1441
1000	Dyn11	ONAN	60	1400	7000	4.75	3190	604	1700	950	1561

RATED VOLTAGE : 33/0.433 kV

RATED (kVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (W)		IMPEDANCE (%)	TOTAL WEIGHT (KG)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
100	Dyn11	ONAN	60	300	1500	5.00	1329	526	1478	968	1629
300	Dyn11	ONAN	60	730	4500	5.00	2194	766	1778	1063	1643
500	Dyn11	ONAN	60	1020	7180	5.00	2447	753	1705	1018	1745
750	Dyn11	ONAN	60	1385	9200	5.00	2987	949	1823	1068	1890
1000	Dyn11	ONAN	60	1665	11850	5.00	3684	1065	1934	1098	1911

Note : a) Dimension and weight are for reference only and subject to product drawing.
b) The above is a sample of our product offering. Please contact us for detail of other ratings and specifications.

TECHNICAL DATA FOR 3D WOUND CORE DISTRIBUTION TRANSFORMERS

OIL-IMMERSED TRANSFORMER

RATED VOLTAGE : 11/0.433 kV

RATED (kVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (W)		IMPEDANCE (%)	TOTAL WEIGHT (KG)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
1000	Dyn11	ONAN	60	1400	7000	4.75	2646	501	1699	1059	1629

DRY TYPE TRANSFORMER

1. CAST RESIN TRANSFORMER : CLASS F (150°)

RATED VOLTAGE : 11/0.433 kV

RATED (kVA)	NOISE LEVEL dB (A)	NO LOAD CURRENT %	LOSSES (W)		EFFICIENCY (%)			TOTAL WEIGHT (KG)	OVERALL DIMENSION (mm)		
			NO LOAD	LOAD	FULL LOAD UNITY PF	3/4 LOAD UNITY PF	1/2 LOAD UNITY PF		LENGTH	WIDTH	HEIGHT
100	50	0.60	360	1370	98.30	98.51	98.61	480	1045	1065	1160
250	50	0.50	640	2410	98.79	98.95	99.02	960	1125	1167	1210
315	50	0.50	790	3030	98.80	98.96	99.03	1080	1230	1200	1230
500	51	0.40	1040	4260	98.95	99.09	99.17	1490	1310	1250	1280
800	53	0.30	1360	6080	99.08	99.21	99.29	2020	1590	1420	1350
1000	53	0.30	1590	7100	99.14	99.26	99.33	2410	1690	1530	1440
1250	53	0.25	1880	8460	99.18	99.3	99.36	2930	1762	1590	1525
1600	55	0.25	2200	10240	99.23	99.34	99.41	3450	1812	1640	1640

RATED VOLTAGE : 33/0.433 kV

RATED (kVA)	NOISE LEVEL dB (A)	NO LOAD CURRENT %	LOSSES (W)		EFFICIENCY (%)			TOTAL WEIGHT (KG)	OVERALL DIMENSION (mm)		
			NO LOAD	LOAD	FULL LOAD UNITY PF	3/4 LOAD UNITY PF	1/2 LOAD UNITY PF		LENGTH	WIDTH	HEIGHT
100	53	0.70	560	1820	97.68	97.93	98.01	610	1430	1630	1540
250	54	0.60	890	3310	98.35	98.55	98.64	1110	1550	1750	1620
315	54	0.60	1050	3930	98.44	98.64	98.73	1550	1640	1840	1650
500	55	0.50	1450	5800	98.57	98.76	98.85	1980	1690	1890	1780
800	55	0.40	1940	7960	98.78	98.94	99.03	2730	1770	1970	1810
1000	55	0.40	2180	9120	98.88	99.03	99.12	3300	1810	2010	1970
1250	57	0.35	2540	11110	98.92	99.07	99.16	3575	1900	2100	1980
1600	57	0.35	2910	13510	98.98	99.13	99.22	4140	1910	2110	2100

2. OPEN VENTILATED TRANSFORMER : CLASS (220°C)

RATED VOLTAGE : 11/0.433 kV

RATED (kVA)	NOISE LEVEL dB (A)	NO LOAD CURRENT %	LOSSES (W)		EFFICIENCY (%)			TOTAL WEIGHT (KG)	OVERALL DIMENSION (mm)		
			NO LOAD	LOAD	FULL LOAD UNITY PF	3/4 LOAD UNITY PF	1/2 LOAD UNITY PF		LENGTH	WIDTH	HEIGHT
100	50	0.60	320	1490	98.22	98.48	98.63	550	1050	1100	1290
250	50	0.50	590	2690	98.70	98.89	99.00	925	1103	1180	1403
315	50	0.50	700	3240	98.76	98.94	99.05	1030	1160	1230	1410
500	51	0.40	930	4510	98.92	99.09	99.18	1470	1276	1270	1548
800	53	0.30	1230	6440	99.05	99.20	99.30	2015	1415	1345	1595
1000	53	0.30	1400	7680	99.10	99.24	99.34	2265	1433	1385	1657
1250	53	0.25	1620	9090	99.15	99.29	99.38	2695	1584	1435	1696
1600	55	0.25	2160	11130	99.18	99.30	99.39	3100	1590	1490	1760

RATED VOLTAGE : 33/0.433 kV

RATED (kVA)	NOISE LEVEL dB (A)	NO LOAD CURRENT %	LOSSES (W)		EFFICIENCY (%)			TOTAL WEIGHT (KG)	OVERALL DIMENSION (mm)		
			NO LOAD	LOAD	FULL LOAD UNITY PF	3/4 LOAD UNITY PF	1/2 LOAD UNITY PF		LENGTH	WIDTH	HEIGHT
100	53	0.70	560	1820	97.68	97.93	98.01	1400	1700	1850	1760
250	54	0.60	890	3310	98.35	98.55	98.64	1630	1780	1900	1830
315	54	0.60	1050	3930	98.44	98.64	98.73	1680	1790	1930	1880
500	55	0.50	1450	5800	98.57	98.76	98.85	2000	1820	1950	1940
800	55	0.40	1940	7960	98.78	98.94	99.03	3200	1870	2070	2150
1000	55	0.40	2180	9120	98.88	99.03	99.12	3770	1910	2110	2190
1250	57	0.35	2540	11110	98.92	99.07	99.16	3960	1930	2130	2250
1600	57	0.35	2910	13510	98.98	99.13	99.22	4970	1980	2180	2330

Note : a) Dimension and weight are for reference only and subject to product drawing.
b) The above is a sample of our product offering. Please contact us for detail of other ratings and specifications.

TECHNICAL DATA FOR LARGE DISTRIBUTION TRANSFORMERS

RATED VOLTAGE : 33/11 kV

RATED (MVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (kW)		IMPEDANCE (%)	TOTAL WEIGHT (METRIC TONNE)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
5	Dyn11	ONAN	60	5	30	7.0	15.0	4331	3494	3305	3400

TECHNICAL DATA FOR POWER TRANSFORMERS

RATED VOLTAGE : 33/11 kV

RATED (MVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (kW)		IMPEDANCE (%)	TOTAL WEIGHT (METRIC TONNE)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
7.5	Dyn11	ONAN	64	9	39	7.5	20.0	5402	5881	3136	3113
10/15	Dyn11	ONAN/ONAF	64	12	80	10.0	27.9	7726	6386	3540	3628
21/30	Dyn11	ONAN/ONAF	55	15	120	10.0	46.7	11255	7800	3654	4557

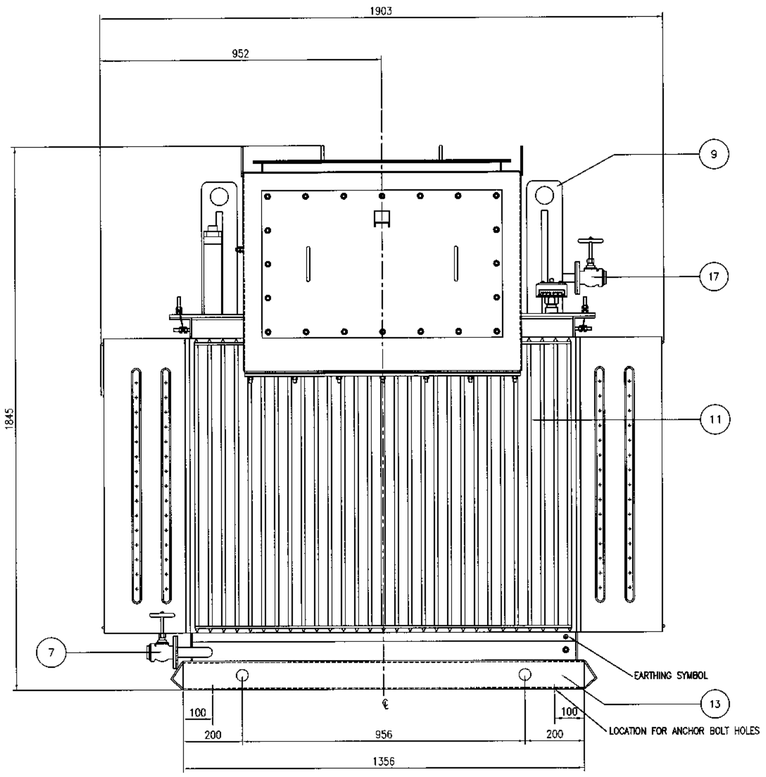
RATED VOLTAGE : 132/11 kV

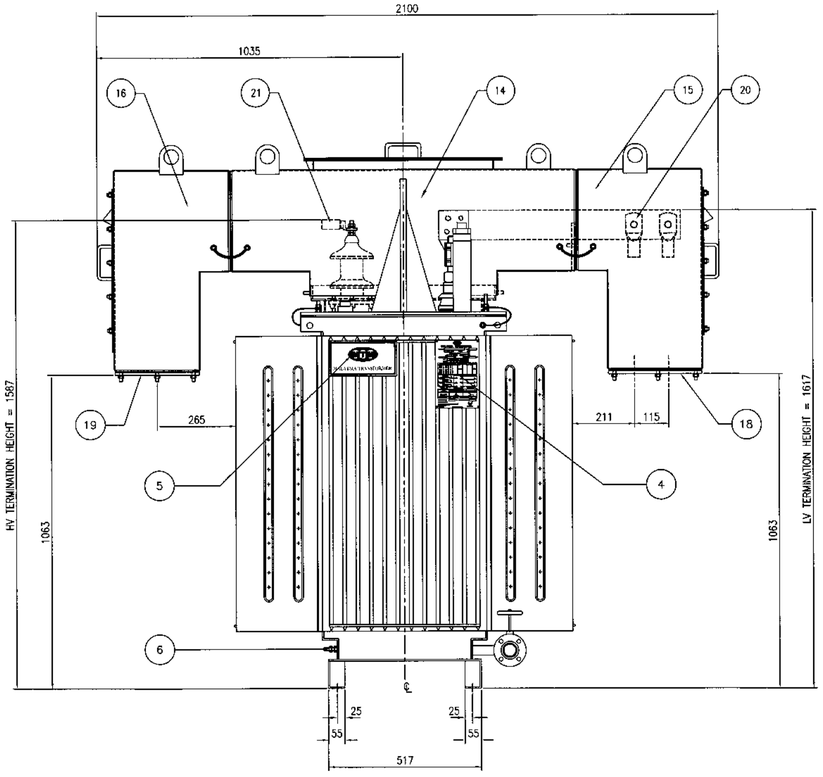
RATED (MVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (kW)		IMPEDANCE (%)	TOTAL WEIGHT (METRIC TONNE)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
30/45	YNd11	ONAN/ONAF	73	25	205	16.0	79.0	24050	6751	5176	6745

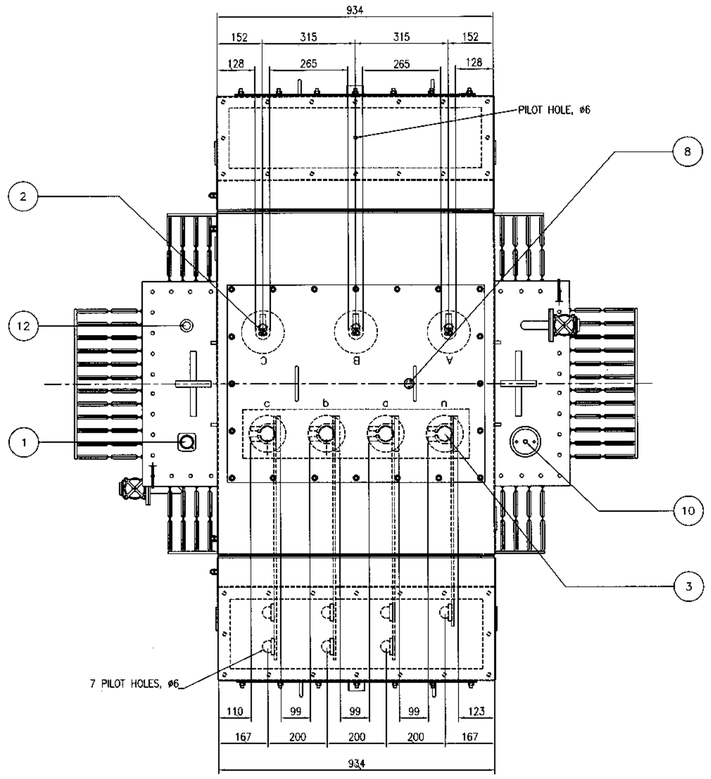
RATED VOLTAGE : 132/33 kV

RATED (MVA)	VECTOR GROUP	COOLING TYPE	NOISE LEVEL dB (A)	LOSSES (kW)		IMPEDANCE (%)	TOTAL WEIGHT (METRIC TONNE)	OIL (LITRE)	OVERALL DIMENSION (mm)		
				NO LOAD	LOAD				LENGTH	WIDTH	HEIGHT
60/90	YNd1	ONAN/ONAF	73	38	269	13.5	116.0	31000	7796	5490	6745

Note : a) Dimension and weight are for reference only and subject to product drawing.
b) The above is a sample of our product offering. Please contact us for detail of other ratings and specifications.







NOMINAL SYSTEM VOLTAGE	MINIMUM CLEARANCE	
(VOLTS)	LIVE METAL TO EARTH (mm)	PHASE TO PHASE (mm)
433	58	77
11000	76	127

MASS AND OIL QUANTITY		
WINDING, CORE AND COVER	2321	KGS
TANK AND FITTING MASS	960	KGS
OIL MASS/QUANTITY	742/854	KGS/LITERS
TOTAL MASS	4023	KGS

NOTES:

THE OUTLINE DRAWING IS NOT INTENDED TO INDICATE DETAILS OF CONSTRUCTION.

THE TRANSFORMER WILL BE DESPATCHED COMPLETE WITH OIL.

ALL DIMENSION ARE GIVEN IN mm

HV/LV TERMINATION MUST BE PARTIALLY INSULATED ACCORDING TO BS 6435

ORIGINAL

ITEM	DESCRIPTIONS/DIMENSIONS/MATERIAL/TYPE	QTY.
21	HV BIMETAL LUG (1 X 70mm² FOR EACH PHASE)	3
20	LV COPPER LUG (2 X 500mm² FOR EACH PHASE AND 1 X 500mm² FOR NEUTRAL)	7
19	HV GLAND PLATE (BAKELITE)	1
18	LV GLAND PLATE (BAKELITE)	1
17	OIL FILTER (IN) VALVE DN 25	1
16	HV CABLE BOX	1
15	LV CABLE BOX	1
14	TRUNKING BOX	1
13	SKID UNDERBASE WITH 4-40 mm DIA ROLLER AXLE AND 4-M20 ANCHOR BOLT HOLES	1
12	PRESSURE RELIEF DEVICE	1
11	COOLING FINWALL	4
10	OIL TEMPERATURE INDICATOR WITH 2 CONTACT (AKM 44612)	1
9	LIFTING LUGS FOR COMPLETE UNIT	2
8	OFF LOAD TAP CHANGER	1
7	OIL DRAIN (OUT) VALVE DN 25	1
6	EARTHING TERMINALS	10
5	MTM LOGO PLATE	1
4	RATING AND DIAGRAM PLATE	1
3	LOW VOLTAGE BUSHING (DIN 42530)	4
2	HIGH VOLTAGE BUSHING (DIN 42531)	3
1	MAGNETIC OIL LEVEL GAUGE	1

AUTHORITY/CONSULTANT APPROVAL

ENGINEERING CONTROLLED COPY
Unauthorized Duplication is Prohibited

REVISION	DESCRIPTION	DATE

AMENDMENTS / REVISIONS

MANUFACTURER :

MALAYSIA TRANSFORMER

Malaysia Transformer Mfg Sdn. Bhd. (31108-W)
Lot 22, Jalan AU3/1, Ulu Klang,
54200 Kuala Lumpur.
Tel :603-41076233 Fax :603-41054580

PROJECT :

PERMOHONAN PELAN BANGUNAN BAGI :
CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :-

1. FASA 1-GUDANG 1 TINGKAT (120m X 360m) DENGAN PEJABAT/BLOK SOSIAL 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200 KTN UNTUK KOLAM TAKUNGAN (2.414 EKAR) DI ATAS LOT 7316 (P.T 3609), JALAN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.

UNTUK :
RHB TRUSTEES BERHAD.
(As Trustee for Axis Real Estate Investment Trust)

HAN YANG CONSULTANCY SDN BHD
MECHANICAL & ELECTRICAL CONSULTING ENGINEERS
No. 19, Lorong Desa Pauh 1,
Taman Desa Pauh, 13700 Perai,
Pulau Pinang,
Tel : 04-3979100 Fax : 04-3979101
E-mail : hanyang.sdn.bhd@gmail.com

DRAWING TITLE:

AN OUTLINE
1250kVA 3 PHASES
11/.433 kV - Dyn11

DRAWN/CHECKED	APPROVED

SPEC NO. : 1250-109(11/.433)

SCALE	DATE
1 : 10	31.01.17

DRAWING NO.
TF10/1/1028

J:\DED\Dwg\ACADDIST\wan\DWG THN 2017\QUOTATION DWG\TF10\1028_SUANGKANG (1250-109) .dwg

Combined overcurrent and earth-fault relay

SPAJ 140 C

1MRS 750361-MBG
Page 1
Issued: April 1999
Status: New
Data subject to change without notice



Features

- Three-phase, low-set phase overcurrent unit with definite time or inverse definite minimum time (IDMT) characteristic
- Three-phase, high-set phase overcurrent unit with instantaneous or definite time operation
- Low-set earth-fault unit with definite time or inverse definite minimum time (IDMT) characteristic
- High-set earth-fault unit with instantaneous or definite time operation
- Built-in circuit-breaker failure protection
- Two heavy-duty and four signal output relays
- Output relay matrix allowing start or trip signals from the protection stages to be routed to the desired output relay
- Local display of measured and set values and data recorded at the moment of a fault
- Reading and writing of setting values either via local display and front panel push-buttons or from higher-level systems over the serial interface and the fibre-optic bus
- Self-supervision system continuously monitoring the operation of the electronics and the microprocessor
- Powerful software support for parameterization of the relay, for reading measured and recorded values, events, etc., and for storing readings
- Member of the SPACOM product family, ABB's Distribution Automation system and ABB's Panorama concept
- CE marking according to the EC directive for EMC

Application

The combined overcurrent and earth-fault relay SPAJ 140 C is intended to be used for the selective short-circuit and earth-fault protection of radial feeders in solidly earthed, resistance earthed or impedance earthed power systems. The integrated protection relay includes an overcurrent unit and an earth-fault unit with flexible tripping and signalling facilities. The overcurrent and earth-fault relays can also be used for other applications requiring single-, two-, or three-phase overcurrent protection. The combined overcurrent and earth-fault relay includes a circuit-breaker failure protection unit.

The combined overcurrent and earth-fault relay SPAJ 140 C is part of ABB's Distribution Automation concept, which is a product segment of Panorama, the complete ABB solution for the control and management of electric power systems.

TERASAKI
Innovators in Protection Technology

Low-Voltage Circuit Breakers

Selection Guide

TemPower 2
TemBreak 2



www.terasaki.co.jp

CATALOGUE No. '12-G90E-SEA

TERASAKI is always pleased to send you the world's top-class products.

Already for many decades TERASAKI has been internationally minded. This is proven by the number of certifications, authorizations and approvals by the world's leading organizations and authorities.
TERASAKI maintains the top position.
TERASAKI will exert its further efforts to attain more international quality recognition.


ASTA CERTIFICATION SERVICES

CERTIFICATE OF SHORT-CIRCUIT RATING

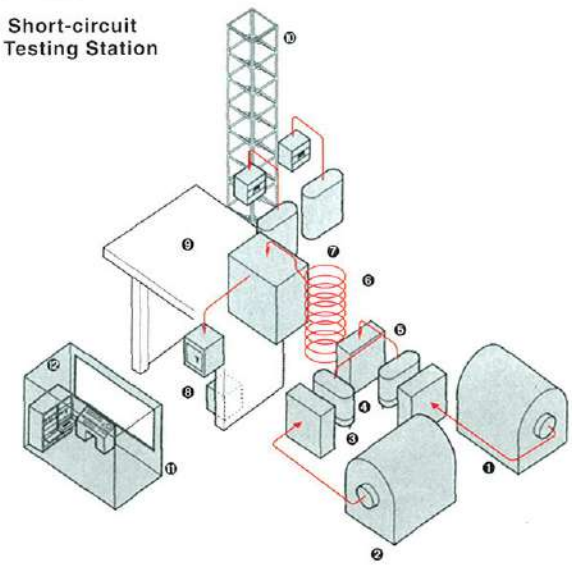
Certifications, Authorizations or Approvals by World's Leading Organizations

Air Circuit Breakers	Moulded Case Circuit Breakers
ASTA/U.K. ASTA CERTIFICATION SERVICES	**ASTA/U.K.** ASTA CERTIFICATION SERVICES
SECV/Australia State Electricity Commission Of Victoria	**SECV/Australia** State Electricity Commission Of Victoria
LR/U.K. Lloyd's Register of Shipping	**LR/U.K.** Lloyd's Register of Shipping
BV/France Bureau Veritas	**BV/France** Bureau Veritas
GL/Germany Germanischer Lloyd	**GL/Germany** Germanischer Lloyd
AB/U.S.A. American Bureau of Shipping	**AB/U.S.A.** American Bureau of Shipping
NK/Japan Nippon Kaiji Kyokai	**NK/Japan** Nippon Kaiji Kyokai

Based Standards

Air Circuit Breakers	Moulded Case Circuit Breakers
IEC 60947-2 International Electrotechnical Commission	**IEC 60947-2** International Electrotechnical Commission
BS EN 60947 Part 2/U.K. British Standard	**BS EN 60947 Part 2/U.K.** British Standard
VDE 0660 Part 101/Germany Verband Deutscher Elektrotechnicker	**VDE 0660 Part 101/Germany** Verband Deutscher Elektrotechnicker
NEMA PUB NO. SG3/U.S.A. National Electrical Manufacturers Association	**CEI EN 60947 Part 101/Geramany** Italian Standard
ANSI C37. 13/U.S.A. American National Standard Institute	**NEMA AB-1/U.S.A.** National Electrigal Manufacturers Association
JIS C8372/Japan Japanese Industrial Standard	**JIS C8370/Japan** Japanese Industrial Standard
JEC-160/Japan Japanese Electrical Committee	

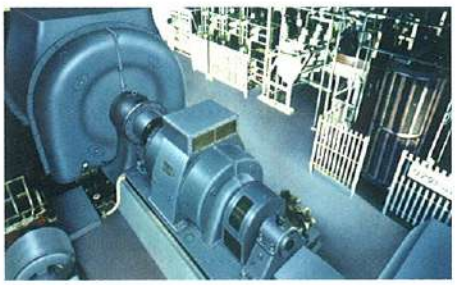
• Short-circuit Testing Station

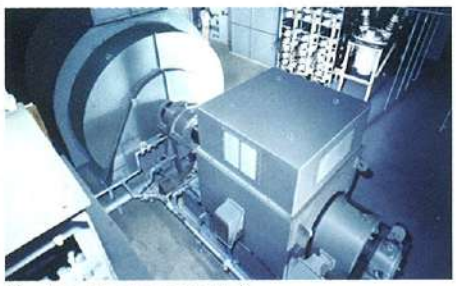


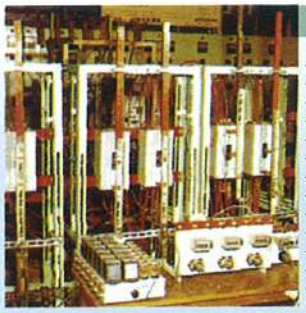
❶ Short-circuit test generator No.1
❷ Short-circuit test generator No. 2
❸ Voltage change device
❹ Back-up breaker
❺ Making switch
❻ Reactors, Resistance
❼ Step-down 3ø transformer
❽ 800V d.c. short-circuit testing equipment
❾ Pit
❿ Impulse generator
⓫ Control room
⓬ Computerized control equipment

Combined Short-circuit Capacity (MVA) When TwoShort-circuit Test Generators (No.1 and No.2) are Paralleled.

Time after short-circuit (Cycle)	Sym. 3ø R.M.S.
0	1060
1/2	950
1	860
3	710


Short-circuit test generator No.1


Short-circuit test generator No.2



TYPE TESTS on every lot

★Construction test
★Operation test
★Tripping test
★Overload test
★Overshooting test
★Temperature rise test
★Endurance test
★Insulation resistance test
★Withstand voltage test
★Short-circuit test
★Flexible cord protection test
★Short-circuit making capacity test
★Short-time withstand current test



RELIABILITY TESTS

★Vibration test
★Mechanical operation test
★Rust proof test
★Mechanical impact test
★Heat-shock test
★Gas proof test
★Aging test

TemBreak

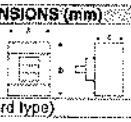
Moulded Case Circuit Breakers (New Compact Breakers)

Frame Size [A]		100	125	160	160	160	250	250
Type		**E100SF**	**S125SF**	**E160SF**	**S160SCF**	**S160SF**	**E250SF**	**S250SF**
Number of Poles		2 3	2 3 4	2 3 4	2 3 4	2 3 4	3 4	3 4
■ RATED CURRENT (In) [A] at 40°C (45°C for marine applications)		10 30 60 15 40 75 20 50 100	15 40 75 20 50 100 30 60 125	15 40 75 20 50 100 30 60 125 160	15 40 75 20 50 100 30 60 125 160	15 40 75 20 50 100 30 60 125 160	125 225 150 250 175 200	125 225 150 250 175 200
Rated impulse withstand voltage (Uimp) [kV]		6	8	8	8	8	8	8
Rated insulation voltage (Ui) [VAC]		690	690	690	690	690	690	690
■ AC RATED BREAKING CAPACITY [kA sym. rms.]								
JIS C 8370	550V	7.5	—	—	—	—	—	—
	450V	10	25	—	—	—	—	—
	220V	25	—	—	—	—	—	—
IEC 60947-2	Icu/Ics 690V	—	—	—	—	6/3	—	4/2
EN 60947-2	500V	7.5/3.8	12/6	6/3	7.5/4	10/7.5	10/7.5	25/13
	440V	10/5	25/13	10/5	15/7.5	25/13	15/12	30/15
	415V	10/5	30/15	16/8	25/13	40/20	25/19	40/20
	380V	16/8	30/15	16/8	25/13	40/20	25/19	40/20
	240V	25/13	50/25	25/13	35/18	50/25	35/27	85/43
■ DC RATED BREAKING CAPACITY [kA] ①	250V	7.5/3.8	25/13	13/7	20/10	25/13	15/12	25/13
	125V	15/7.5	40/20	20/10	30/15	40/20	25/19	40/20
Rated short time current (Icw) [kA. rms.]		—	—	—	—	—	—	—
Protection								
Adjustable thermal, adjustable magnetic		—	—	—	—	—	—	—
Fixed thermal, fixed magnetic		■	■	■	■	■	■	■
Microprocesor		—	—	—	—	—	—	—
Utilization Category		A	A	A	A	A	A	A
■ DIMENSIONS (mm)								
	a	50 75	50 75 100	50 75 100	50 75 100	50 75 100	105 140	105 140
	b	120	130	130	130	130	165	165
	c	68	68	68	68	68	68	68
	d	87	95	95	95	95	95	95
Weight (kg) (standard type)		0.48 0.74	0.6 0.8 1.0	0.6 0.8 1.0	0.6 0.8 1.0	0.6 0.8 1.0	1.5 1.9	1.5 1.9

TemBreak

Moulded Case Circuit Breakers

Frame Size (A)		100	125	100	125	125	100	125
Type		**S100NF**	**S125NF**	**S100GF**	**S125GF**	**S125RF**	**H100NF**	**H125NF**
Number of Poles		2 3 4	2 3 4	2 3 4	2 3 4	3 4	3 4	3 4
■ RATED CURRENT (In) [A] at 40°C (45°C for marine applications)		15 50 20 60 30 75 40 100	125	15 50 20 60 30 75 40 100	125	15 50 20 60 30 75 40 100 125	15 50 20 60 30 75 40 100	125
Rated impulse withstand voltage Uimp [kV]		8	8	8	8	8	8	8
AC rated insulation voltage (Ui) [VAC]		690	690	690	690	690	690	690
■ AC RATED BREAKING CAPACITY sym. r.m.s. [kA]								
JIS C 8370	550V	—	—	—	—	—	—	—
	460V	—	—	—	—	65	—	—
	220V	—	—	—	—	100	—	—
IEC 60947-2	Icu/Ics 690V	6/6	6/6	6/6	6/6	20/15	20/15	20/15
EN 60947-2	500V	22/22	22/22	25/22	25/22	35/35	45/45	45/45
	440V	25/25	25/25	50/25	50/25	65/65	120/80	120/80
	415V	30/30	30/30	65/33	65/33	70/70	125/85	125/85
	380V	30/30	30/30	65/33	65/33	70/70	125/85	125/85
	240V	50/50	50/50	85/85	85/85	100/100	150/150	150/150
■ DC RATED BREAKING CAPACITY [kA]	250V	25/19	25/19	40/40	40/40	40/40	40/40	40/40
	125V	40/30	40/30	40/40	40/40	40/40	40/40	40/40
Rated short time current r.m.s. [kA] (Icw)		—	—	—	—	—	—	—
Protection								
Adjustable thermal, adjustable magnetic		—	—	—	—	—	—	—
Fixed thermal, adjustable magnetic		—	—	—	—	—	—	—
Fixed thermal, fixed magnetic		■	■	■	■	■	■	■
Microprocesor		—	—	—	—	—	—	—
Utilization Category		A	A	A	A	A	A	A
■ OUTLINE DIMENSIONS (mm)								
	a	80 90 120	80 90 120	80 90 120	80 90 120	105 140	105 140	105 140
	b	155	155	155	155	165	165	165
	c	68	68	68	68	107	103	103
Weight (kg) (standard type)		0.7 1.1 1.4	0.7 1.1 1.4	0.7 1.1 1.4	0.7 1.1 1.4	2.4 3.2	2.4 3.2	2.4 3.2

Frame Size (A)			100	125	225	250	225	250	225
Type			**L100NF**	**L125NF**	**S225NF**	**S250NF**	**S225GF**	**S250GF**	**S225RF**
Number of Poles			3 | 4	3 | 4	3 | 4	3 | 4	3 | 4	3 | 4	3 | 4
■ RATED CURRENT (In) [A] at 40°C (45°C for marine applications)			15 50 20 60 30 75 40 100	125	125 200 150 225 175	250	125 200 150 225 175	250	125 200 150 225 175
Rated impulse withstand voltage Uimp [kV]			8	8	8	8	8	8	8
AC rated insulation voltage (Ui) [VAC]			690	690	690	690	690	690	690
■ AC RATED BREAKING CAPACITY sym. r.m.s. [kA]									
JIS C 8370		550V	—	—	—	—	—	—	—
		460V	—	—	—	—	—	—	—
		220V	—	—	—	—	—	—	—
IEC 60947-2	Icu/Ics	690V	25/20	25/20	7.5/7.5	7.5/7.5	7.5/7.5	7.5/7.5	20/15
EN 60947-2		500V	65/65	65/65	25/25	25/25	25/25	25/25	35/35
		440V	180/135	180/135	25/25	25/25	50/25	50/25	65/65
		415V	200/150	200/150	35/35	35/35	65/35	65/35	70/70
		380V	200/150	200/150	35/35	35/35	65/35	65/35	70/70
		240V	40/40	40/40	65/65	65/65	85/85	85/85	100/100
■ DC RATED BREAKING CAPACITY (kA)		250V	40/40	40/40	40/40	40/40	40/40	40/40	40/40
		125V			40/40	40/40	40/40	40/40	40/40
Rated short time current r.m.s. [kA] [Icw]			—	—	—	—	—	—	—
Protection									
Adjustable thermal, adjustable magnetic			—	—	—	—	—	—	—
Fixed thermal, adjustable magnetic			—	—	—	—	—	—	—
Fixed thermal, fixed magnetic			■	■	■	■	■	■	■
Microprocesor			—	—	—	—	—	—	—
Utilization Category			A	A	A	A	A	A	A
■ OUTLINE DIMENSIONS (mm)									
		a	105 | 140	105 | 140	105 | 140	105 | 140	105 | 140	105 | 140	105 | 140
		b	165	165	165	165	165	165	165
		c	103	103	68	68	68	68	107
Weight (kg) (standard type)			2.4 | 3.2	2.4 | 3.2	1.5 | 1.9	1.5 | 1.9	1.5 | 1.9	1.5 | 1.9	2.4 | 3.2

TemBreak
Moulded Case Circuit Breakers

Frame Size (A)			225	250	225	250	400	400	400
Type			**H225NF**	**H250NF**	**L225NF**	**L250NF**	**S400CF**	**S400NF**	**S400GF**
Number of Poles			3 | 4	3 | 4	3 | 4	3 | 4	3 | 4	3 | 4	3 | 4
■ RATED CURRENT (In) [A] at 40°C (45°C for marine applications)			125 225 150 175 200	250	125 225 150 175 200	250	125 225 400 150 250 175 300 200 350	125 225 400 150 250 175 300 200 350	125 225 400 150 250 175 300 200 350
Rated impulse withstand voltage Uimp [kV]			8	8	8	8	8	8	8
AC rated insulation voltage (Ui) [VAC]			690	690	690	690	690	690	690
■ AC RATED BREAKING CAPACITY sym. r.m.s. [kA]									
JIS C 8370		550V	—	—	—	—	—	—	—
		460V	—	—	—	—	—	—	—
		220V	—	—	—	—	—	—	—
IEC 60947-2	Icu/Ics	690V	20/15	20/15	25/20	25/20	15/15	20/15	20/15
EN 60947-2		500V	45/45	45/45	65/65	65/65	22/22	30/30	30/30
		440V	120/80	120/80	180/135	180/135	30/30	45/45	65/50
		415V	125/85	125/85	200/150	200/150	36/36	50/50	70/50
		380V	125/85	125/85	200/150	200/150	36/36	50/50	70/50
		240V	150/150	150/150	200/150	200/150	50/50	85/85	100/85
■ DC RATED BREAKING CAPACITY (kA)		250V	40/40	40/40	40/40	40/40	40/40	40/40	40/40
		125V	40/40	40/40	40/40	40/40	40/40	40/40	40/40
Rated short time current r.m.s. [kA] [Icw]			—	—	—	—	—	—	—
Protection									
Adjustable thermal, adjustable magnetic			—	—	—	—	—	—	—
Fixed thermal, adjustable magnetic			—	—	—	—	—	—	—
Fixed thermal, fixed magnetic			■	■	■	■	■	■	■
Microprocesor			—	—	—	—	—	—	—
Utilization Category			A	A	A	A	A	A	A
■ OUTLINE DIMENSIONS (mm)									
		a	105 | 140	105 | 140	105 | 140	105 | 140	140 | 185	140 | 185	140 | 185
		b	165	165	165	165	260	260	260
		c	103	103	103	103	103	103	103
Weight (kg) (standard type)			2.4 | 3.2	2.4 | 3.2	2.4 | 3.2	2.4 | 3.2	4.2 | 5.6	4.2 | 5.6	4.2 | 5.6

TemBreak

Moulded Case Circuit Breakers

| | | |

Frame Size [A]		630		630		800		800		800		1000		1000		1250	
Type		**S630CE**		**S630GE**		**S800NJ**		**S800NE**		**H800NE**		**S1000SE**		**S1000NE**		**S1250NE**	
Number of Poles		3	4	3	4	3	4	3	4	3	4	3	4	3	4	3	4
■ **RATED CURRENT** (In) [A] at 40°C		630		630		630 800		630 800		630 800		1000		1000		1250	
Rated impulse withstand voltage (Uimp) [kV]		8		8		8		8		8		8		8		8	
Rated insulation voltage (Ui) [VAC]		800		800		800		800		800		800		800		800	
■ **AC RATED BREAKING CAPACITY** [kA sym. rms.]																	
JIS C 8370	525V	30		30		30		30		40		30		45		30	
	440V	45		65		45		45		125		45		65		45	
	220V	85		100		85		85		150		85		100		85	
IEC 60947-2	Icu/Ics 690V	20/15*		20/15*		20/20*		20/20*		25/19*		20/15*		25/20*		20/15*	
EN 60947-2	525V	30/30		30/30		30/30		30/30		45/34		30/23		45/34		30/23	
	440V	45/45		65/50		45/45		45/45		125/94		45/34		65/50		45/34	
	415V	50/50		70/50		50/50		50/50		125/94		50/38		70/50		50/38	
	240V	85/85		100/85		85/85		85/85		150/150		85/65		100/75		85/65	
■ **DC RATED BREAKING CAPACITY** [kA] ◎	250V	—		—		50		—		—		—		—		—	
Rated short time current (Icw) [kA. rms.]	0.3 Seconds	—		—		—		10		10		—		—		15	
Protection																	
Adjustable thermal, adjustable magnetic		—		—		■		—		—		■		■		■	
Fixed thermal, fixed magnetic		—		—		—		—		—		—		—		—	
Microprocesor		■		■		—		■		■		■		■		■	
Utilization Category		A		A		A		B		B		A		A		B	
■ **DIMENSIONS** (mm)																	
	a	140	185	140	185	210	280	210	280	210	280	210	280	210	280	210	280
	b	260		260		273		273		273		273		273		370	
	c	103		103		103		103		140		103		103		120	
Weight (kg) (standard type)		5.0	6.5	5.0	6.5	6.5	11.5	1*	2*	3*	4*	11.0	14.8	11.0	14.8	19.8	25.0

* 1) 8.7kg/630A, 9.1kg/800A
  2) 11.9kg/630A, 12.3kg/800A
  3) 13.3kg/630A, 14.8kg/800A
  4) 16.8kg/630A, 18.8kg/800A

* MCCB cannot be used in IT system at this voltage

TemBreak
Moulded Case Circuit Breakers

Frame Size [A]		1250		1600		1600											
Type		**S1250GE**		**S1600SE**		**S1600NE**											
Number of Poles		3	4	3	4	3	4										
■ **RATED CURRENT** (In) [A] at 40°C		1250		1600		1600											
Rated impulse withstand voltage (Uimp) [kV]		8		8		8											
Rated insulation voltage (Ui) [VAC]		800		800		800											
■ **AC RATED BREAKING CAPACITY** [kA sym. rms.]																	
JIS C 8370	525V	65		30		65											
	440V	85		45		85											
	220V	125		85		125											
IEC 60947-2	Icu/Ics 690V	45/34*		20/15*		45/34*											
EN 60947-2	525V	65/50		30/23		65/50											
	440V	85/65		45/34		85/65											
	415V	85/65		50/38		85/65											
	240V	125/94		85/65		125/94											
■ **DC RATED BREAKING CAPACITY** [kA] ◎	250V	—		—		—											
Rated short time current (Icw) [kA. rms.]	0.3 Seconds	15		20		20											
Protection																	
Adjustable thermal, adjustable magnetic		—		—		—											
Fixed thermal, fixed magnetic		—		—		—											
Microprocesor		■		■		■											
Utilization Category		B		B		B											
■ **DIMENSIONS** (mm)																	
	a	210	280	210	280	210	280										
	b	370		370		370											
	c	120		140		140											
Weight (kg) (standard type)		19.8	25.0	27.0	35.0	27.0	35.0										

* MCCB cannot be used in IT system at this voltage

Appearance of major products

TemPower
Air Circuit Breakers with enhanced OCR



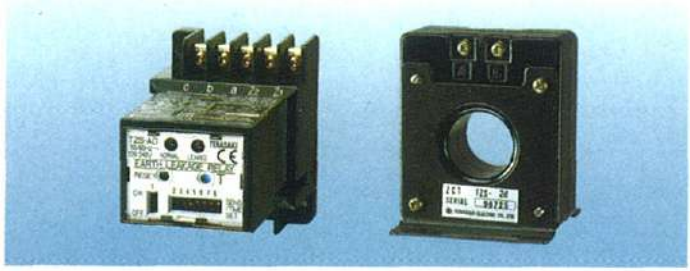
TemBreak
Moulded Case Circuit Breakers



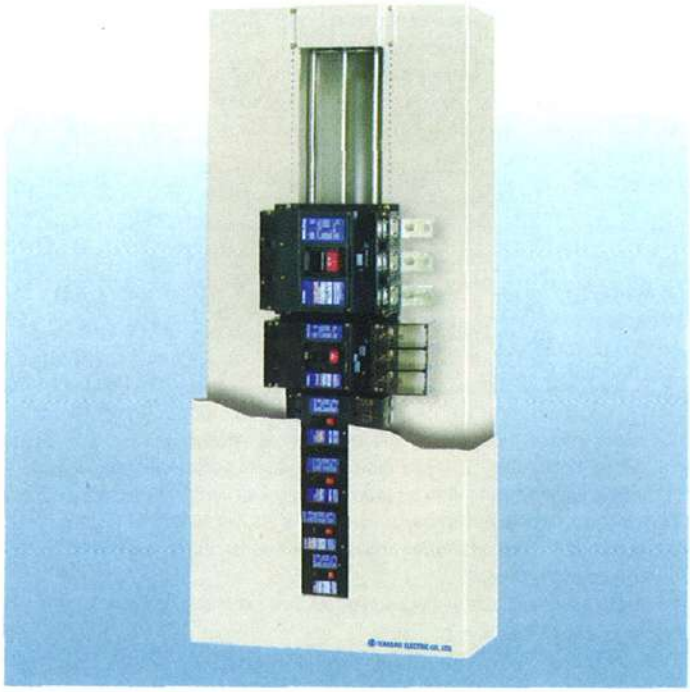
Air Circuit Breakers
(AME series for Generator Protection)



Earth-leakage Relays



TemPlug
Direct bus plug-in mounting base



TECS
DIN MODULAR DEVICES
MCB / RCCB / RCBO



⚠CAUTION

Be sure to read the instruction manual carefully to ensure correct and safe use of the product.

TERASAKI OVERSEAS NETWORK

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The contents of this publication may be subject to change without notice.

MCB

TECS DIN MODULAR DEVICES

• Our Belief
Safety and protection are the prime purposes of Terasaki products. You care about safety and protection. The people who depend on products you specify care about safety and protection.

• Ratings
Our range of DIN modular protection products covers ratings from 2A-125A.

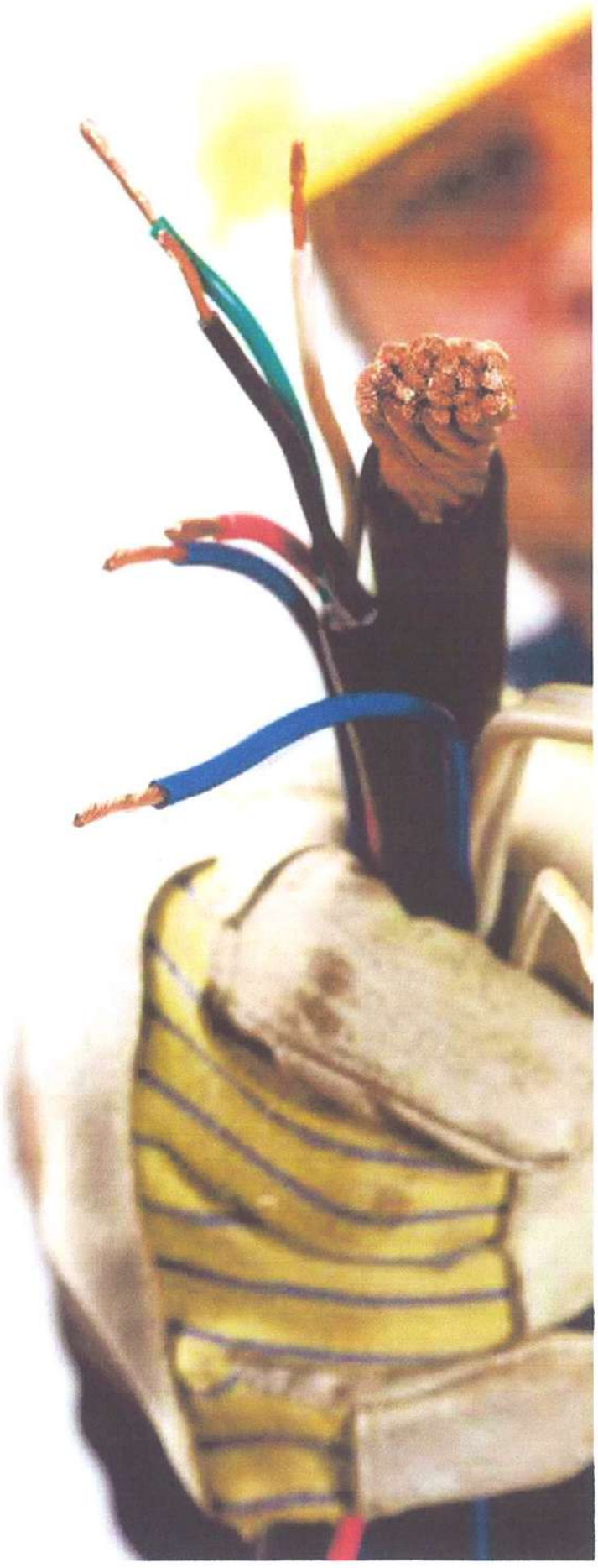
• Circuit Breakers
For overload and short-circuit protection.

• Residual Current Devices
Designed for the prevention of electrical shock and fires.

• Combination
Circuit Breakers with functions combining overload, short-circuit and residual current protection.

• There is a solution for your applications
Contact us today.

MCB | RCCB | RCBO



TERASAKI

次代に応える技術価値、企業価値の創造を

当社は1923年の創業以来、電気エネルギー制御技術をベースにした配電制御システム、ブレーカ、電子デバイスの製造に努め、船舶、建築、産業部門に貢献してきました。日本の産業構造の大きな変容、技術の世界標準志向や市場のグローバル化など激動の時代にあって、真に価値ある企業活動を推進することは容易ではありません。そんな中、当社は長年に渡り蓄積されたノウハウと実績を基盤に変革と刷新の志をもって、3事業分野におけるリーディングカンパニーとして邁進していきたいと考えます。産業と、環境と、暮らしの明日をみつめ、テラサキは進化し続けます。

Creating technical values and corporate values for the next generation……

Since our founding in 1923, TERASAKI has manufactured electric distribution and motor control systems, circuit breakers and electronic devices based on electrical energy control technologies and through our pursuit of excellence made solid contributions to the shipbuilding, construction and manufacturing industries. Yet in the turbulent times of great transformation in Japan's industrial structures, technology's path towards worldwide standardization and globalization, it is not an easy task to promote corporate activities of true value. Amidst the situation, we stand strong on our know-how and performance records accumulated over the many years and are marching forward with a will for innovations and restructuring to be a leading company in these three business fields. TERASAKI will continue to strive towards excellence with considerations on outlook on the future of industry, the environment and lifestyles.

TECS


MARINE


INDUSTRIAL


COMMERCIAL


RESIDENTIAL

DIN MODULAR DEVICES

TECS

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MCB
TECHNICAL DESCRIPTION

For use in commercial and industrial electrical distribution systems
Protects against overloads and short circuits, switching and isolation.

TRIP CHARACTERISTICS

TYPE "B" CHARACTERISTICS

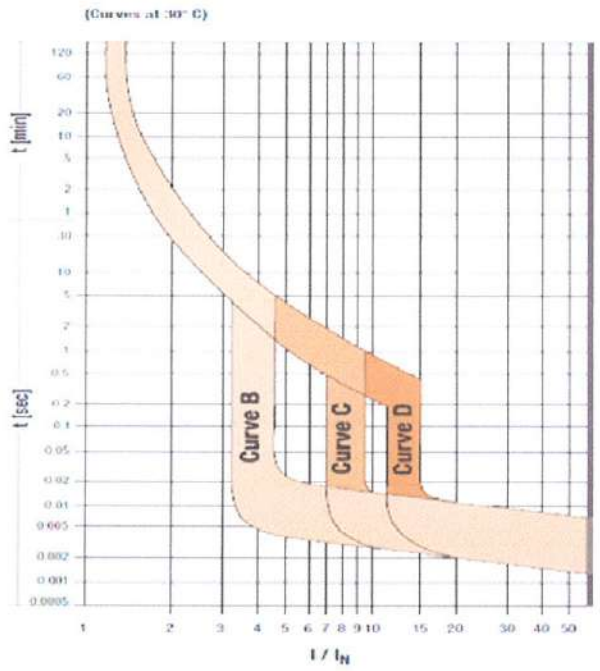
Developed primarily to protect conductors and low level signal devices such as PLCs. Instantaneous trip is three to five times the rated current of the Supplementary Protector (3~5 x In). The fast trip time of these devices minimizes damage to control circuit conductors from low-level faults.

TYPE "C" CHARACTERISTICS

Developed primarily for applications with moderate inrush currents such as lighting, control circuits and appliances. Instantaneous trip is five to ten times the rated current of the Supple¬mentary Protector (5~10 x In). The higher instantaneous trip level prevents nuisance tripping, and components being protected can typically withstand higher fault currents without being damaged.

TYPE "D" CHARACTERISTICS

Developed primarily for applications with high inrush currents, i.e., transformers, and motors. Instantaneous trip is ten to twenty times the rated cur¬rent of the Supplementary Protector (10~20 x In). The high instantaneous trip level prevents nuisance tripping, and components being protected can typically withstand higher fault currents without being damaged.



DC CIRCUITS USE

Thermal Characteristics for TECS breakers are unaffected by the current applied, that is either direct current or alternatiting current. The magnetic trip current value increases by 40%. Eg. In the case; a breaker of tripping characteristic B and 10A rated current, its magnetic tripping value will be between 30A and 50A in alternating current. The magetic tripping value for this very same breaker in direct current will be between 42.4A and 70.7A .

For DC service, the MCBs full rated breaking capacity can be achieved without any reduction in performance by connecting protected poles in series. For values up to 48V=, 1 protected pole can be used unimpaired of the breaking capacity value. Between 48 and 100V=, 2 protected poles series connected can be used without reduction in the breaking capacity. Between 110 and 150V=, 3 protected poles series connected must be used, and 4 poles up to 200V=. Connected must be used, and 4 poles up to 200V=.

TECS MCB

TERASAKI

EP SERIES

SPECIFICATION

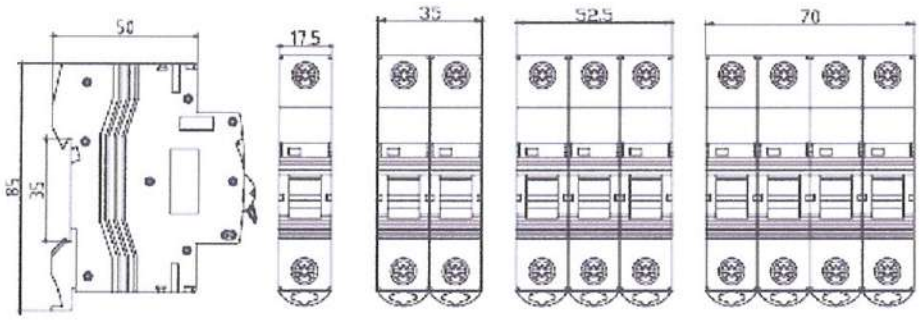
CE KEMA IEC SNI RoHS compliant ABS

SPECIFICATIONS

Rated Capacity	Phase to Neutral 230V/240V~ / Phase to Phase 400V/415V~
Rigid Conductor	25mm² Maximum
Flexible Conductor	16mm² Maximum
Characteristics	B CURVE / C CURVE / D CURVE
Capacity	6 kA / 10kA
Standards	EN 60898 / EN 60947-2 / KEMA / SEMCO / SNI / CE / ROHS
Frequency	50/60Hz
Calibration Temperature	30°C
Electrical Endurance	8000
Mechanical Endurance	20000



DIMENSIONS



TECS RCCB
TECHNICAL DESCRIPTION

Providing protection against overload and short-circuit currents and protects people against earth fault currents: direct or indirect contact, fire.....

TRIP CHARACTERISTICS

The RCD employs the current balance principle which involves the supply conductors to the load (phase and neutral) wound onto a common transformer core to form the primary windings. Under healthy conditions, the current in the phase conductor is equal to the current in the neutral and the vector sum of the current is zero.

In the event of an earth fault, an amount of current will flow to earth, creating an out of balance situation in the transformer assembly. This out of balance detected by the secondary winding of the transformer will activate the trip mechanism at a pre-determined level. Single phase and neutral or three phases and neutral units (suitable for both 3 wire and 4 wire systems) are available, the latter being suitable for balanced or unbalanced 3 phase loads.

The RCD tripping mechanism will operate at a residual current of between 50%-100% of its rated tripping current. (Sensitivity)

RESIDUAL TRIPPING CURRENTS

10mA	Suitable for use in special applications where additional protection against contact is essential
30mA	Tripping current to provide additional protection against direct contact shock
100mA	Suitable for use against direct contact shock or where protection is guard against fire hazards etc.
300mA	Suitable for use in large installations where equipment protection are main considerations and high levels of earth leakage are experienced.

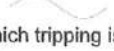
FAULT CURRENT SENSITIVITY

Semi-conductor devices are extensively integrated in equipments in industries, commerce and in our homes.
They can be found in control panels to computers to toys.

As equipments are fed from the mains electrical supply; in the event of an earth fault, the presence of semi-conductors may result in the normal AC waveform being replaced by a non-sinusoidal fault current. In some cases, the waveform may be rectified. These waveforms are said to contain a pulsating DC component which can either partially desensitize a standard type AC RCD.

International standards IEC 1008 (RCCBs) and IEC 1009 (RCBOs) divide RCDs into two performance classes:

Type AC



RCDs for which tripping is ensured for residual sinusoidal alternating currents; whether suddenly applied or slowly arising.

Type A

RCDs for which tripping is ensured for residual sinusoidal alternating currents and residual pulsating direct currents, whether suddenly applied or slowly arising.

TERASAKI

TECS RCCB

EPR SERIES

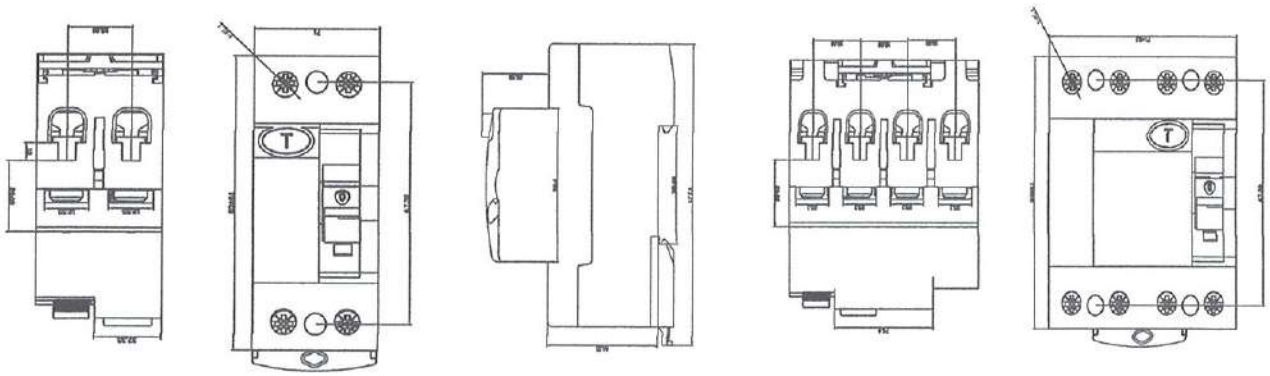
SPECIFICATION

SPECIFICATIONS

Rated Capacity	25 A, 32 A, 40 A, 63 A, 80 A, 100 A
Rigid / Flexible Conductor	35mm² / 25mm² MAXIMUM
Calibration Temperature	30°C
Frequency	50/60Hz
Electrical Endurance	10000
Mechanical Endurance	20000
Standards	EN 61008-1 / EN 61008-2-1 / ROHS / CE
Poles	2P and 4P; Ue: 230 Vac (2P), 230/400 Vac (4P); 50/60 Hz;
IΔn	30 mA, 100 mA, 300 mA, type A and AC;
Inc = IΔc	6 kA; Im = IΔm: 10 In or 500 A whichever is the greater;



DIMENSIONS



TECS RCBO

EPR SERIES

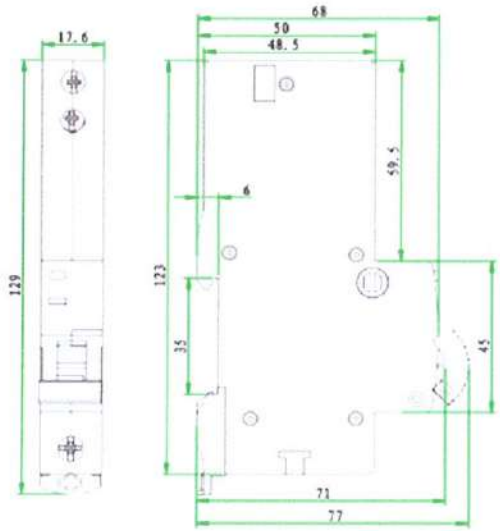
SPECIFICATION

SPECIFICATIONS

Rated Current (In)	6, 10, 15, 16, 20, 25, 32, 40A
Rated Voltage (Un)	230VAC
Breaking Capacity	6KA
Rated Tripping Current	30mA, 100mA, 300mA
Characteristics	B, C CURVE
Number of Poles	1P+N
Type of Terminal	LUG TYPE
Terminal Capacity	25mm² Maximum
Width	17.6mm / Module
Standards	IEC61009, EN6009

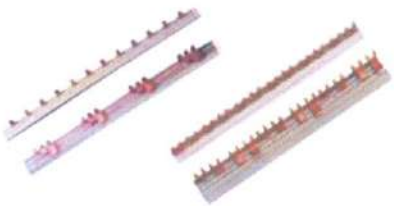


DIMENSIONS



COMPLEMENTING OUR ACCESSORY DIN MODULAR DEVICE RANGE

INSULATED PIN TYPE BUSBAR / INSULATED FORK TYPE BUS BAR

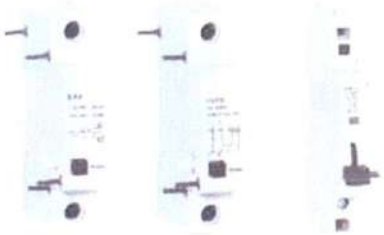


Current carrying capacity

		1 pole				2, 3, 4 poles	
Feed-in from the end cross section mm²		10	12	16	20	10	16
max. current I_n/phase (A)	$I_n \leq I_n$	63	65	80	90	63	80
Feed-in from the middle							
max. current I_n/phase (A)	I_n ... I_n	100	110	130	150	130	130
max. feed-in current I_n/phase	$I_n \leq \Sigma I_n$	Depends on the cross section for connection					

If you feed-in from the middle you have to observe that the sum of the outgoings in not higher than the max. current of the busbars Is/phase

SHUNT TRIP / UNDER VOLTAGE TRIP / AUXILLARY CONTACTS



SHUNT TRIP RATINGS
- Shunt trip 12-48VAC / VDC
- Shunt trip 110-415VAC and 110-125VDC

UNDER VOLTAGE TRIP RATINGS
- UVT 12-48VAC / VDC
- UVT 110-415VAC and 110-125VDC

AUXILLARY CONTACT RATINGS
- AUX 1C / 2C
- UVT 110-415VAC and 110-125VDC

LOAD CENTRE



Our load centre has been designed to take incoming supplies of 125A, 160A and 250A, with outgoing terminals at 18 mm or 25 mm centres and 27 mm.

ORDERS CODES



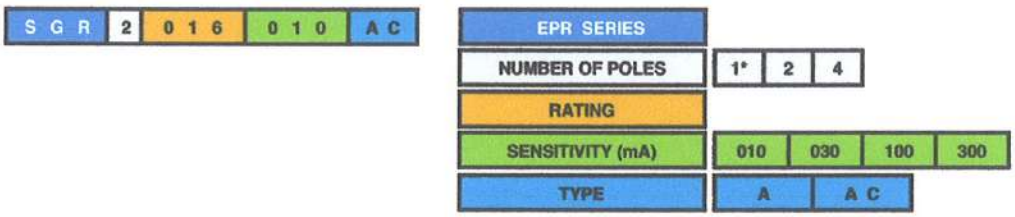
EP SERIES				
CURVE TYPE	B	C	D	
BREAKING CAPACITY	06	10		
AMPERE RATING				
NUMBER OF POLES	1	2	3	4

MCB ORDER CODES

		6kA			10kA		
		B Curve	C Curve	D Curve	B Curve	C Curve	D Curve
1 POLE	2	EPB 06021	EPC 06021	EPD 06021	EPB 10021	EPC 10021	EPD 10021
	4	EPB 06041	EPC 06041	EPD 06041	EPB 10041	EPC 10041	EPD 10041
	6	EPB 06061	EPC 06061	EPD 06061	EPB 10061	EPC 10061	EPD 10061
	10	EPB 06101	EPC 06101	EPD 06101	EPB 10101	EPC 10101	EPD 10101
	16	EPB 06161	EPC 06161	EPD 06161	EPB 10161	EPC 10161	EPD 10161
	20	EPB 06201	EPC 06201	EPD 06201	EPB 10201	EPC 10201	EPD 10201
	25	EPB 06251	EPC 06251	EPD 06251	EPB 10251	EPC 10251	EPD 10251
	32	EPB 06321	EPC 06321	EPD 06321	EPB 10321	EPC 10321	EPD 10321
	40	EPB 06401	EPC 06401	EPD 06401	EPB 10401	EPC 10401	EPD 10401
	50	EPB 06501	EPC 06501	EPD 06501	EPB 10501	EPC 10501	EPD 10501
	63	EPB 06631	EPC 06631	EPD 06631	EPB 10631	EPC 10631	EPD 10631
2 POLE	2	EPB 06022	EPC 06022	EPD 06022	EPB 10022	EPC 10022	EPD 10022
	4	EPB 06042	EPC 06042	EPD 06042	EPB 10042	EPC 10042	EPD 10042
	10	EPB 06102	EPC 06102	EPD 06102	EPB 10102	EPC 10102	EPD 10102
	16	EPB 06162	EPC 06162	EPD 06162	EPB 10162	EPC 10162	EPD 10162
	20	EPB 06202	EPC 06202	EPD 06202	EPB 10202	EPC 10202	EPD 10202
	25	EPB 06252	EPC 06252	EPD 06252	EPB 10252	EPC 10252	EPD 10252
	32	EPB 06322	EPC 06322	EPD 06322	EPB 10322	EPC 10322	EPD 10322
	40	EPB 06402	EPC 06402	EPD 06402	EPB 10402	EPC 10402	EPD 10402
	50	EPB 06502	EPC 06502	EPD 06502	EPB 10502	EPC 10502	EPD 10502
	63	EPB 06632	EPC 06632	EPD 06632	EPB 10632	EPC 10632	EPD 10632
3 POLE	2	EPB 06023	EPC 06023	EPD 06023	EPB 10023	EPC 10023	EPD 10023
	4	EPB 06043	EPC 06043	EPD 06043	EPB 10043	EPC 10043	EPD 10043
	6	EPB 06063	EPC 06063	EPD 06063	EPB 10063	EPC 10063	EPD 10063
	10	EPB 06103	EPC 06103	EPD 06103	EPB 10103	EPC 10103	EPD 10103
	16	EPB 06163	EPC 06163	EPD 06163	EPB 10163	EPC 10163	EPD 10163
	20	EPB 06203	EPC 06203	EPD 06203	EPB 10203	EPC 10203	EPD 10203
	25	EPB 06253	EPC 06253	EPD 06253	EPB 10253	EPC 10253	EPD 10253
	32	EPB 06323	EPC 06323	EPD 06323	EPB 10323	EPC 10323	EPD 10323
	40	EPB 06403	EPC 06403	EPD 06403	EPB 10403	EPC 10403	EPD 10403
	50	EPB 06503	EPC 06503	EPD 06503	EPB 10503	EPC 10503	EPD 10503
	63	EPB 06633	EPC 06633	EPD 06633	EPB 10633	EPC 10633	EPD 10633
4 POLE	2	EPB 06024	EPC 06024	EPD 06024	EPB 10024	EPC 10024	EPD 10024
	4	EPB 06044	EPC 06044	EPD 06044	EPB 10044	EPC 10044	EPD 10044
	6	EPB 06064	EPC 06064	EPD 06064	EPB 10064	EPC 10064	EPD 10064
	10	EPB 06104	EPC 06104	EPD 06104	EPB 10104	EPC 10104	EPD 10104
	16	EPB 06164	EPC 06164	EPD 06164	EPB 10164	EPC 10164	EPD 10164
	20	EPB 06204	EPC 06204	EPD 06204	EPB 10204	EPC 10204	EPD 10204
	25	EPB 06254	EPC 06254	EPD 06254	EPB 10254	EPC 10254	EPD 10254
	32	EPB 06324	EPC 06324	EPD 06324	EPB 10324	EPC 10324	EPD 10324
	40	EPB 06404	EPC 06404	EPD 06404	EPB 10404	EPC 10404	EPD 10404
	50	EPB 06504	EPC 06504	EPD 06504	EPB 10504	EPC 10504	EPD 10504
	63	EPB 06634	EPC 06634	EPD 06634	EPB 10634	EPC 10634	EPD 10634

MCB 80A, 100A, 125A ORDER CODES

		6kA			10kA		
		80A	100A	125A	80A	100A	125A
80A, 100A, 125A	1P	EP 06801	EP 061001	EP 061251	EP 10801	EP 101001	EP 101251
	2P	EP 06802	EP 061002	EP 061252	EP 10802	EP 101002	EP 101252
	3P	EP 06803	EP 061003	EP 061253	EP 10803	EP 101003	EP 101253
	4P	EP 06804	EP 061004	EP 061254	EP 10804	EP 101004	EP 101254



RCCB ORDER CODES

		2P		4P	
	In	AC TYPE	A TYPE	AC TYPE	A TYPE
10 mA	16	SGR2016010AC	SGR2016010A	SGR4016010AC	SGR4016010A
	20	SGR2020010AC	SGR2020010A	SGR4020010AC	SGR4020010A
30 mA	16	SGR2016030AC	SGR2016030A	SGR4016030AC	SGR4016030A
	25	SGR2025030AC	SGR2025030A	SGR4025030AC	SGR4025030A
	32	SGR2032030AC	SGR2032030A	SGR4032030AC	SGR4032030A
	40	SGR2040030AC	SGR2040030A	SGR4040030AC	SGR4040030A
	63	SGR2063030AC	SGR2063030A	SGR4063030AC	SGR4063030A
	80	SGR2080030AC	SGR2080030A	SGR4080030AC	SGR4080030A
	100	SGR2010030AC	SGR2100030A	SGR4100030AC	SGR4100030A
100 mA	16	SGR2016100AC	SGR2016100A	SGR4016100AC	SGR4016100A
	25	SGR2025100AC	SGR2025100A	SGR4025100AC	SGR4025100A
	32	SGR2032100AC	SGR2032100A	SGR4032100AC	SGR4032100A
	40	SGR2040100AC	SGR2040100A	SGR4040100AC	SGR4040100A
	63	SGR2063100AC	SGR2063100A	SGR4063100AC	SGR4063100A
	80	SGR2080100AC	SGR2080100A	SGR4080100AC	SGR4080100A
	100	SGR2100100AC	SGR2100100A	SGR4100100AC	SGR4100100A
300 mA	16	SGR2016300AC	SGR2016300A	SGR4016300AC	SGR4016300A
	25	SGR2025300AC	SGR2025300A	SGR4025300AC	SGR4025300A
	32	SGR2032300AC	SGR2032300A	SGR4032300AC	SGR4032300A
	40	SGR2040300AC	SGR2040300A	SGR4040300AC	SGR4040300A
	63	SGR2063300AC	SGR2063300A	SGR4063300AC	SGR4063300A
	80	SGR2080300AC	SGR2080300A	SGR4080300AC	SGR4080300A
	100	SGR2100300AC	SGR2100300A	SGR4100300AC	SGR4100300A

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TERASAKI ELECTRIC CO., LTD

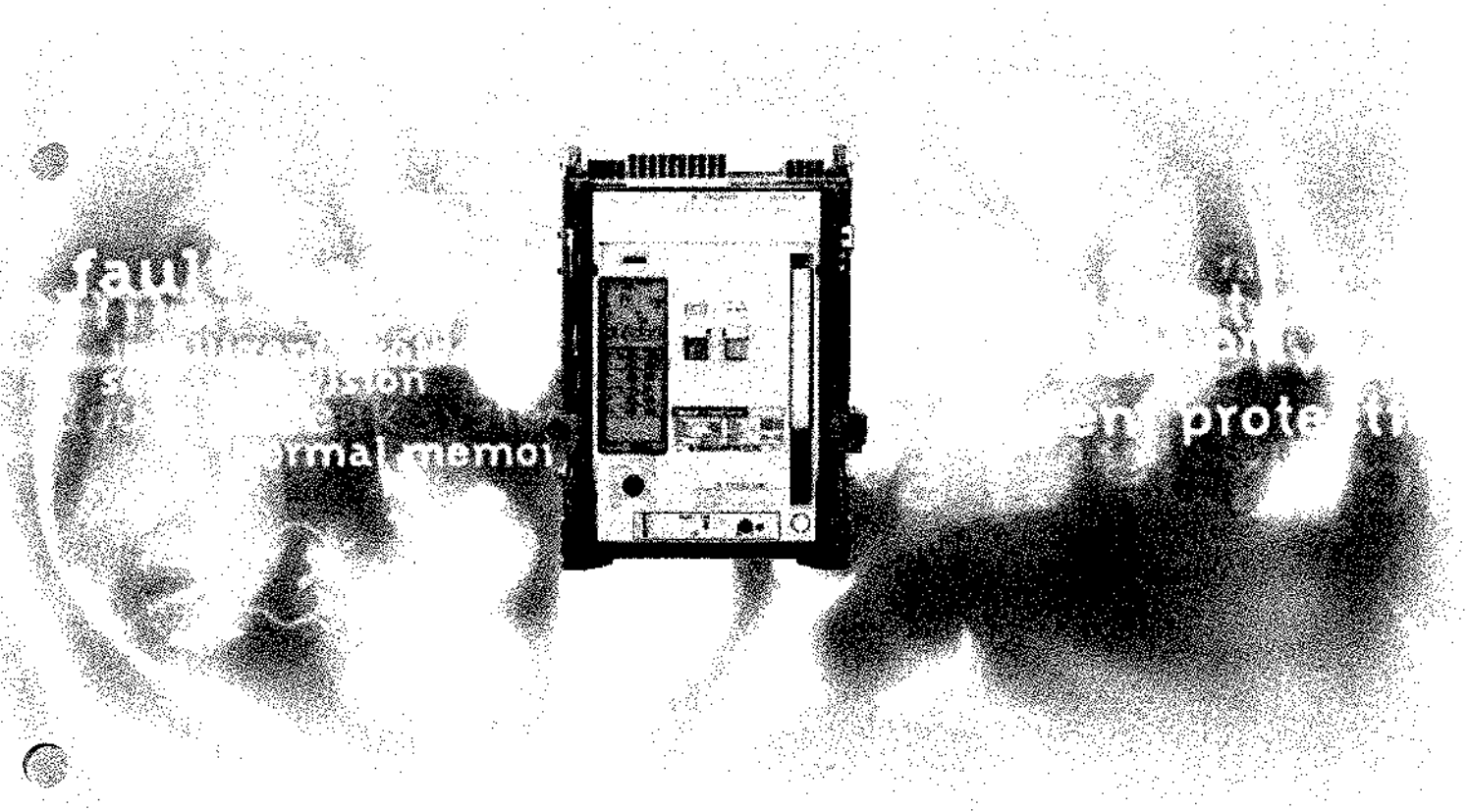
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WEB : http://www.terasaki.co.jp

TERASAKI follows a policy of continuous innovation and development, and therefore reserves the right to supply products which may differ in detail from those shown in this publication.

For further information, please contact our sales department.

TERASAKI



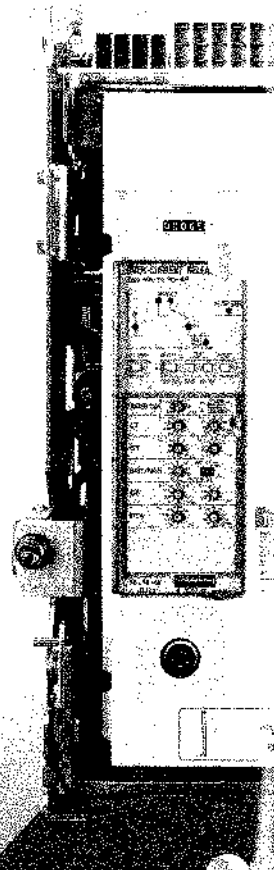
TemPower ACB

aware

- for your PROTECTION

World Class Air

Terasaki's *TemPower2* A.C.B is the result of an intensive market research program which took into account the requirements of switchboard builders, consultants and end users.
TemPower2 Air Circuit Breaker is one of the smallest in the market with a 1 second rating (Icw).



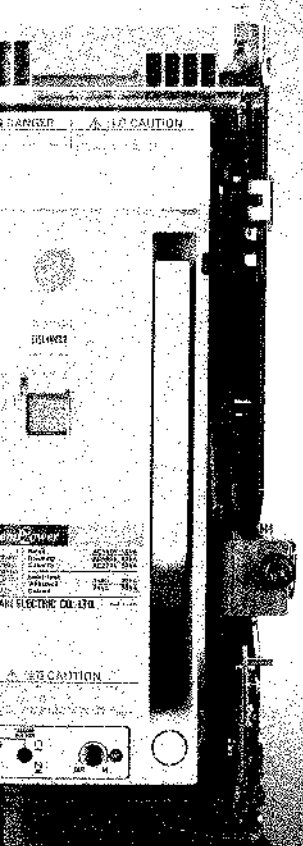
★Based Standards

JIS C8372 .....
(New JIS C8201-2 is also supported)
IEC60947-2 .....
EN60947-2 .....
AS 3947-2 .....
NEMA PUB NO.SG3 .....
ANSI C37.13 .....

★Certification and Authorization

ASTA, UK .....
NK, Japan .....
LR, UK .....
ABS, USA .....
GL, Germany .....
BV, France .....

Circuit Breakers



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..... Japanese Industrial Standard

..... International Electrotechnical Commission
..... European Standard
..... Australian Standard
..... National Electrical Manufacturers Association
..... American National Standard Institute

..... ASTA Certification Services
..... Nippon Kaiji Kyokai
..... Lloyd's Register of Shipping
..... American Bureau of Shipping
..... Germanischer Lloyd
..... Bureau Veritas

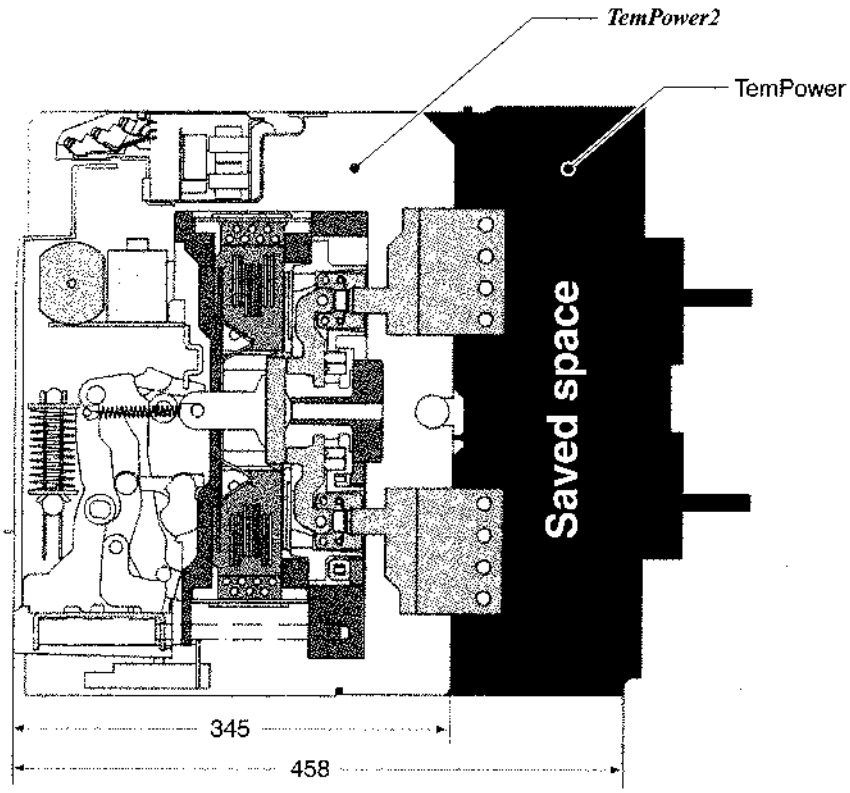
1 Features

The ultimate in compactness and operational capability

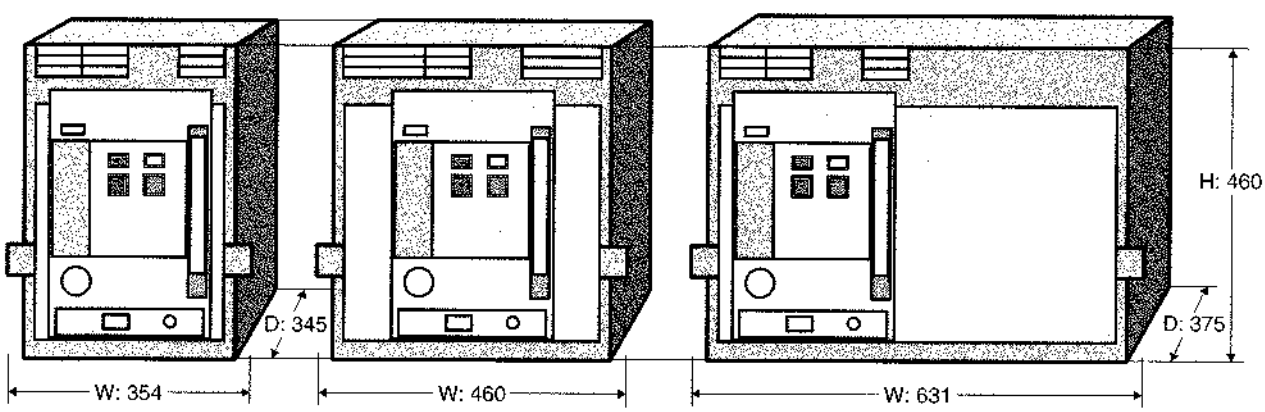
Geared toward the smallest depth in the world

Direct connection of the isolating main contacts to the hinges of the fixed main contacts eliminates the need for intermediate conductors. Allowing the *TemPower2* ACBs have the world's smallest depth resulting in space saving in switchboards.

More than twenty design patents have been registered for the *TemPower2* ACB.



The height and depth dimensions are identical in all sizes to 3200A. There are two common widths or frame size, from 800-2000A and from 2500-3200A for the standard series. The panel cutout size is the same for all types of *TemPower2*, which makes it easy to arrange the ACBs in switchboards.
Maximum power from minimum volume was central to the design specification. With a depth of 290mm for the fixed type and 345mm for draw-out, it is one of the smallest ACBs in the world.
ACBs with front connections are available off-the-shelf.
Front connections are especially suitable for smaller-depth switchboards.



Standard series 800-2000A
High fault series 1250-2000A

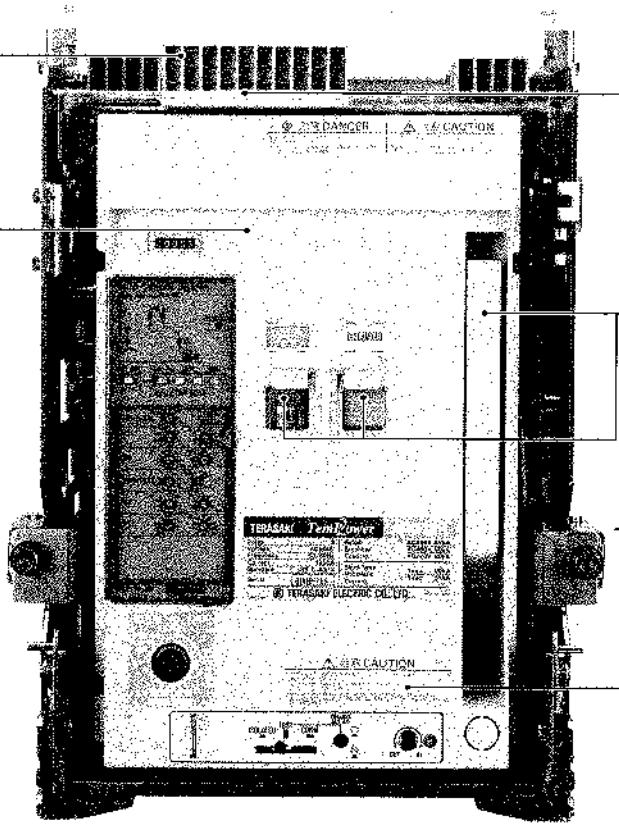
2500-3200A
1600-3200A

4000A



Increased accessibility from the front

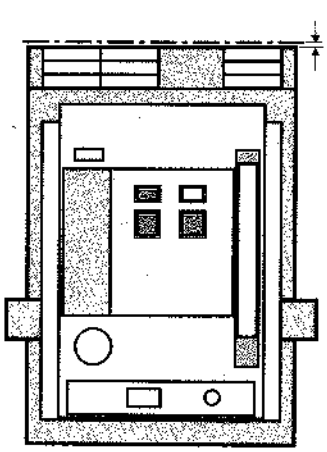
It enhances ease of installation, operation, and maintenance.



The double insulated design ensures that most accessories can be safely and easily, installed by the user. Control, auxiliary and position switch terminals are mounted at the front on the ACB body for easy access. Horizontal, vertical and front terminal connections, can also be changed by the user for any last minute alterations. Due to the increased level of harmonics within the distribution network, the neutral phase is fully rated as standard.



No extra arc space required, vertical stacking permitted

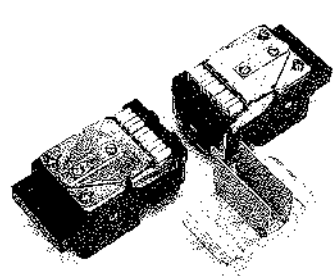


The *TemPower2* ACB dissipates all arc energy within its unique *"DoubleBreak"* arc chamber. The internal energy dissipation within the ACB allows the clearance distance of the ACB to nearby earthed metal to be zero. This will assist in minimizing switchboard height and costs.



Replacement of the main contacts

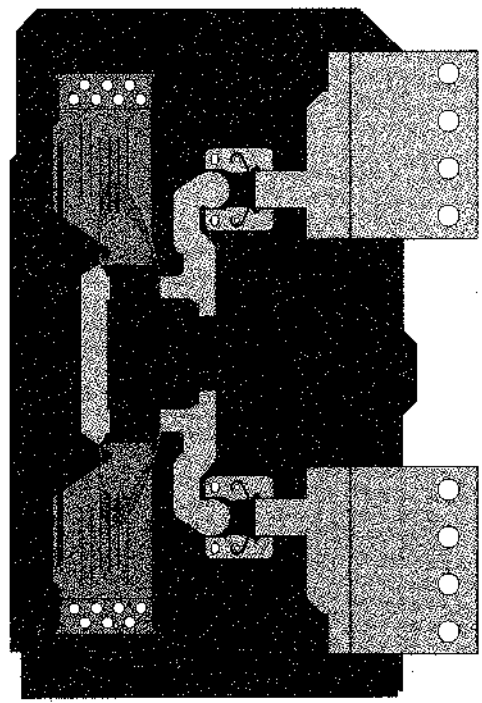
The fixed and moving main contacts can easily be replaced in the field, thus prolonging the life on the circuit breaker. Changing each pole takes around 15 minutes.



1 Features
A high performance and reliability

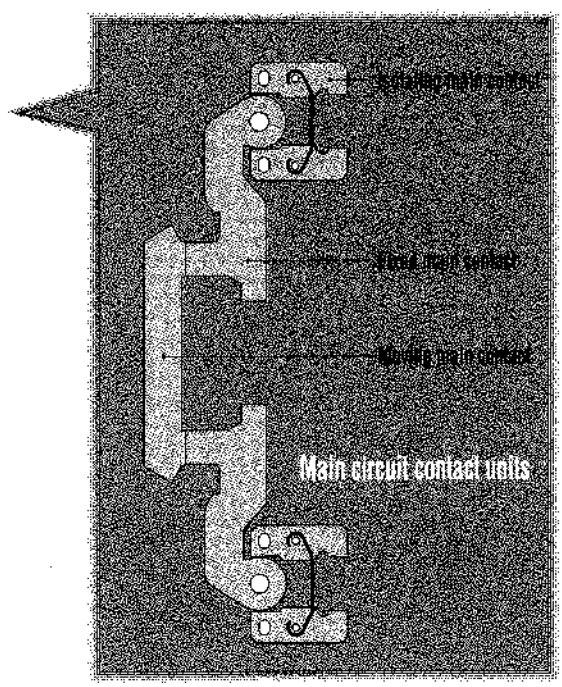
Very fast interruption by *"DoubleBreak"* system

The unique ***"DoubleBreak"*** main contact system ensures extremely fast interruption of short circuit currents and substantially reduces main contact wear. The internally symmetrical ***"DoubleBreak"*** structure allows reverse power connection.



No clamp screws used for the main circuit contact units

There are no clamp screws or flexible leads in the main circuit contact units.
This substantially enhances the durability of the main circuit contact units and improves the reliability in ON-OFF operation.



Contactless closing/tripping operation circuitry using the AGR2.

When the AGR2 OCR is used, the closing/tripping operation circuits of the ***TemPower2*** series are contactless and free of the possibility of poor conduction or contact, thereby remarkably increasing the reliability in operation.



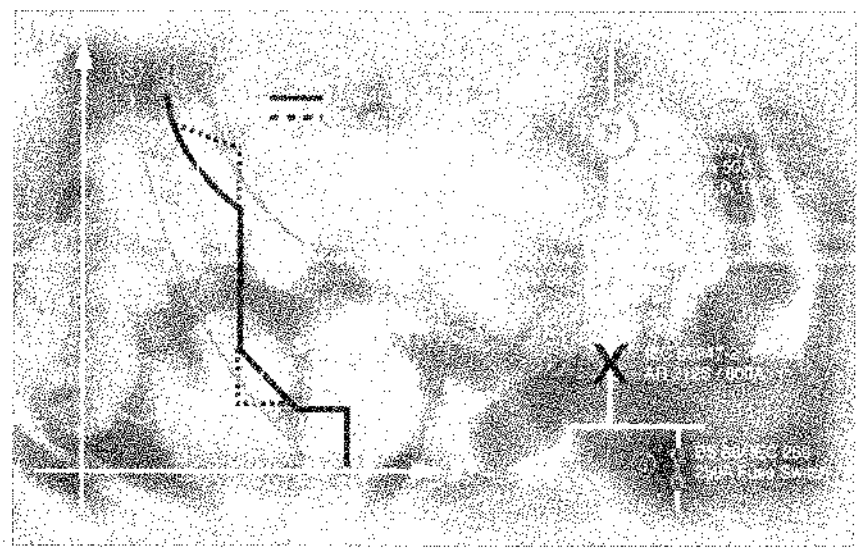
Enhanced selectivity

L Long time delay
S Short time delay
I Instantaneous

At Terasaki we are so concerned about selectivity that all our protection relays have 'LSI' characteristics as standard.

This provides an adjustable time delay on overload (L) and also the I^2t ramp characteristic (S).

As shown, these are essential to provide selectivity when grading with other protective devices such as downstream fuses and upstream relays.



The standard 'LSI' curve provides more than five million combinations of unique time current characteristics.
Zone selective interlocking is available to provide zero time delay selectivity.

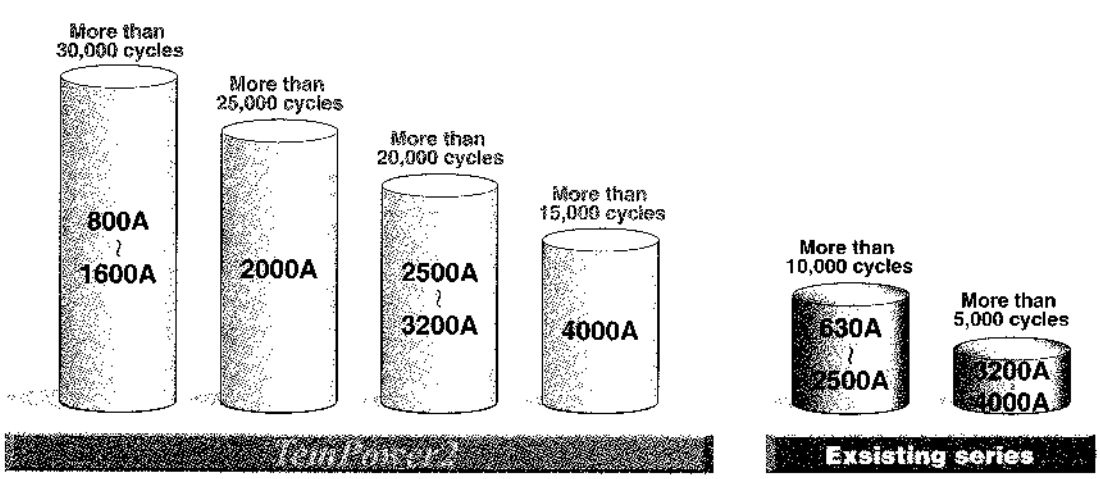
As the rated breaking capacity is identical to the rated short-time withstand current full selectivity can be achieved.

Performance \ Type and rated current		AR208S 800A AR212S 1250A AR216S 1600A AR220S 2000A	AR212H 1250A AR216H 1600A AR220H 2000A	AR325S 2500A AR332S 3200A	AR316H 1600A AR320H 2000A AR325H 2500A AR332H 3200A	AR440S 4000A
Rated breaking current (at AC440V)	With INST trip function	65kA	80kA	85kA	100kA	100kA
	With ST delay trip function (Without INST trip/MCR functions)					
Rated short-time withstand current (for 1 sec.)						



A substantial improvement in life cycles

The *TemPower2* series achieved very high life cycles compared with our existing series.

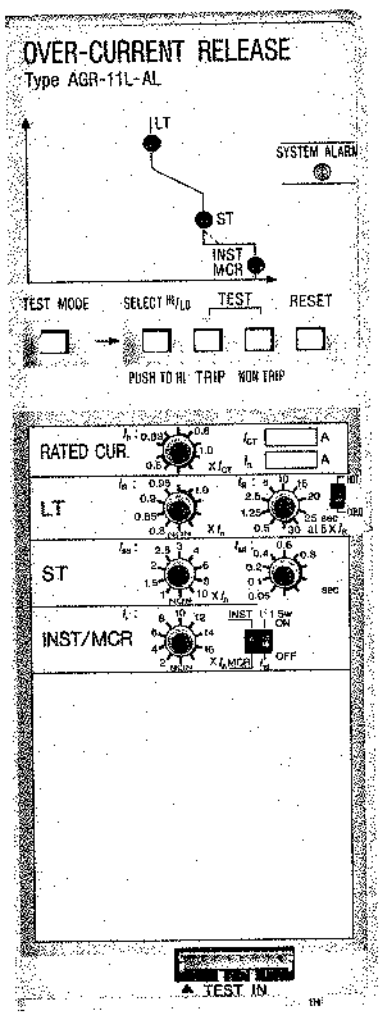


Note: aboves are the mechanical endurance with maintenance. For details please refer to pages 12 & 13.

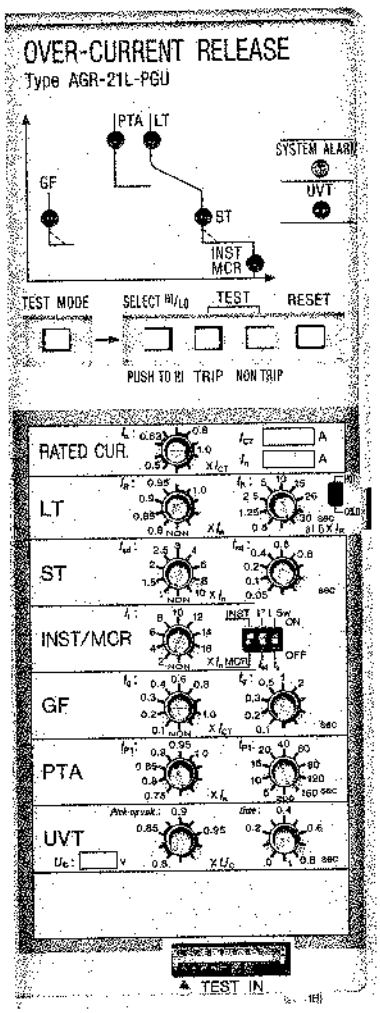
1 Features

TemPower2 provides positive protection for electric power systems.

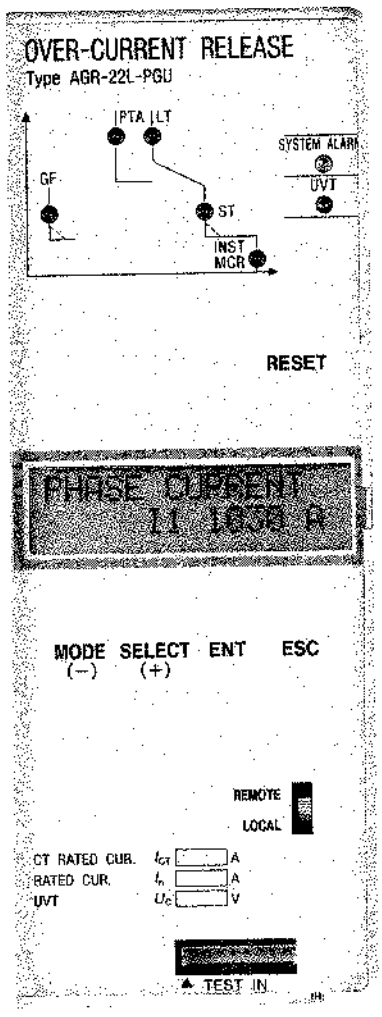
The *TemPower2* series is equipped with an RMS sensing over-current release (OCR) having a wide range of protection functions and capabilitie



Standard OCR with adjustment dial Type AGR-11.



Enhanced OCR with adjustment dial Type AGR-21.

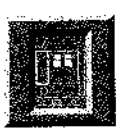


Enhanced OCR with L.C.D. display Type AGR-22.



Overload protection

Adjustable from 40–100% of rated current. True r.m.s detection up to the 19th harmonic, a distant vision for the competition who rarely see past the 7th. Neutral protection for all those Triple-N harmonics, such as 3rd, 9th and 15th. Also in case we forgot to mention, a **"thermal memory"** as standard!



Reverse power trip function

(S-characteristic) ※1

(The first-ever feature for ACBs)

This feature provides additional protection when paralleling generators. The AGR21/22 OCR for generator protection with the reverse power trip function, negates the need for installation and wiring in an external reverse power relay. This feature is available using an AGR2 OCR with a generator "S" type characteristic only.

For general feeder circuits (L-characteristic)
For general feeder circuits (R-characteristic)
For generator protection (S-characteristic)



Two channel pre-trip alarm function (S-characteristic) ※1

This function can be used to monitor and switch on additional power backup to feed critical circuits. For example, the function can be set so that when a pre-trip alarm is activated, an emergency generator starts to ensure a constant supply. This feature is only available on some AGR21/22 OCR models with a generator "S" characteristic - refer features table pages 28-29.



N-phase protection function (optional)

In 3-phase, 4-wire systems that contain harmonic distortion, the 3rd harmonic may cause large currents to flow through the neutral conductor. The N-phase protection function prevents the neutral conductor from sustaining damage or burnout due to these large currents. Available in all OCRs except for generator "S" characteristic types.



Earth leakage trip function (L/R-characteristic) ※1

Used in conjunction with an externally mounted Zero phase Current Transformer (ZCT), this function provides protection against leakage to earth of very small levels of current. Trip or alarm indication, and contact output is available to enhance the level of system protection. Available using general purpose L / R -characteristic AGR21/22 OCRs - refer features tables pages 28-29.



Adjustable undervoltage trip function UVT ※1

Available as a fixed type, or with adjustable voltage pick up and an adjustable time delay. 3 Phase, Phase failure protection is also available. AGR11/21/22 OCR's - refer features table pages 28-29.



Advanced L.C.D. display, Over Current Relay: type AGR-22

The AGR-22 OCR comes standard with an LCD display. It can monitor and indicate phase currents, voltages, power, energy, power factor, frequency, and more. Fault Analysis and maintenance information can also be displayed. For features refer page 27.



Remote Communications Protocols (optional) ※1

This function supports LONTALK® and Modbus protocol. Also we can cope with PROFIBUS, DeviceNet and the other open network. (LONTALK® is a registered trademark of the Echelon Corporation)

Energy Measurement

I, V, kW, MWh, kVar, cosø, frequency

Intelligent Fault Analysis

Status, fault type, fault size, tripping time, fault history

Maintenance Information

Trip circuit supervision, protection relay supervision, contact temperature measurement.

For details please refer to page 10.

For other protocols please contact terasaki.



Contact temperature monitoring function (optional) ※2

This function monitors the temperature of the ACBs main contacts. An alarm indicates when the temperature exceeds 155°C. Continuous monitoring of the contact temperature provides valuable input for preventative and predictive maintenance programs.

※1: Not available for standard OCRs, type AGR-11.
※2: Available for type AGR-21 OCR only.

1 Features

Optimum protective coordination

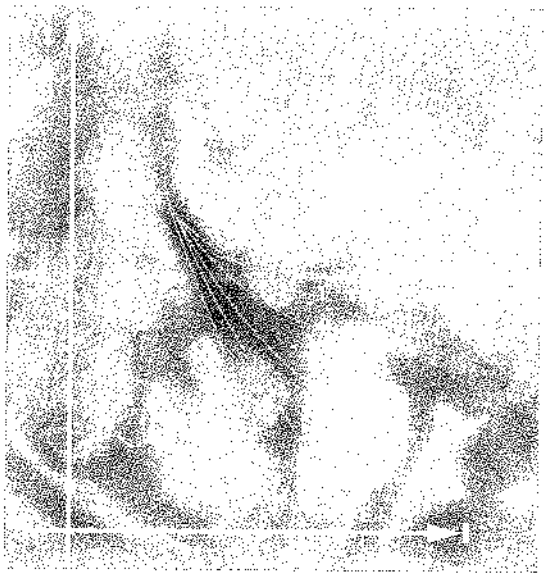
Why use a separate panel mounted protection relay when you can have all the benefits of I.D.M.T. protection integral to the ACB?

TemPower2 is available with a choice of flexible protection curves to assist in selectivity applications.

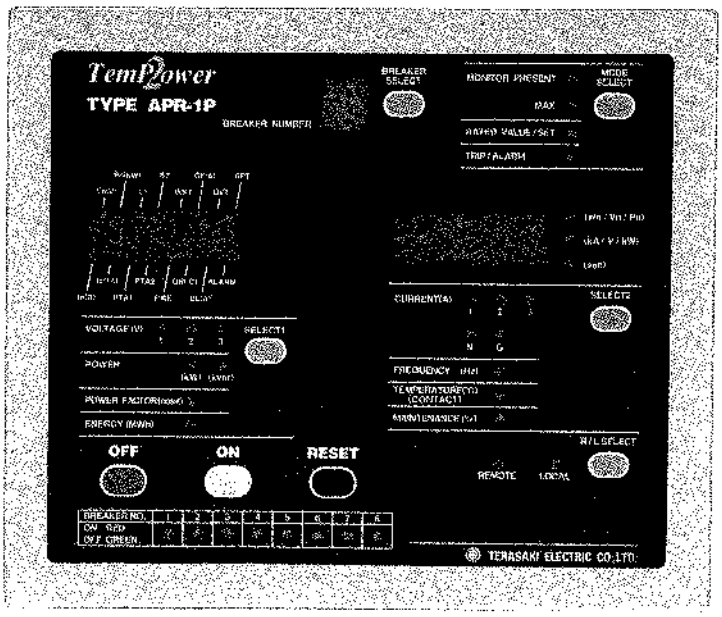
S.I. Standard Inverse
V.I. Very Inverse
E.I. Extremely Inverse

All these curves are user definable and comply with IEC 60255-3. Standard transformer and generator protection characteristics are also available.

AGR-L Industrial & transformer protection
AGR-S Generator protection
AGR-R Characteristics to IEC 60255-3



Inverse Definite Minimum Time (I.D.M.T.)



Operation panel available for centralised indication and control

The *TemPower2* operation panel provides a lower cost alternative to the P.C. based system.

Incorporating a dual LED display, the information gathered by the AGR-21 intelligent protection relay can be displayed.

The operation panel can also provide the option of remote closing and opening ACB operation.

Up to eight *TemPower2* ACBs can be connected to one operation panel.

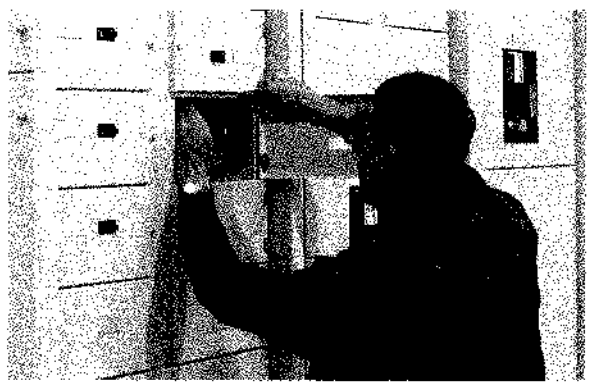
(See page 38 for details).

Meeting customer requirements

TemPower2 **provides solutions to satisfy customer needs.**

SWITCHBOARD BUILDER

- Compact size for high packing density
- No extra arc space required for clearance
- Low temperature dissipation
- Built in trip supervision circuit
- Fully rated neutral as standard
- Terminal connections and accessories are field changeable
- Uniform panel cut out size



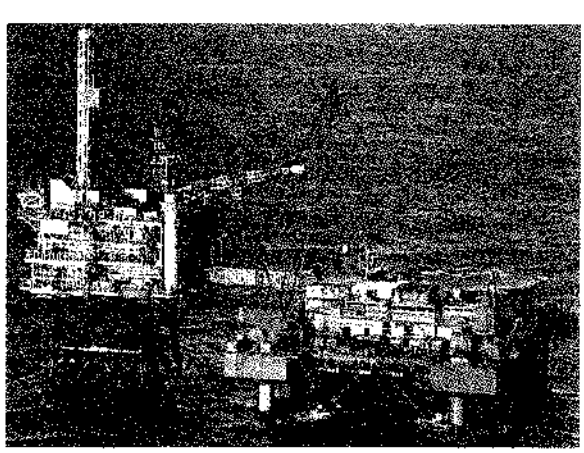
CONSULTANT

- Time Current Characteristics to IEC 60255-3
- Standard, Very and Extremely Inverse curves available
- Restricted and Unrestricted ground fault protection in one relay
- LSI characteristic curves as standard
- True r.m.s. protection
- Sophisticated undervoltage/phase failure protection
- Integral reverse power protection and load shedding relay



END USER

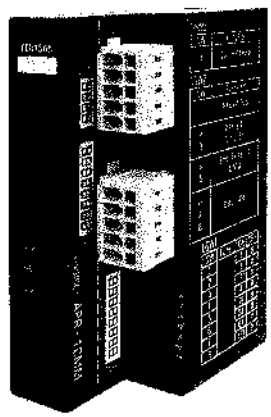
- Self checking protection relay and tripping coil
- Built in relay tester - can check on line without tripping ACB
- Percentage contact wear indicator
- Contact temperature monitoring
- Fault diagnosis - type of fault, magnitude, tripping time & trip history
- High making capacity for operator safety
- Communication via B.M.S. or S.C.A.D.A. system
- Main contacts can be changed within around 15 minutes per pole



1 Features

Communication facility added to *TemPower2*

TemPower2 is equipped with a communication interface unit that allows data exchange with a host PC via a Modbus or LonWorks® open network. Data communicated includes measurements, fault log, maintenance information, ON/OFF status, settings, and control (ON/OFF/RESET) signals.



Communication interface unit

Fault log

Cause	Whichever trip functions, LTD, STD, INST, or GF is activated is then transmitted.
Fault current	The fault current at which the breaker tripped open is transmitted.
Trip pickup time	The trip pickup time is transmitted.

Maintenance information

Tripping circuit monitoring	The tripping coil is always monitored for disconnection. If the breaker is not open within approx. 300 ms of a trip signal delivered from the OCR, an alarm signal is generated.
Overcurrent release (OCR) monitoring	A self-diagnostic function always monitors the CPU and peripheral circuits for normal operation.

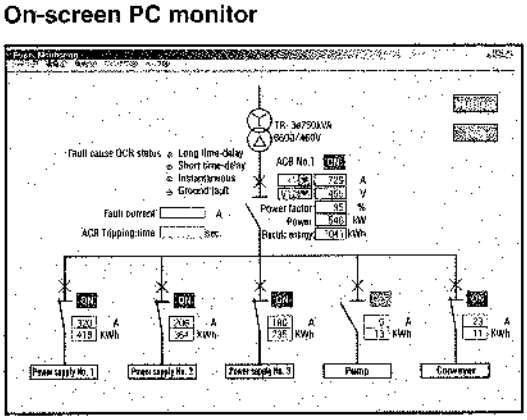
Data measurement

Phase current	The phase current I1, I2, I3, IN, IG and max current Imax are measured and transmitted.
Line-to-line voltage	V12, V23 and V31 are measured.
Active power	The three-phase power, reverse power and max power are measured.
Reactive power	The reactive power is measured.
Effective electric energy	The three-phase electric energy is measured.
Power factor	The circuit power factor is measured.
Frequency	The frequency is measured.

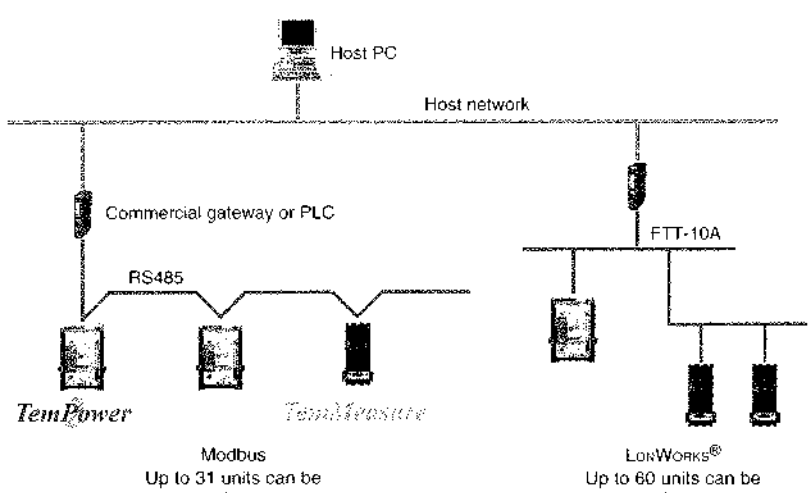
Network interface I/O specifications

Item	Modbus	LonWorks®
Transmission standard	RS-485	Echelon FTT-10A
Transmission method	Two-wire half-duplex, Four-wire full-duplex	Two-wire half-duplex
Topology	Multi-drop bus	Free topology
Transmission rate	115.2 kbps max	78.1 kbps
Transmission distance	1.2 km max (at 57.6 kbps)	500 m max, 400 m max between nodes
Data format	Modbus-RTU or ASCII	Conforming to LonTalk® protocol
Max number of nodes	1 - 247 (provided that a repeater is used every 32 nodes)	Service pushbutton switch used (32,768 nodes max)

On-screen PC monitor



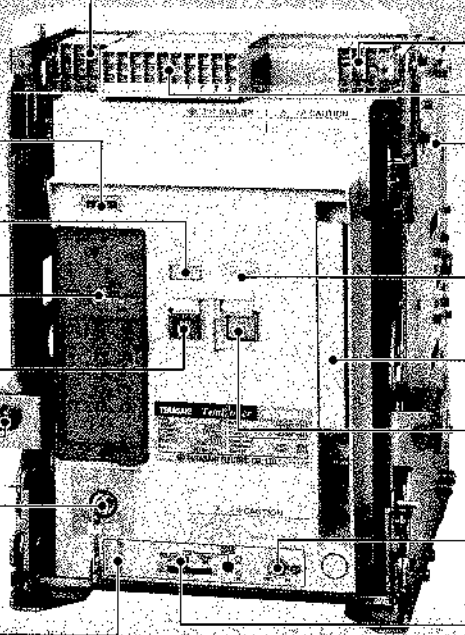
Communication network



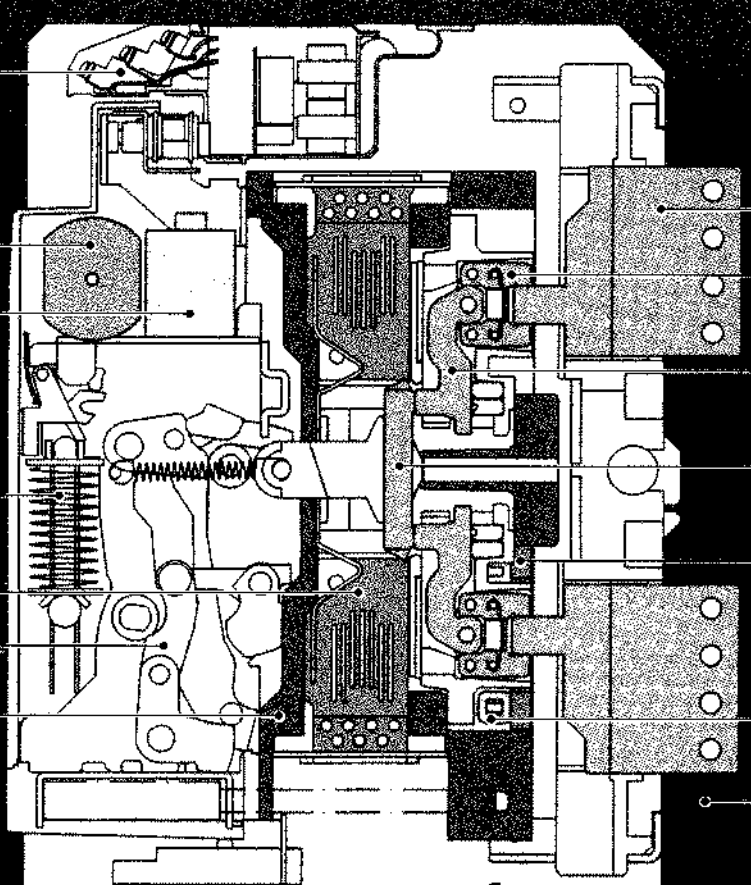
2 Appearance and Internal Construction

TemPower

Appearance

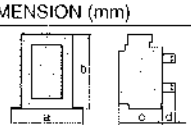
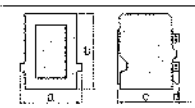


Internal Construction



3 Ratings

Standard Series

AMPERE RATING(A)			800	1250	1600	2000	2500	3200	4000
TYPE			**AR208S**	**AR212S**	**AR216S**	**AR220S**	**AR325S**	**AR332S**	**AR440S**
RATED CURRENT (max) [I_n](A) ①②	IEC, EN, AS		800	1250	1600	2000	2500	3200	4000
	JIS		800	1250	1600	2000	2500	3200	3700
	NEMA, ANSI		800	1250	1540	2000	2500	3200	3700
	Marine		800	1250	1600	2000	2500	3200	4000
NEUTRAL POLE AMPERES FRAME (A)			800	1250	1600	2000	2500	3200	4000
NUMBER OF POLES ③④			3 | 4	3 | 4	3 | 4	3 | 4	3 | 4	3 | 4	3 | 4
RATED PRIMARY CURRENT OF OVER-CURRENT RELEASE [I_{CT}](A) • for general feeder circuit use			200 400 800	400 800 1250	400 800 1250 1600	400 800 1250 1600 2000	2500	3200	4000
RATED CURRENT OF OVER-CURRENT RELEASE (A) • for generator protection use [I_n] is generator rated current.			$100 \leqq I_n \leqq 200$ $200 < I_n \leqq 400$ $400 < I_n \leqq 800$	$200 \leqq I_n \leqq 400$ $400 < I_n \leqq 800$ $630 < I_n \leqq 1250$	$200 \leqq I_n \leqq 400$ $400 < I_n \leqq 800$ $630 < I_n \leqq 1250$ $800 < I_n \leqq 1600$	$200 \leqq I_n \leqq 400$ $400 < I_n \leqq 800$ $630 < I_n \leqq 1250$ $800 < I_n \leqq 1600$ $1000 < I_n \leqq 2000$	$1250 \leqq I_n \leqq 2500$	$1600 \leqq I_n \leqq 3200$	$2000 \leqq I_n \leqq 4000$
AC RATED INSULATION VOLTAGE [U_i](V. 50/60Hz) ⑤			1000	1000	1000	1000	1000	1000	1000
RATED OPERATIONAL VOLTAGE [U_e](V. 50/60Hz) ⑥			690	690	690	690	690	690	690
AC RATED BREAKING CAP [kA sym rms]/MAKING CAP [kA peak]									
IEC,EN,AS		AC 690V ⑦	50/105	50/105	50/105	50/105	65/143	65/143	75/165
[$I_{cs} = I_{cu}$]		440V	65/143 ⑧	65/143 ⑧	65/143 ⑧	65/143 ⑧	85/187 ⑧	85/187 ⑧	100/220
NEMA		AC 600V	42/96.6	42/96.6	42/96.6	42/96.6	50/115	50/115	65/149.5
ANSI		480V	50/115	50/115	50/115	50/115	65/149.5	65/149.5	75/172.5
		240V	65/149.5	65/149.5	65/149.5	65/149.5	85/195.5	85/195.5	100/230
JIS		AC 550V	50/105	50/105	50/105	50/105	65/143	65/143	75/165
		460V	65/143	65/143	65/143	65/143	85/195.5	85/195.5	100/230
		220V	65/143	65/143	65/143	65/143	85/195.5	85/195.5	100/230
	⑨	DC 600V ⑩	40/40	40/40	40/40	40/40	40/40	40/40	40/40
		250V	40/40	40/40	40/40	40/40	40/40	40/40	40/40
NK	⑫	AC 690V	50/115	50/115	50/115	50/115	65/153	65/153	75/179
		450V	65/153 ⑧	65/153 ⑧	65/153 ⑧	65/153 ⑧	85/201 ⑧	85/201 ⑧	100/245
LR, AB,	⑫	AC 690V	50/115	50/115	50/115	50/115	65/153	65/153	75/179
GL, BV		450V	65/153 ⑧	65/153 ⑧	65/153 ⑧	65/153 ⑧	85/201 ⑧	85/201 ⑧	100/245
RATED IMPULSE WITHSTAND VOLTAGE [U_{imp}](kV)			12	12	12	12	12	12	12
RATED SHORT TIME WITHSTAND		1s	65	65	65	65	85	85	100
CURRENT[I_{cw}][kA rms]		3s	50	50	50	50	65	65	85
LATCHING CURRENT (kA)			65	65	65	65	85	85	100
TOTAL BREAKING TIME (s)			0.03	0.03	0.03	0.03	0.03	0.03	0.03
CLOSING OPERATION TIME									
SPRING CHARGING TIME (s) max.			10	10	10	10	10	10	10
CLOSE TIME (s) max.			0.08	0.08	0.08	0.08	0.08	0.08	0.08
No. of operating cycles									
Mechanical life	with maintenance		30000	30000	30000	25000	20000	20000	15000
	without maintenance		15000	15000	15000	12000	10000	10000	8000
Electrical life	without maintenance	AC460V	12000	12000	12000	10000	7000	7000	5000
		AC690V	10000	10000	10000	7000	5000	5000	2500
WEIGHT (kg) draw-out type			73 | 86	73 | 86	76 | 90	79 | 94	105 | 125	105 | 125	139 | 176
OUTLINE DIMENSION (mm)									
FIXED TYPE 		a	360 | 445	360 | 445	360 | 445	360 | 445	466 | 586	466 | 586	— | —
		b	460	460	460	460	460	460	—
		c	290	290	290	290	290	290	—
		d	75	75	75	75	75	75	—
DRAW-OUT TYPE ⑬ 		a	354 | 439	354 | 439	354 | 439	354 | 439	460 | 580	460 | 580	631 | 801
		b	460	460	460	460	460	460	460
		c	345	345	345	345	345	345	375
		d	40	40	40	40	40	40	53

①: Values in open air at 40°C (45°C for marine applications).
②: Values of AR208S ~ 216S for draw-out type with horizontal terminals, Values of AR220S ~ 440S for draw-out type with vertical terminals.
③: For 2poles use both opposite ends poles of 3poles ACBs.
④: 4poles ACBs without Neutral phase protection can not be applied to IT earthing systems.
⑤: Rated insulation voltage depends on applied standard: 1000V AC according to IEC 60947-2 and JIS C8201-2.
⑥: Rated operational voltage depends on applied standard: 690V according to IEC 60947-2 and JIS C8201-2.
⑦: Cannot apply IT earthing system, ie, insulated from earth.
⑧: For 500V AC.
⑨: Please contact TERASAKI for DC application.
⑩: 3poles in series should be applied for 600V DC.
⑫: Applicable to only 3poles ACBs.
⑬: For vertical terminals or horizontal terminals.

※1 : Please refer to catalogue No. I52E for 5000 & 6300 amperes frame ACB's.

High Fault Series

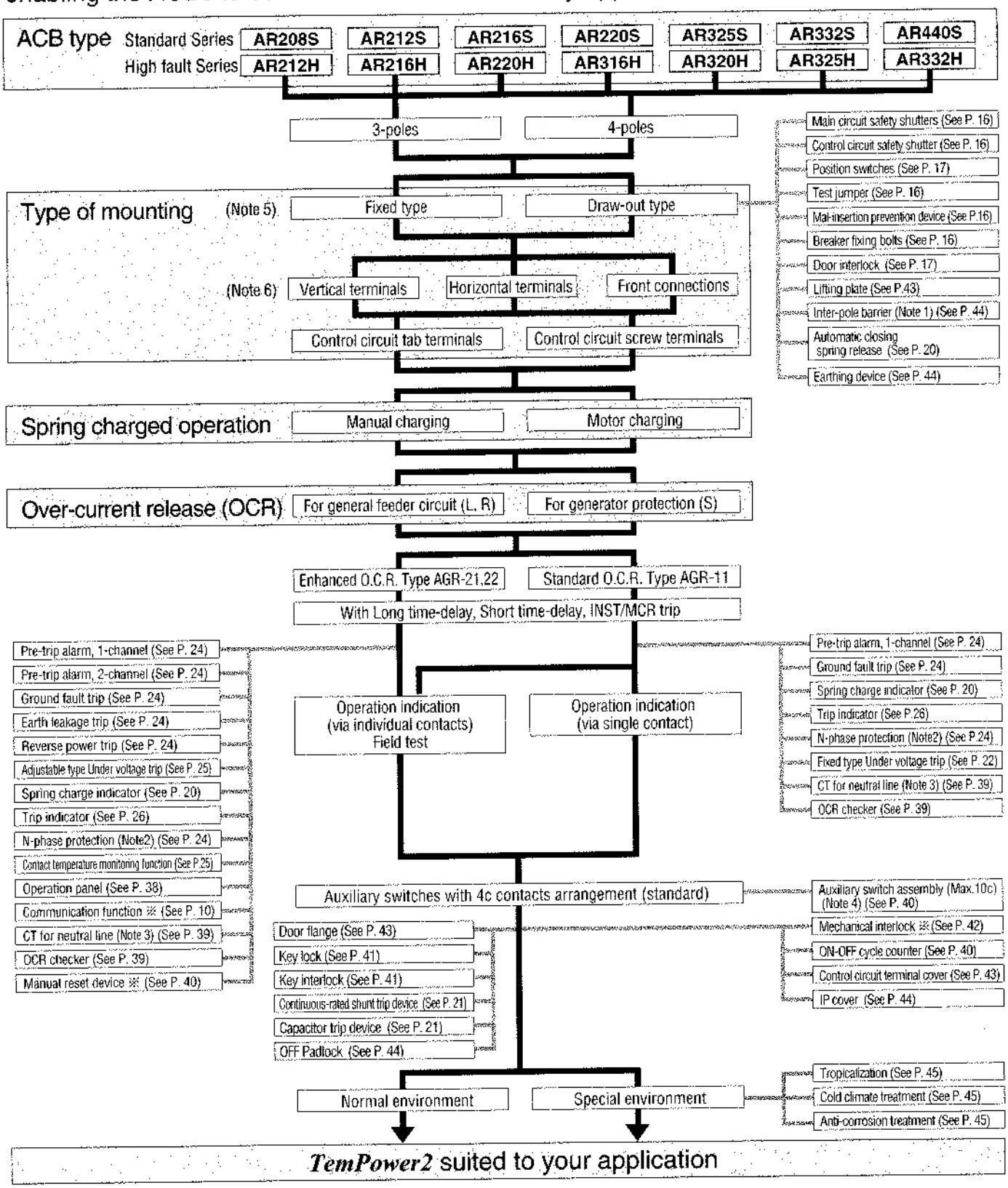
AMPERE RATING(A)			1250	1600	2000	1600	2000	2500	3200
TYPE			**AR212H**	**AR216H**	**AR220H**	**AR316H**	**AR320H**	**AR325H**	**AR332H**
RATED CURRENT (max) [I_n](A)	IEC, EN, AS		1250	1600	2000	1600	2000	2500	3200
① ②	JIS		1250	1600	2000	1600	2000	2500	3200
	NEMA, ANSI		1250	1600	2000	1600	2000	2500	3200
	Marine		1250	1600	2000	1600	2000	2500	3200
NEUTRAL POLE AMPERES FRAME (A)			1250	1600	2000	1600	2000	2500	3200
NUMBER OF POLES	③ ④		3 4	3 4	3 4	3 4	3 4	3 4	3 4
RATED PRIMARY CURRENT OF OVER-CURRENT RELEASE [I_{CT}](A) • for general feeder circuit use			200 400 800 1250	1600	2000	200 400 800 1250 1600	2000	2500	3200
RATED CURRENT OF OVER-CURRENT RELEASE (A) • for generator protection use [I_n] is generator rated current.			$100 \leqq I_n \leqq 200$ $200 < I_n \leqq 400$ $400 < I_n \leqq 800$ $630 < I_n \leqq 1250$	$800 \leqq I_n \leqq 1600$	$1000 \leqq I_n \leqq 2000$	$100 \leqq I_n \leqq 200$ $200 < I_n \leqq 400$ $400 < I_n \leqq 800$ $630 < I_n \leqq 1250$ $800 < I_n \leqq 1600$	$1000 \leqq I_n \leqq 2000$	$1250 \leqq I_n \leqq 2500$	$1600 \leqq I_n \leqq 3200$
AC RATED INSULATION VOLTAGE [U_i](V. 50/60Hz) ⑤			1000	1000	1000	1000	1000	1000	1000
RATED OPERATIONAL VOLTAGE [U_e](V. 50/60Hz) ⑥			690	690	690	690	690	690	690
AC RATED BREAKING CAP [kA sym rms]/MAKING CAP [kA peak]※2									
IEC,EN,AS	AC	690V ⑦	55/121	55/121	55/121	85/187	85/187	85/187	85/187
[$I_{cs} = I_{cu}$]		440V	80/176	80/176	80/176	100/220	100/220	100/220	100/220
NEMA	AC	600V	42/96.6	42/96.6	42/96.6	50/115	50/115	50/115	50/115
ANSI		480V	65/149.5	65/149.5	65/149.5	80/184	80/184	80/184	80/184
		240V	80/184	80/184	80/184	100/230	100/230	100/230	100/230
JIS	AC	550V	55/121	55/121	55/121	85/196	85/196	85/196	85/196
		460V	80/176	80/176	80/176	100/230	100/230	100/230	100/230
		220V	80/176	80/176	80/176	100/230	100/230	100/230	100/230
⑨	DC	600V ⑩	40/40	40/40	40/40	40/40	40/40	40/40	40/40
		250V	40/40	40/40	40/40	40/40	40/40	40/40	40/40
NK ⑪ ⑫	AC	690V	55/128	55/128	55/128	85/201	85/201	85/201	85/201
		450V	80/186	80/186	80/186	100/233	100/233	100/233	100/233
LR, AB, ⑪ ⑫	AC	690V	55/128	55/128	55/128	85/201	85/201	85/201	85/201
GL, BV		450V	80/186	80/186	80/186	100/233	100/233	100/233	100/233
RATED IMPULSE WITHSTAND VOLTAGE [U_{imp}](kV)			12	12	12	12	12	12	12
RATED SHORT TIME WITHSTAND		1s	80	80	80	100	100	100	100
CURRENT[I_{cw}][kA rms]		3s	55	55	55	75	75	75	75
LATCHING CURRENT (kA)			65	65	65	85	85	85	85
TOTAL BREAKING TIME (s)			0.03	0.03	0.03	0.03	0.03	0.03	0.03
CLOSING OPERATION TIME									
SPRING CHARGING TIME (s) max.			10	10	10	10	10	10	10
CLOSE TIME (s) max.			0.08	0.08	0.08	0.08	0.08	0.08	0.08
No. of operating cycles									
Mechanical life	with maintenance		30000	30000	30000	25000	20000	20000	20000
	without maintenance		15000	15000	15000	12000	10000	10000	10000
Electrical life	without maintenance	AC460V	12000	12000	12000	10000	7000	7000	7000
		AC690V	10000	10000	10000	7000	5000	5000	5000
WEIGHT (kg) draw-out type			79 94	79 94	79 94	105 125	105 125	105 125	105 125
OUTLINE DIMENSION (mm)									
DRAW-OUT TYPE ⑬ 		a	354 439	354 439	354 439	460 580	460 580	460 580	460 580
		b	460	460	460	460	460	460	460
		c	345	345	345	345	345	345	345
		d	40	40	40	40	40	40	40

① : Values in open air at 40°C (45°C for marine applications).
② : Values for draw-out type with vertical terminals.
③ : For 2poles use both opposite ends poles of 3poles ACBs.
④ : 4poles ACBs without Neutral phase protection can not be applied to IT earthing systems.
⑤ : Rated insulation voltage depends on applied standard: 1000V AC according to IEC 60947-2 and JIS C8201-2.
⑥ : Rated operational voltage depends on applied standard: 690V according to IEC 60947-2 and JIS C8201-2.
⑦ : Contact TERASAKI for details.
⑨ : Please contact TERASAKI for DC application.
⑩ : 3poles in series should be applied for 600V DC.
⑪ : Will apply soon.
⑫ : Applicable to only 3poles ACBs.
⑬ : For vertical terminals.

※1 : Please refer to catalogue No. I52E for 5000 & 6300 amperes frame ACB's.
※2 : When the ACB is used without Instantaneous trip function MCR should be set to work. The rated breaking capacity will reduce to the level of the latching current without MCR function.
※3 : Available on request for Fixed type.

4 Specifications

TemPower2 series ACBs have an extensive range of accessories available, enabling the ACBs to be "custom built" to suit every application.



Note 1: Not applicable to ACBs equipped with front connections or reverse power trip device.
Note 2: Applicable to 4-pole ACBs.
Note 3: Required for ground fault protection for 3-poles ACB on 3-phase, 4-wire systems.
Note 4: Microload switch assembly with 3c arrangement available.
Note 5: Fixed type is not available for High fault series.
Note 6: Vertical terminal is standard and horizontal terminal is optional for High fault series. Front connection is not available for High fault series.
※: Contact Terasaki for details.

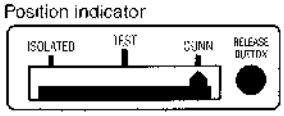
1 Types of Mounting

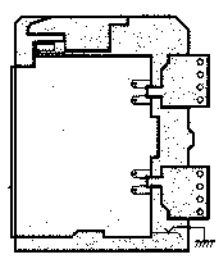
Draw-out type

This type of ACB consists of a breaker body and a draw-out cradle. The breaker body can be moved within or removed from the draw-out cradle that is fixed in the switchboard.
There are four breaker body positions: CONNECTED, TEST, ISOLATED, and WITHDRAWN. The switchboard panel door can be kept closed in the CONNECTED, TEST, and ISOLATED positions ("shut-in three positions").

1 CONNECTED position

Position indicator

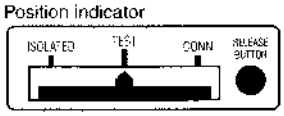


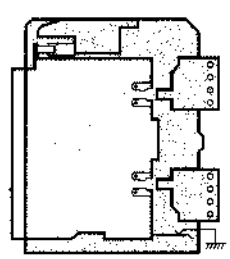


Both the main and control circuits are connected for normal service.

2 TEST position

Position indicator

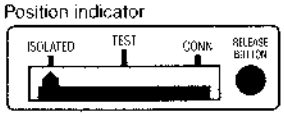


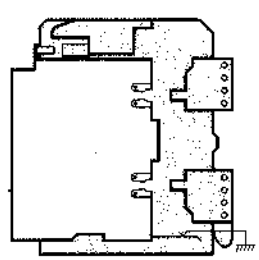


The main circuit is isolated and the control circuits are connected. This position permits operation tests without the need for opening the switchboard panel door.

3 ISOLATED position

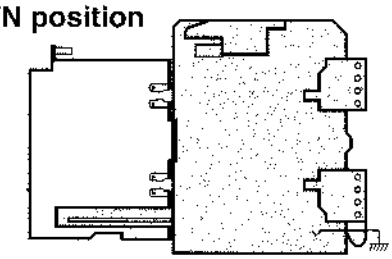
Position indicator





Both the main and control circuits are isolated.
The switchboard panel door does not need to be opened.

4 WITHDRAWN position



The breaker body is fully withdrawn from the draw-out cradle.

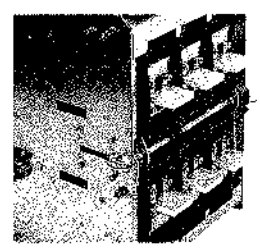
Fixed type (standard series only)

This type of ACB has no draw-out cradle and is designed to be directly mounted in the switchboard.

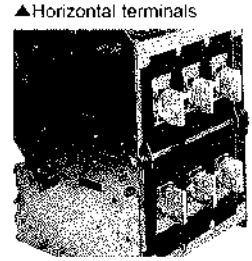
Connection methods

■ Main circuit terminals

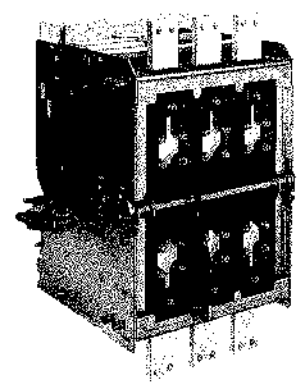
Three(3) types of main circuit terminal arrangements are available: vertical terminals, horizontal terminals, and front connections. Different types of terminal arrangements can be specified for the line and load sides. Unless otherwise specified by the user, horizontal terminals are given to types AR208S, AR212S and AR216S ACBs on both the line and load sides, and vertical terminals to AR220S, AR235S, AR332S and AR 440S. For AR440S, only vertical terminals available. For High fault series, vertical terminals are standard and horizontal terminals are optional, and front connections are not available.



▲Horizontal terminals



▲Vertical terminals

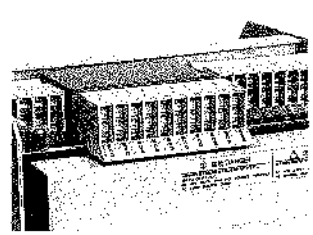


▲Front connections

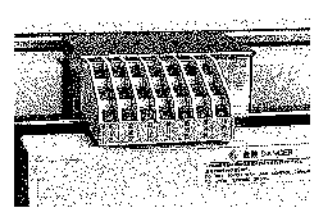
■ Control circuit terminals

Control circuit terminals are front located to allow easy wiring/access.

- The terminal blocks (for auxiliary switches, position switches, and control circuits) are positioned on the top of the ACB front panel and can be accessed from the front for wiring.
- 0.5 mm-thick tab terminals (#187) are used. Receptacle terminals fully insulated with #187 insulation sleeve are required. M4 screw terminals are also available.



▲Tab terminals



▲Screw terminals

4 Specifications

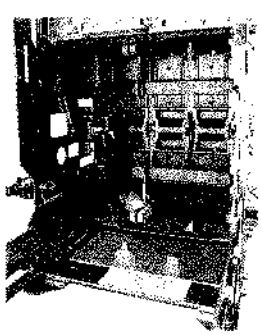
Accessories for Draw-out Type

※: Standard equipment

Main circuit safety shutters

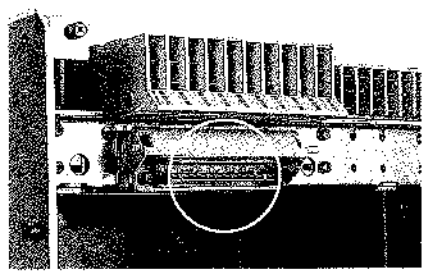
The main circuit safety shutters automatically conceal the main circuit contacts on the draw-out cradle when the ACB is drawn out.

- The top and bottom shutters operate independently and can be separately padlocked in the closed position.
- Up to three padlocks (with ø6 hasp) can be installed on each side using padlocking unit. (Padlock not supplied)
- In the closed position, the shutters are locked to the extent that they cannot be easily unlocked by hand. They can be unlocked and held open if required for the purpose of inspection or maintenance.



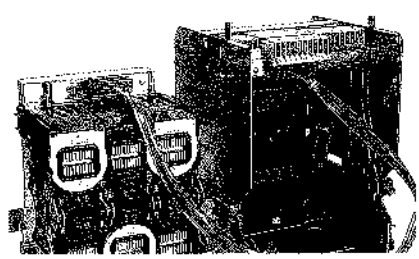
Control circuit safety shutter

The control circuit safety shutter covers the control circuit contacts, ensuring safety.



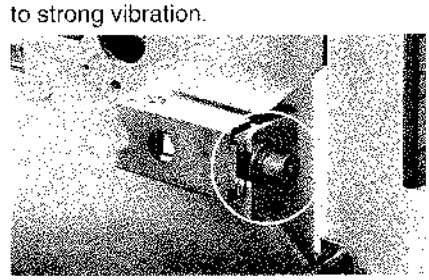
Test jumper

The test jumper is a plug-in type, and allows ON-OFF tests on all the *TemPower2* series ACBs with the breaker body drawn out from the draw-out cradle. The standard jumper cable is 5 m long.



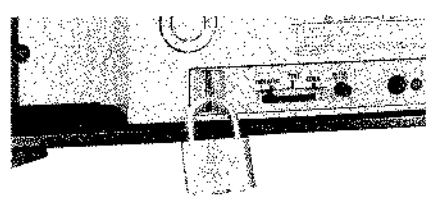
Breaker fixing bolts

The breaker fixing bolts hold the breaker body securely to the draw-out cradle in position. Use them if the ACB is subject to strong vibration.



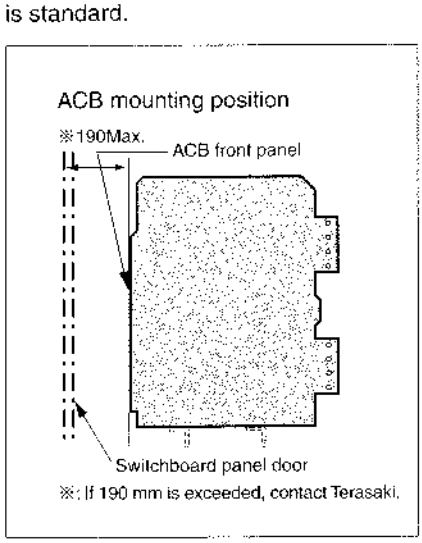
Position padlock lever ※

Using the position padlock lever prevents the breaker body from inadvertently being drawn out. The position padlock lever in the pulled-out position locks the breaker body in the CONNECTED, TEST, or ISOLATED position. Up to three padlocks (with ø6 hasp) can be installed.

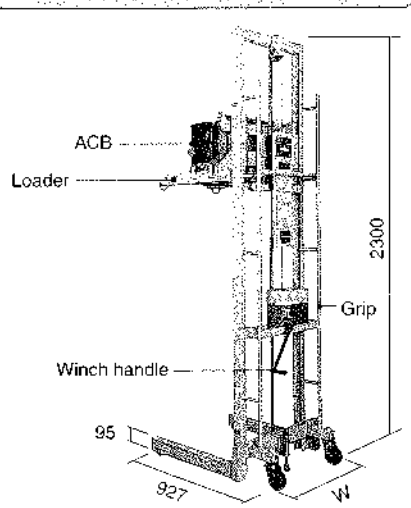


Lifter

A special lifter is available to allow easy and safe transportation or installation of the ACB. A drop prevention mechanism is standard.



※: If 190 mm is exceeded, contact Terasaki.



Contact Terasaki for products with CE marking.

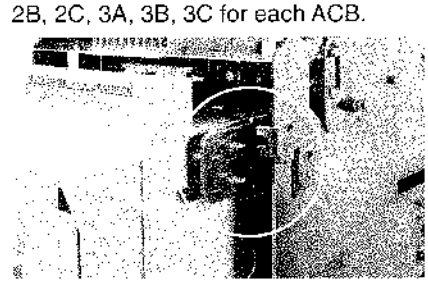
Type of Lifter	Weight (kg)	W (mm)	Applicable ACBs
AWR-1	110	700	AR2, AR3
AWR-2	120	890	AR2, AR3, AR4

Mal-insertion prevention device

Interchangeability exists within the *TemPower2* series of ACBs. Because of this feature, there is a possibility for an ACB of a different specification being placed into the draw-out cradle. Using the mal-insertion prevention device eliminates such a possibility.

This device is capable of distinguishing nine different breaker bodies.

Please specify the Code 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B, 3C for each ACB.

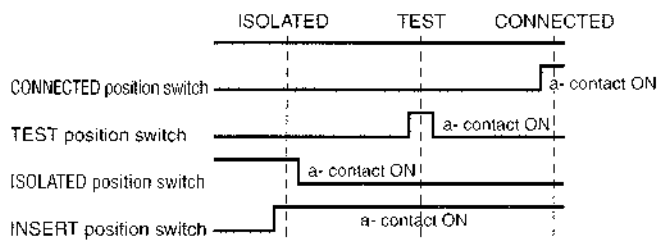


Position switches

The position switches operate to give indication of breaker positions: CONNECTED, TEST, ISOLATED, and INSERT.
There are two contact arrangements: 2c and 4c.
Connections to the switches are made via tab or screw type terminals.
The following table lists the available types of the switches.

Type	Number of contacts	Contact arrangement			
		INSERT	ISOLATED	TEST	CONN
ALR-0110P	2c	0	1	1	0
ALR-0101P		0	1	0	1
ALR-0011P		0	0	1	1
ALR-0200P		0	2	0	0
ALR-0020P		0	0	2	0
ALR-0002P		0	0	0	2
ALR-1111P	4c	1	1	1	1
ALR-1210P		1	2	1	0
ALR-1201P		1	2	0	1
ALR-0211P		0	2	1	1
ALR-1120P		1	1	2	0
ALR-1021P		1	0	2	1
ALR-0121P		0	1	2	1
ALR-1102P		1	1	0	2
ALR-1012P		1	0	1	2
ALR-0112P		0	1	1	2
ALR-0220P		0	2	2	0
ALR-0202P		0	2	0	2
ALR-0022P		0	0	2	2
ALR-1030P		1	0	3	0
ALR-0130P		0	1	3	0
ALR-0031P		0	0	3	1
ALR-1003P		1	0	0	3
ALR-0103P		0	1	0	3
ALR-0013P		0	0	1	3
ALR-0040P		0	0	4	0
ALR-0004P		0	0	0	4

Position switch operation sequence



INSERT position means the breaker body is in any position between ISOLATED and CONNECTED.

Position switch ratings

Voltage	Resistive load (A)	Inductive load (A) (COS ø = 0.6, L/R = 0.07)
AC 100-250V	11	6
DC 250V	0.3	0.3
DC 125V	0.6	0.6
DC 30V	6	5
DC 8V	10	6

Door interlock

The door interlock prevents the switchboard door from being opened unless the breaker body is in the ISOLATED position.
When the draw-out handle※ is removed while the ACB is in the ISOLATED position, the interlock is released and the switchboard door can be opened.
The breaker body cannot be inserted unless the switchboard door is closed.
Contact Terasaki for details.

Note 1: When a Door interlock is specified, a storage draw-out handle is supplied.
Note 2: Door interlock can not be specified with Door flange.
Note 3: Contact TERASAKI for the details for fitting Door Interlock with IP55 cover.

4 Specifications

3 Spring Charged Operation

Manual charging type

For this type of ACB, the closing springs are charged by means of the spring charging handle. ON/OFF operation of the ACB is performed by means of ON/OFF buttons on the ACB.

■ Charging the closing springs

Pumping the spring charging handle by hand charges the closing springs.

■ Closing the ACB

Pressing the ON button on the ACB closes the ACB.

■ Opening the ACB

Pressing the OFF button on the ACB opens the ACB.

The ACB cannot be closed as long as the OFF button is pressed.

Motor charging type

For this type of ACB, the closing springs are charged by means of a motor. ON/OFF operation of the ACB can be performed remotely.

The control circuits provide optimum control to the spring charging and ACB ON/OFF operation.

A manual charging mechanism is also fitted to facilitate inspection or maintenance work.

■ Charging the closing springs

A motor is used to charge the closing springs.

When the closing springs are released to close the ACB, they are automatically charged again by the motor for the next ON operation.

■ Closing the ACB

Turning on "remote" ON switch enables the ACB to be remotely closed.

- Anti-pumping mechanism

  Even if the ON switch is kept on, ACB closing operation is performed only once.

  To close the ACB again, remove the ON signal to reset the anti-pumping mechanism and then reapply the ON signal.
- If ON and OFF signals are simultaneously given to the ACB, the ON signal is ignored.

■ Opening the ACB

(1) With AGR-11 OCR or without OCR.

For opening the ACB remotely, specify the shunt trip device (See P. 21) or the undervoltage trip (See P. 22).

(2) With AGR-21 or AGR-22 OCR.

Turning on an external OFF switch excites the tripping coil TC , thus enabling the ACB to be remotely opened.

The tripping coil TC is equipped as standard.

■ Operation power supply

(1) With AGR-11 OCR or without OCR.

Rated voltage (V)	Applicable voltage range (V)		Operation power supply ratings		
	CHARGE/ ON operation	OFF operation (Note1)	Motor inrush current (peak) (A)	Motor steady-state current (A)	Closing command current (peak) (A)
AC 100	85-110		6	0.8	0.48
AC 110	94-121		6	0.8	0.39
AC 120	102-132		6	0.8	0.37
AC 200	170-220		8	0.7	0.24
AC 220	187-242		8	0.7	0.19
AC 240	204-264		8	0.7	0.18
DC 24	20-26		12	3.5	1.65
DC 48	41-53		9	1.4	0.86
DC 100	85-110		5	0.7	0.39
DC 110	94-121		5	0.7	0.37
DC 125	106-138		5	0.7	0.31
DC 200	170-220		6	0.5	0.19
DC 220	187-242		6	0.5	0.18

Note 1: For the ratings refer to the shunt trip device of page 21.

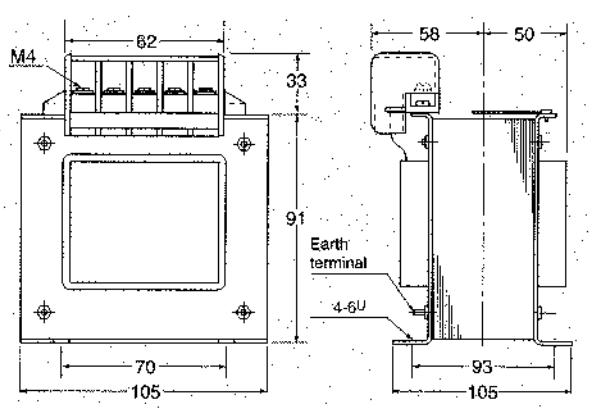
(2) With AGR-21 or AGR-22 OCR

Rated voltage (V)	Applicable voltage range (V)		Operation power supply ratings		
	CHARGE/ ON operation	OFF operation	Motor inrush current (peak) (A)	Motor steady-state current (A)	Closing command current (peak) (A)
AC 100-120	85-132	70-132	6	0.8	3.0
AC 200-240	170-264	140-264	8	0.7	3.5
DC 24	18-26	17-26	12	3.5	7
DC 48	36-53	34-53	15	3	9
DC 100-125	75-138	70-138	5	0.7	2.5
DC 200-250	150-275	140-275	6	0.5	3

Step-down transformer (external)

The maximum rated control voltage applicable to the operation power supply is AC240V. If far higher voltages, a step-down transformer is needed.
The following step-down transformers are available as options.

Rated control voltage	Transformer		
	Type	Capacity	Voltage ratio
AC410-470V	TSE-30M	300VA	450/220V
AC350-395V	TSE-30M	300VA	380/220V



4 Specifications

4.1 Accessories for Spring Charged Operation

Automatic closing spring release

This device allows the charged closing springs to be automatically released when the ACB is drawn out from the ISOLATED position to the REMOVED position.
ANSI or NEMA-compliant ACBs require this option.

Spring charge indicator

This switch can be used to indicate that the closing springs have been fully charged.

(1) With AGR-11 OCR or without OCR

Voltage (V)		Switch contact ratings (A)	
		Resistive load	Inductive load
AC	250	6	3
DC	250	0.1	0.1
	125	0.5	0.5
	30	3	2

(2) With AGR-21 or AGR-22 OCR

Voltage (V)		Switch contact ratings (A)	
		Resistive load	Inductive load
AC	250	0.5	0.2
DC	250	0.27	0.04
	125	0.5	0.2
	30	2	0.7

Trip Devices

Continuously-rated shunt trip device

The continuous-rated shunt trip device allows the ACB to be opened when an external protection relay against overcurrent or reverse power is activated.

Because of its continuous rating, the device can also be used to provide an electrical interlock to the ACB.

When an AGR-11 OCR is fitted or no OCR is fitted continuously rated shunt trip and fixed type undervoltage trip can not be fitted to the same ACB. However, Instantaneously rated shunt trip can be used together with fixed type undervoltage trip with special specification.

Shunt Trip Rating (Continuously rated type)

Type	Rated voltage (V)	Operational voltage (V)	Peak excitation current (A)	Steady-state current (A)	Opening time (max.) (ms)
AVR-1C	AC100	AC70–110	0.48	0.32	40
	AC110	AC77–121	0.39	0.26	
	AC120	AC84–132	0.37	0.24	
	AC200	AC140–220	0.24	0.16	
	AC220	AC154–242	0.19	0.13	
	AC240	AC168–264	0.18	0.12	
	DC24	DC16.8–26.4	1.65	1.1	
	DC48	DC33.6–52.8	0.86	0.57	
	DC100	DC70–110	0.39	0.26	
	DC110	DC77–121	0.37	0.25	
	DC125	DC87.5–137.5	0.31	0.21	
	DC200	DC140–220	0.19	0.13	
	DC220	DC154–242	0.18	0.12	

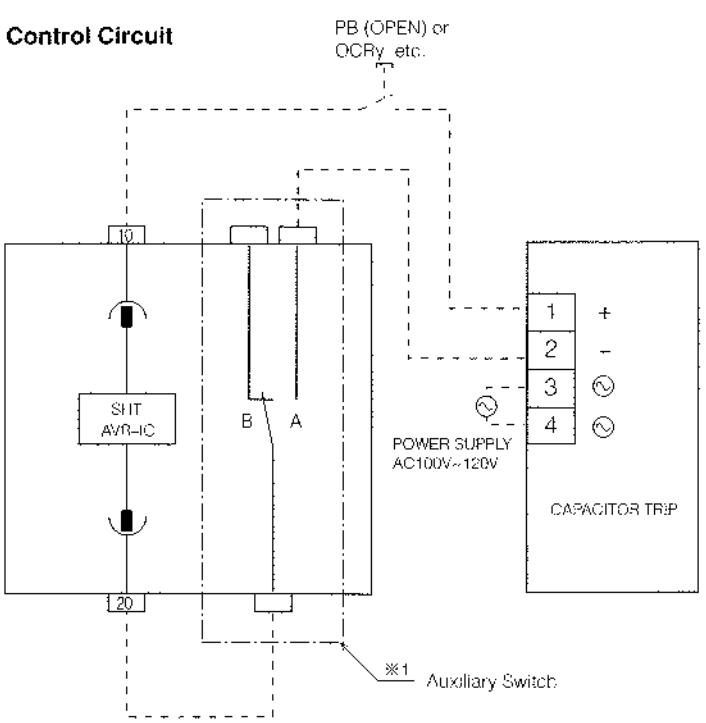
Capacitor trip device

In conjunction with the continuously-rated shunt trip device, the capacitor trip device can be used to trip the ACB within a limited period of 30 sec if large voltage drop occurs due to an ac power failure or short-circuit.

When the continuously-rated shunt trip device is used with capacitor trip device, "a" contact of auxiliary switch of ACB should be inserted in series, otherwise, the internal damage may occur.

Type	AQR-1
Rated Voltage	AC100-120V
Operational Voltage	Rated Voltage X 70 to 110%
Rated frequecy	50/60Hz
Rated Voltage of Shunt Trip Used	DC48V
Power Consumption	100VA

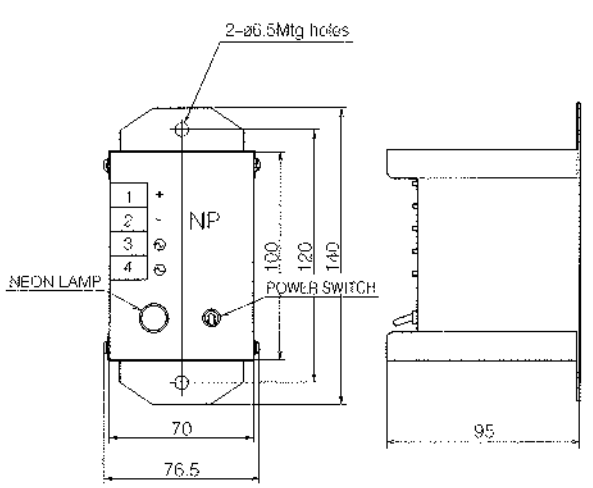
• Control Circuit



- - - - - - - - User Wiring

※1: Use Auxiliary Switch for capacitor trip

• Outline Dimensions



4 Specifications

Fixed type Undervoltage Trip (UVT) (With AGR-11 or Without OCR)

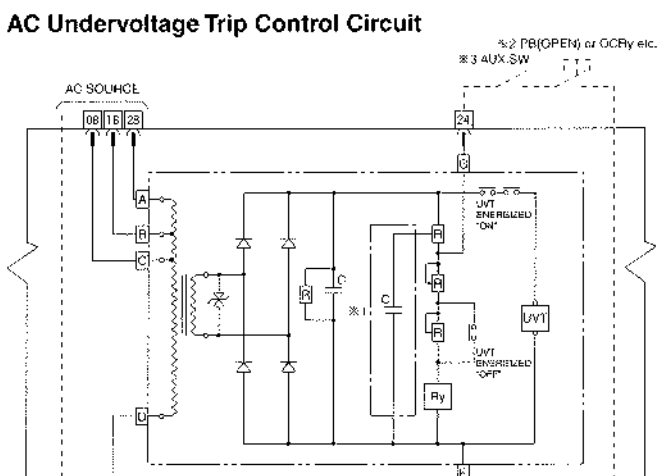
The undervoltage trip (UVT) automatically trips the ACB when the control power voltage drops below a pre-determined value. When the control voltage is restored to a value equal to or greater than the pick-up value, the ACB can be closed.

The UVT consists of a trip control device and a tripping mechanism.

Two types of UVT are available. AUR-1BS (instantaneous trip type) and AUR-1BD (500ms time delay type).

Remote opening of the circuit breaker by the UVT is possible by connection of a normally open push button across terminals 24 and 30.

AC Undervoltage Trip Control Circuit



※1 For AUR-1BD only
※2 For tripping command apply minimum 50ms
※3 "a" contact of auxiliary switch of ACB to be used.

• Rating

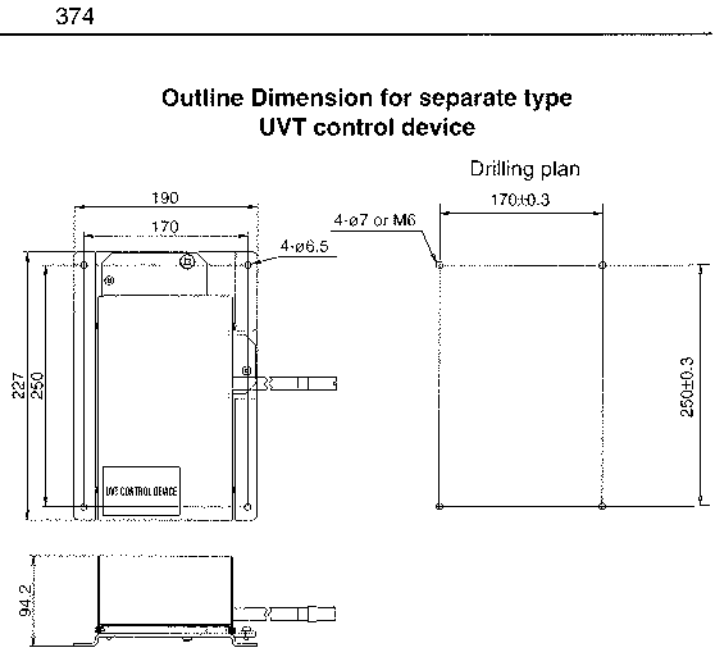
Type of UVT Control Device	Rated Control Voltage (V), 50/60Hz		Opening Voltage (V)	Pick-up Voltage (V)	Coil Excitation Current (A)	Power Consumption (VA)	
						Normal	Reset
AUR-1BS	AC	100	35 – 70	85			
AUR-1BD		110	38.5 – 77	93.5			
		120	42 – 84	102			
		200	70 – 140	170			
		220	77 – 154	187	0.3	30	50
		240	84 – 168	204			
		380	133 – 266	323			
		415	145 – 290	352			
		440	154 – 308	374			

※24V DC UVT also available as special specification.

UVT control device can be installed separate from the ACB body.

2 m lead wire is provided to connect the UVT control device with the ACB.

Outline Dimension for separate type UVT control device



6 Over-current Releases (OCRs)

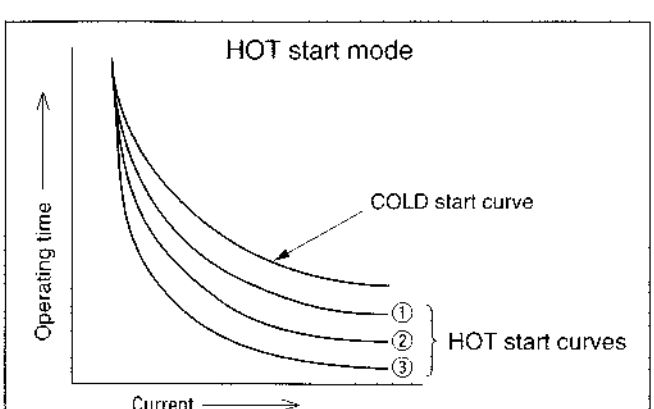
The AGR series of over-current releases (OCRs) featuring high reliability and multiple protection capabilities is available for *TemPower2*.
Controlled by an internal 8-bit microprocessor, the OCR provides reliable protection against overcurrent.
The OCR range is divided into three groups: L-characteristic, R-characteristic (both for general feeder) and S-characteristic (for generator protection).
Each group consists of,:
Type AGR-11: Standard OCR with adjustment dial
Type AGR-21: Enhanced OCR with adjustment dial
Type AGR-22: Enhanced OCR with L.C.D. display
Optional protection functions of the OCR include those against ground fault, earth leakage, undervoltage and reverse power.
Pre-trip alarm function can also be installed.

Protective functions

①Adjustable long time-delay trip function LT

RMS sensing is used to accurately read through distorted waveforms.
In addition to the standard L and S-characteristics, the R-characteristic is available in five types for long time-delay trip.
The R-characteristic can be used to give selectivity with e.g., fuses. (See P. 8).

■ HOT start mode (applicable to L-characteristic)
HOT or COLD start mode is user-selectable.
In HOT start mode, the OCR operates faster than in COLD start mode in response to an overload. The HOT start mode gives protection, taking account of the behavior of loads under heat stress.

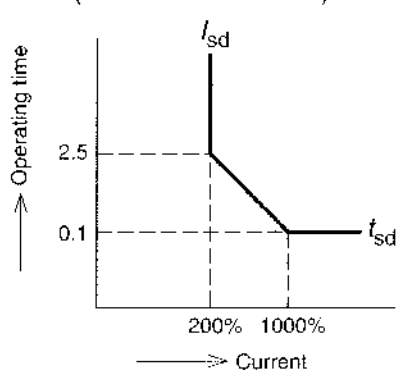


①When the OCR is set to start operation at 50% of the rated current, its operating time in HOT start mode is approx. 80% of that in COLD start mode.
②When the OCR is set to start operation at 75% of the rated current, its operating time in HOT start mode is approx. 60% of that in COLD start mode.
③When the OCR is set to start operation at 100% of the rated current, its operating time in HOT start mode is approx. 20% of that in COLD start mode.

②Adjustable short time-delay trip function ST

The ST delay trip function has a "definite time delay characteristic" and a "ramp characteristic". These characteristics are switch-selectable.
The ramp characteristic provides close selectivity with downstream circuit breakers or fuses.
The group AGR-21L and AGR-21R OCRs come in operation with the definite time characteristic when the load current reaches 1000% or more of the rated current [I_n] (500% or more of the rated current [I_n] for AGR-21S).
The ST trip function is factory set to the definite time characteristic.

Ramp characteristic curve
("L" or "R" characteristic)



③Adjustable instantaneous trip function INST/MCR

The INST trip function trips the ACB when the short circuit current exceeds the pickup current setting, irrespective of the state of the ACB.
The making current release (MCR) trips the ACB when the short circuit current exceeds the pickup current setting during closing operation. After the ACB is closed, the MCR is locked and kept inoperative.
The INST and MCR are switch-selectable.
Note) The MCR needs the control power. If the control power is lost, the MCR provides the INST trip function only.

4 Specifications

④Adjustable pre-trip alarm function PTA

The pre-trip alarm function provides an alarm signal via the alarm contact (1a-contact) when the load current exceeding a predetermined value lasts for a predetermined time. A 2-channel pre-trip alarm function is available for S-characteristic. This function can be used to adjust feeding to loads according to their priority.
The pre-trip alarm is automatically reset when the load current drops to the predetermined value.
Note that this function needs the control power.

⑤Ground fault trip function GF

The peak value sensing is used (the residual current of each phase is detected).
The GF pickup current can be set between 10% and 100% of the CT rated primary current [I_{CT}].

<Ramp characteristic is added>
The ramp and definite time characteristics are switch selectable. The GF trip function comes into operation with the definite time characteristic when the load current reaches 100% or more of the CT rated primary current [I_{CT}].
The GF trip function is factory set to the definite time characteristic.

When using a 3-pole ACB in a 3-phase, 4-wire system, be sure to use an optional CT for neutral line (see P. 39).

Note 1: The GF trip function comes usually with operation indications (LED and contact output). If you need nothing but ground fault indication without a ground fault tripping operation, specify at the time of ordering.

⑥Earth leakage trip function ELT
(For AGR-21 and AGR-22 only.)

In conjunction with an external Zero phase Current Transformer (ZCT), the ELT function provides protection against earth leakage.
The ELT pickup current can be set at 0.2, 0.3, 0.5 and 1A (Medium sensitivity) or 3 and 5A (Low sensitivity).
This function needs the control power.

Note 1: For details on specifications of the external ZCT, contact Terasaki.

Note 2: The ELT function comes usually with operation indications (LED and contact output). If you need nothing but earth leakage indications without earth leakage tripping operation, specify at the time of ordering.

Note 3: The ELT function is available up to 3200A rated current [I_n]

⑦Reverse power trip function RPT
(For AGR-21 and AGR-22 only.)

The RPT function protects 3-phase generators running in parallel against reverse power. The RPT pickup current can be set in seven levels: 4% thru 10% of the generator rated power.
The applicable rated voltages are AC100 - 120V, AC200 - 240V, and AC380 - 460V.
The RPT function comes usually with operation indications (LED and contact output).

Note 1: CT for RPT is provided as standard when you specify RPT for AR2 and AR3 Draw-out type. However, CT for RPT for AR440S should be provided by you as TERASAKI do not supply.

Note 2: Applicable ACBs depend on the connection method of main terminals. For the details please contact TERASAKI.

⑧N-phase protection function NP

This NP function is available on 4-pole ACBs and prevents the neutral conductor from suffering damage or burnout due to overcurrent.
The NP trip pickup current can be set between 40% and 100% of the OCR rated primary current for L and R-characteristics or of the generator rated current for S-characteristic.
It is factory set to a value specified at the time of ordering.

Note 1: The NP trip function comes usually with operation indications (LED and contact output). The NP trip pickup current setting is shared by the LT trip function.

Note 2: The HOT start mode is available. The operating time for the NP trip function is linked to that for the LT trip function.

⑨Adjustable type undervoltage trip function UVT
(For AGR-21 and AGR-22 only.)

The applicable rated voltages are AC100 - 120V, AC200 - 240V, and AC380 - 460V.
The UVT function trips the ACB when the UVT control voltage drops to a value equal to 65% of the rated value.
The operating time can be set in ten levels: "instantaneous" thru 1 sec.
The ACB can be closed 2 sec. after the UVT control voltage has returned to the pick-up voltage.
Phase failure protection is available by connecting R,S and T-phase.

Note 1: The UVT control power is shared by the reverse power trip function (if fitted).
Note 2: The UVT function comes usually with operation indications (LED and contact output).
Note 3: The UVT function trips the ACB when any phase is lost in case 3 phases are detected.
Note 4: For the fixed type undervoltage trip device for AGR-11 or no OCR, See page 22.

⑩Contact temperature monitoring function HEAT
(For AGR-21 only.)

The HEAT function prevents the ACB from suffering damage due to overheat.
It monitors the temperature of the ACB main contacts, and gives an alarm via an LED indicator and an output signal via the alarm contact (1a-contact) when the temperature exceeds 155°C.
The alarm can be manually reset when the temperature drops to a normal temperature.
If you want to set the threshold temperature to a lower value, contact Terasaki.
This function needs the control power.

NON setting and fail-safe feature

1 NON setting

Setting a trip pickup current setting dial to the NON position allows you to render the corresponding protection function inoperative.
Dials having the NON position include LT, ST, INST/MCR, and GF.
Appropriate NON setting will be a useful means for optimum selectivity.

2 Fail-safe feature

The OCR has a fail-safe mechanism in case setting dials are improperly set to the NON position.

- If the ST and INST trip pickup current setting dials are both set to NON, the fail-safe mechanism will activate the INST trip function to trip the ACB when a fault current equal to or more than 16 times the rated current [I_n] flows through the ACB.
- If the ST and MCR trip pickup current setting dials are both set to NON, the fail safe mechanism will activate the ST delay trip function to trip the ACB when a fault current equal to or more than 10 times (5 times for generator protection) the rated current [I_n] flows through the ACB.

4 Specifications

Field test facility

The field test facility allows simple field testing on the LT, ST and INST trip functions.
This facility needs control power.

Operation indication function

1 Indication via single contact

When the LT, ST, INST/MCR, or GF trip function is activated, an output is generated via 1a-contact.
The 1a-contact will turn off after 40 ms or more.
A self-hold circuit is needed.

Contact ratings for operation indications (for AGR-11, 21, 22)

Voltage (V)		Current (A)			
		1 Single contact		2 Individual contacts	
		Resistive load	Inductive load	Resistive load	Inductive load
AC	250	8	3	0.5	0.2
DC	250	0.3	0.15	0.27	0.04
	125	0.5	0.25	0.5	0.2
	30	5	3	2	0.7

2 Indication via individual contacts and LED indicators

When the LT trip, ST trip, INST/MCR trip, GF trip, ELT, RPT, UVT, pre-trip alarm, or contact temperature overheat alarm function is activated, the corresponding LED indicator turns on and output is generated via the corresponding contact.
The OCR also has a self-diagnostic feature that monitors the internal tripping circuits and electronic circuits. If detecting any fault in these circuits, this feature turns on the system alarm LED indicator. The control power is needed.

Operation indications
○: Self-hold (Note 1)
×: Auto-reset
—: Not applicable

Protection characteristic	L/R-characteristic		S-characteristic	
Function	LED	Contact	LED	Contact
LT • NP	○	○	○	× (Note 2)
ST	○	○	○	× (Note 2)
INST/MCR	○		○	
GF or ELT	○	○	—	—
UVT or Trip indicator	○	○	○	× (Note 2)(UVT) ○ (Trip ind.)
RPT	—	—	○	× (Note 2)
PTA	×	×	×	×
PTA2 or spring charge indicator	×	×	×	×
Contact temperature monitoring	○	○	○	○
System alarm	○	○	○	○

Note 1: To reset indicators for AGR-11, press the reset button or disconnect the control supply. To reset indicators for AGR-21 and 22, press the reset button or bridge operation circuit terminals 12 and 23.
The ACB can be closed without reset of the indicators.
Note 2: The contact will turn off after 500 ms or more. A self-hold circuit is needed.

3 Contact ratings of Trip indicator for use with AGR-11 or without OCR

Voltage (V)		Switch contact ratings (A)	
		Resistive load	Inductive load
AC	250	6	3
DC	250	0.1	0.1
	125	0.5	0.5
	30	3	3

OCR with L.C.D. display, type AGR-22 (Contact TERASAKI for details)

1 Monitoring various data on L.C.D.

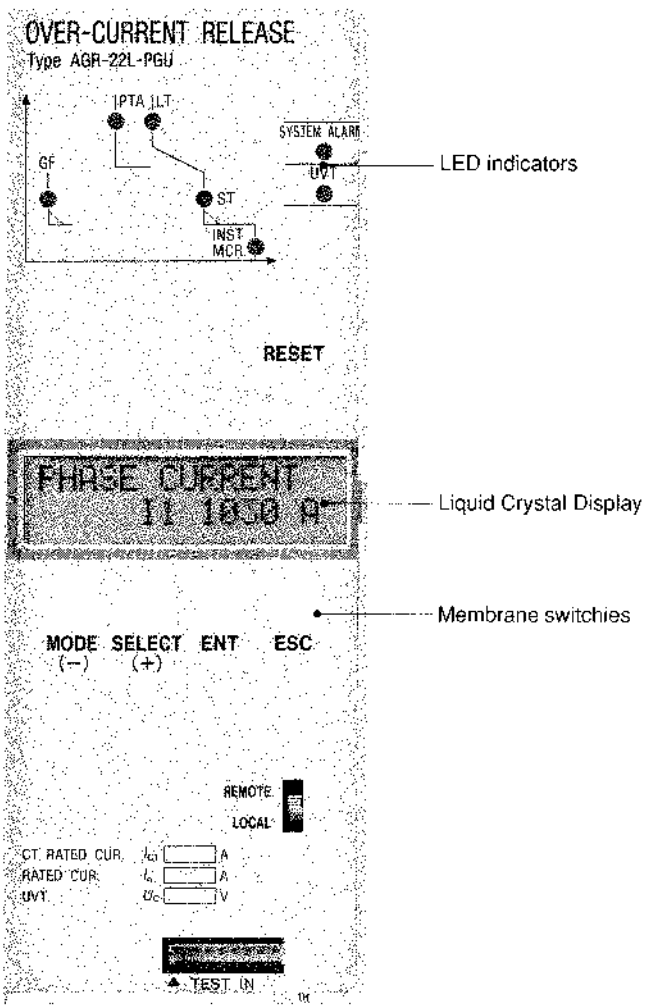
OCR can monitor,

- Phase current (A) of I1, I2, I3, I_N, I_G and their max. peak current
- Line voltage (V) of V12, V23, V31 and their max. peak voltage (or, Phase voltage (V) of V1N, V2N, V3N and their peak voltage)
- Active power max. (kW)
- Reactive power max. (kVar)
- Power factor (cos ø)
- Electric energy (MWh)
- Frequency
- Trip history

Fault current is monitored, and the operation cause is indicated via individual contacts and LED indicators.

2 Gives the system alarm with LED indication and output contact for the following abnormal function.

- Abnormal analog circuit
- UVT reset fail
- Trip function fail
- MHT circuit break
- Abnormal closing time
- Abnormal opening time
- Abnormal charging time



4 Specifications

OCR Specifications

Protection characteristic		Over-current release (OCR) Type	Protection function						
			Long time-delay LT	Short time-delay ST	Instantaneous or Making current release INST/MCR	Pre-trip alarm: 1-channel pre-trip alarm (PTA)	Pre-trip alarm: 2-channel pre-trip alarm (PTA + PTA2) (Note 2)	Ground fault GF①	
Dial adjustment type	For general feeder circuits	AGR-11L-AL		●		—	—	—	
		AGR-11L-GL		●		—	—	●(Note3)	
		AGR-11L-PS		●		●	—	—	
		AGR-11L-PG		●		●	—	●	
		AGR-21L-PS		●		●	—	—	
		AGR-21L-PG		●		●	—	●	
		AGR-21L-PGU ③		●		●	—	●	
		AGR-21L-PE-L ⑧		●		●	—	—	
		AGR-21L-PE-M ⑧		●		●	—	—	
		AGR-11R-AL		●		—	—	—	
		AGR-11R-GL		●		—	—	●(Note3)	
		AGR-11R-PS		●		●	—	—	
		AGR-11R-PG		●		●	—	●	
		AGR-21R-PGU ③		●		●	—	●	
	For generator protection	AGR-11S-AL		●		—	—	—	
		AGR-11S-PS		●		●	—	—	
		AGR-21S-PSU ③		●		●	—	—	
		AGR-21S-PRU ③		●		●	—	—	
		AGR-21S-TRU ③		●		—	●	—	
L.C.D. display type ⑧	For general feeder circuits	AGR-22L-PS ③		●		●	—	—	
		AGR-22L-PG ③		●		●	—	●	
		AGR-22L-PGU ③		●		●	—	●	
		AGR-22L-PE-L ③		●		●	—	—	
		AGR-22L-PE-M ③		●		●	—	—	
		AGR-22R-PS ③		●		●	—	—	
		AGR-22R-PG ③		●		●	—	●	
		AGR-22R-PGU ③		●		●	—	●	
	For generator protection	AGR-22S-PS ③		●		●	—	—	
		AGR-22S-PSU ③		●		●	—	—	
		AGR-22S-PRU ③		●		●	—	—	
		AGR-22S-TRU ③		●		—	●	—	

● : Available as standard
○ : Available as option
— : Not available

① : Not available if CT rated primary current [I_{CT}] is 200A or less.
② : Available up to 3,200A rated current [I_n].
③ : For over AC 460V, a step down PT is required.
④ : 3–5A Adjustable pick-up current (Low sensitivity).
⑤ : 0.2–0.3–0.5–1A Adjustable pick-up current (Medium sensitivity).
⑥ : Fixed type UVT with UVT controller can be selected as option. See P. 22.
⑦ : Trip indicator can be selected as option in place of UVT indication.
⑧ : Contact TERASAKI for details.

Note1: When a protection function of OCRs with single-contact indication is activated, the corresponding operation LED indicator is ON momentarily or OFF.
But the LED indicator is kept ON when the protection function is checked with the optional OCR checker.

Note2: The use of the optional 2-channel pre-trip alarm function may cause the OCR to be subject to some functional constraints. Contact Terasaki for details.

Note3: If the CT rated primary current [I_{CT}] is less than 800A and the GF pick-up current is set to 10 %, control power is required, and specify the control voltage at the time of ordering.

Earth Leakage ELT②	Reverse power RPT	Adjustable type Under voltage UVT	Operation indication: Single contact and LED indicators	Operation indication: Individual contacts and LED indicators	Operation indication: Spring charge indicator	Operation indication: Trip indicator	Field test	Control power
—	—	⑥	●(Note1)	—	○	○	—	Not required
—	—	⑥	●(Note1)	—	○	○	—	Not required
—	—	⑥	—	●	○	○	●	Required
—	—	⑥	—	●	○	○	●	Required
—	—	—	—	●	●	●	●	Required
—	—	—	—	●	●	●	●	Required
—	—	●	—	●	●	—⑦	●	Required
●④	—	—	—	●	●	●	●	Required
●⑤	—	—	—	●	●	●	●	Required
—	—	⑥	●(Note1)	—	○	○	—	Not required
—	—	⑥	●(Note1)	—	○	○	—	Not required
—	—	⑥	—	●	○	○	●	Required
—	—	⑥	—	●	○	○	●	Required
—	—	●	—	●	●	—⑦	●	Required
—	—	⑥	●(Note1)	—	○	○	—	Not required
—	—	⑥	—	●	○	○	●	Required
—	—	●	—	●	●	—⑦	●	Required
—	●	●	—	●	●	—⑦	●	Required
—	●	●	—	●	—	—⑦	●	Required
—	—	—	—	●	●	●	●	Required
—	—	—	—	●	●	●	●	Required
—	—	●	—	●	●	—⑦	●	Required
●④	—	—	—	●	●	●	●	Required
●⑤	—	—	—	●	●	●	●	Required
—	—	—	—	●	●	●	●	Required
—	—	—	—	●	●	●	●	Required
—	—	●	—	●	●	—⑦	●	Required
—	—	—	—	●	●	●	●	Required
—	—	●	—	●	●	—⑦	●	Required
—	●	●	—	●	●	—⑦	●	Required
—	●	●	—	●	—	—⑦	●	Required

If the control power is not supplied or is lost, each function operates as follows:

LT, ST, INST, RPT, UVT		Operates normally.
GF		Operates normally When the CT rated primary current [I_{CT}] is less than 800 A and the GF pick-up current is set to 10 %, the GF becomes inoperative.
MCR		Operates as INST.
PTA	1-channel PTA 2-channel PTA	Is inoperative.
ELT		Is inoperative.
LED indicator on OCRs with single-contact indication		Is on momentarily or off.
Contact output from OCRs with single-contact indication		Turns off after 40 ms or more.
LED indicator on OCRs with individual-contact indication		Is kept off.
Contact output from OCRs with individual contact indication		Is inoperative.
Spring charge indicator		Is inoperative. (For AGR-21,22)
Field test facility		Is inoperative.

4 Specifications

Optional functions

Protection characteristic		Over-current release (OCR) Type	Protection function		
			N-phase protection	Contact temperature monitoring	
		Note 4	N	O	
Dial adjustment type	For general feeder circuits	AGR-11L-AL	○	—	
		AGR-11L-GL	○	—	
		AGR-11L-PS	○	—	
		AGR-11L-PG	○	—	
		AGR-21L-PS	○	○	
		AGR-21L-PG	○	○	
		AGR-21L-PGU	○	○	
		AGR-21L-PE-L	○	○	
		AGR-21L-PE-M	○	○	
		AGR-11R-AL	○	—	
		AGR-11R-GL	○	—	
		AGR-11R-PS	○	—	
		AGR-11R-PG	○	—	
		AGR-21R-PGU	○	○	
	For generator protection	AGR-11S-AL	—	—	
		AGR-11S-PS	—	—	
		AGR-21S-PSU	—	○	
		AGR-21S-PRU	—	○	
		AGR-21S-TRU	—	○	
L.C.D. display type	For general feeder circuits	AGR-22L-PS	○	—	
		AGR-22L-PG	○	—	
		AGR-22L-PGU	○	—	
		AGR-22L-PE-L	○	—	
		AGR-22L-PE-M	○	—	
		AGR-22R-PS	○	—	
		AGR-22R-PG	○	—	
		AGR-22R-PGU	○	—	
	For generator protection	AGR-22S-PS	—	—	
		AGR-22S-PSU	—	—	
		AGR-22S-PRU	—	—	
		AGR-22S-TRU	—	—	

○ : Available as option

— : Not available

⑧ : Contact TERASAKI for details.

⑨ : Communication function can not be applied together with Operation panel.

Note4: When optional functions are required please specify the OCR type designation by adding one or more of the abbreviated letters at the end of the code.

Ex. AGR-21L-PSNO

- N: N-phase protection
- O: Contact temperature monitoring

Fixed type Under Voltage Trip	Operation indication	
	Operation panel	Communication ⑧ ⑨
	P	C
○	—	—
○	—	—
○	—	—
○	—	—
—	—	—
—	○	○
—	○	○
—	○	○
—	○	○
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—	—	○
—	—	○

4 Specifications

L-characteristic for general feeder circuits (Type AGR-11L, 21L, 22L)

Setting range of protection functions

Protection functions	Setting range
■ Adjustable long time-delay trip characteristics LT	
Pick-up current [I_R] (A)	[I_n]×(0.8 – 0.85 – 0.9 – 0.95 – 1.0 – NON) ; 6 graduations • Non tripping when load current ≦ ([I_R]×1.05). • Tripping when ([I_R]×1.05) < load current ≦ ([I_R]×1.2)
Time-delay [t_R] (s)	(0.5 – 1.25 – 2.5 – 5 – 10 – 15 – 20 – 25 – 30) at 600% of [I_R]; 9 graduations
Time-delay setting tolerance (%)	±15% +150ms – 0ms
■ Adjustable short time-delay trip characteristics ST	
Pick-up current [I_{sd}] (A)	[I_n]×(1 – 1.5 – 2 – 2.5 – 3 – 4 – 6 – 8 – 10 – NON) ; 10 graduations
Current setting tolerance (%)	±15%
Time-delay [t_{sd}] (ms) Relay time	50 / 100 / 200 / 400 / 600 / 800 ; 6 graduations
Resettable time (ms)	25 / 75 / 175 / 375 / 575 / 775
Max. total clearing time (ms)	120 / 170 / 270 / 470 / 670 / 870
■ Adjustable instantaneous trip characteristics INST or MCR	
Pick-up current [I_i] (A)	[I_n]×(2 – 4 – 6 – 8 – 10 – 12 – 14 – 16 – NON) ; 9 graduations
Current setting tolerance (%)	±20%
■ Adjustable pre-trip alarm characteristics PTA	
Pick-up current [I_{P1}] (A)	[I_n]×(0.75 – 0.8 – 0.85 – 0.9 – 0.95 – 1.0) ; 6 graduations
Current setting tolerance (%)	±7.5%
Time-delay [t_{P1}] (s)	(5 – 10 – 15 – 20 – 40 – 60 – 80 – 120 – 160 – 200) at [I_{P1}] or more; 10 graduations
Time-delay setting tolerance (%)	±15% +100ms – 0ms
■ Adjustable ground fault trip characteristics GF	Note: Set [I_g] to 1200A or less.
Pick-up current [I_g] (A)	[I_{CT}]×(0.1 – 0.2 – 0.3 – 0.4 – 0.6 – 0.8 – 1.0 – NON) ; 8 graduations
Current setting tolerance (%)	±20%
Time-delay [t_g] (ms) Relay time	100 / 200 / 300 / 500 / 1000 / 2000 ; 6 graduations
Resettable time (ms)	75 / 175 / 275 / 475 / 975 / 1975
Max. total clearing time (ms)	170 / 270 / 370 / 570 / 1070 / 2070
■ N-phase protection characteristics NP	
Pick-up current [I_N] (A)	[I_{CT}]×(0.4 – 0.5 – 0.63 – 0.8 – 1.0) ; Factory set to a user-specified value. • Non tripping when load current ≦ ([I_N]×1.05). • Tripping when ([I_N]×1.05) < load current ≦ ([I_N]×1.2)
Time-delay [t_N] (s)	Tripping at 600% of [I_N] with LT time-delay [t_R]
Current setting tolerance (%)	±15% +150ms – 0ms
■ Adjustable earth leakage trip characteristics ELT (AGR-21,22 only)	
Pick-up current [$I_{\Delta R}$] (A)	0.2 – 0.3 – 0.5 – 1 (Medium sensitivity) or 3 – 5 (Low sensitivity)
Current setting tolerance	Non operate below 50% of [$I_{\Delta R}$], Operate between 50% and 100% of [$I_{\Delta R}$].
Time-delay [$t_{\Delta R}$] (ms) Relay time	100 / 200 / 300 / 500 / 1000 / 2000 ; 6 graduations
Resettable time (ms)	50 / 150 / 250 / 450 / 950 / 1950
Max. total clearing time (ms)	250 / 350 / 450 / 600 / 1150 / 2150
■ Undervoltage trip characteristics UVT (AGR-21,22 only)	
Pick-up voltage (V)	UVT rated supply voltage [U_c]×(0.8 – 0.85 – 0.9 – 0.95) ; 4 graduations
Time-delay [time] (s)	0 – 0.1 – 0.2 – 0.3 – 0.4 – 0.5 – 0.6 – 0.7 – 0.8 – 1.0 ; 10 graduations
■ Control power	AC100 – 120V / AC200 – 240V Common ; DC100 – 125V / DC200 – 250V Common ; DC24V / DC48V Common
	Power consumption: 5 VA

__ : Default setting

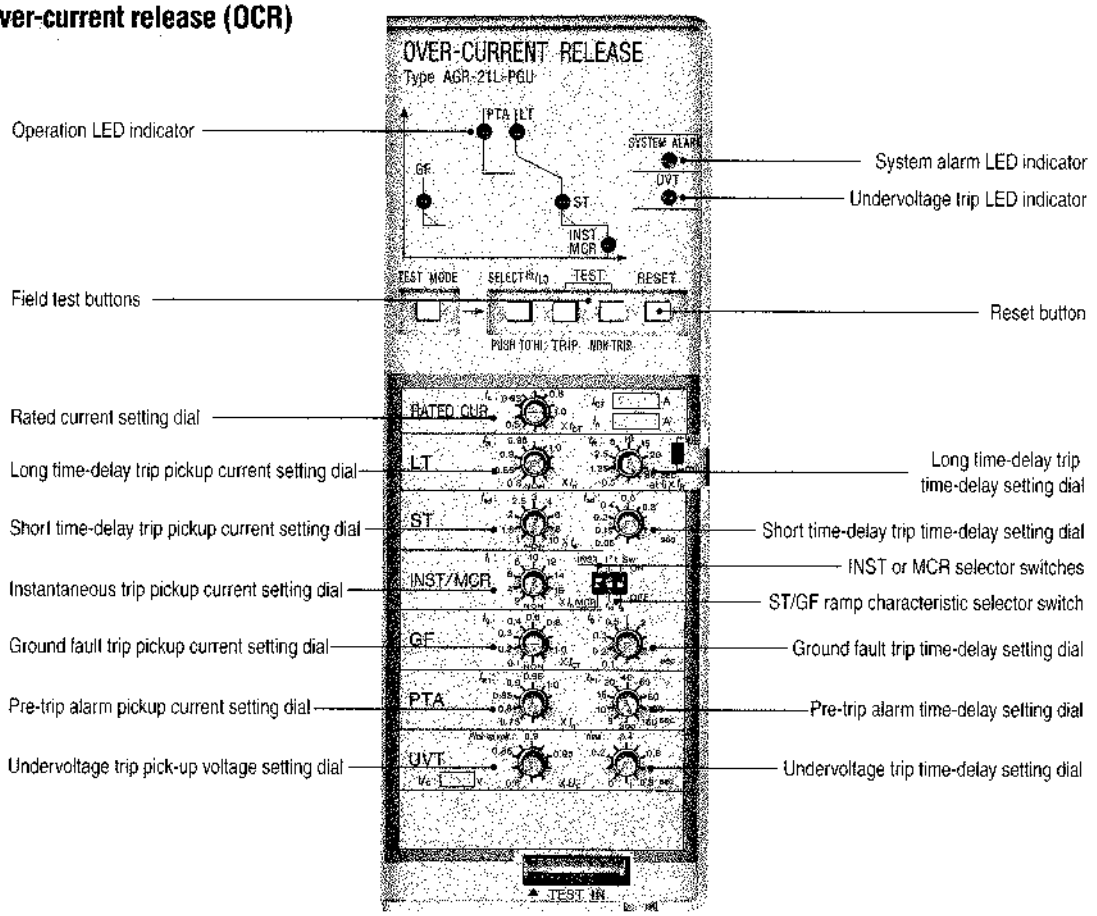
■ Values of [I_{CT}] and [I_n]

Type	Applicable [I_{CT}] (A)	Rated current [I_n](A) [I_{CT}]×0.5	[I_{CT}]×0.63	[I_{CT}]×0.8	[I_{CT}]×1.0
AR208S	**200**	100	125	160	200
	400	200	250	320	400
	800	400	500	630	800
AR212S	**400**	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
AR216S	**400**	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
	1600	800	1000	1250	1600

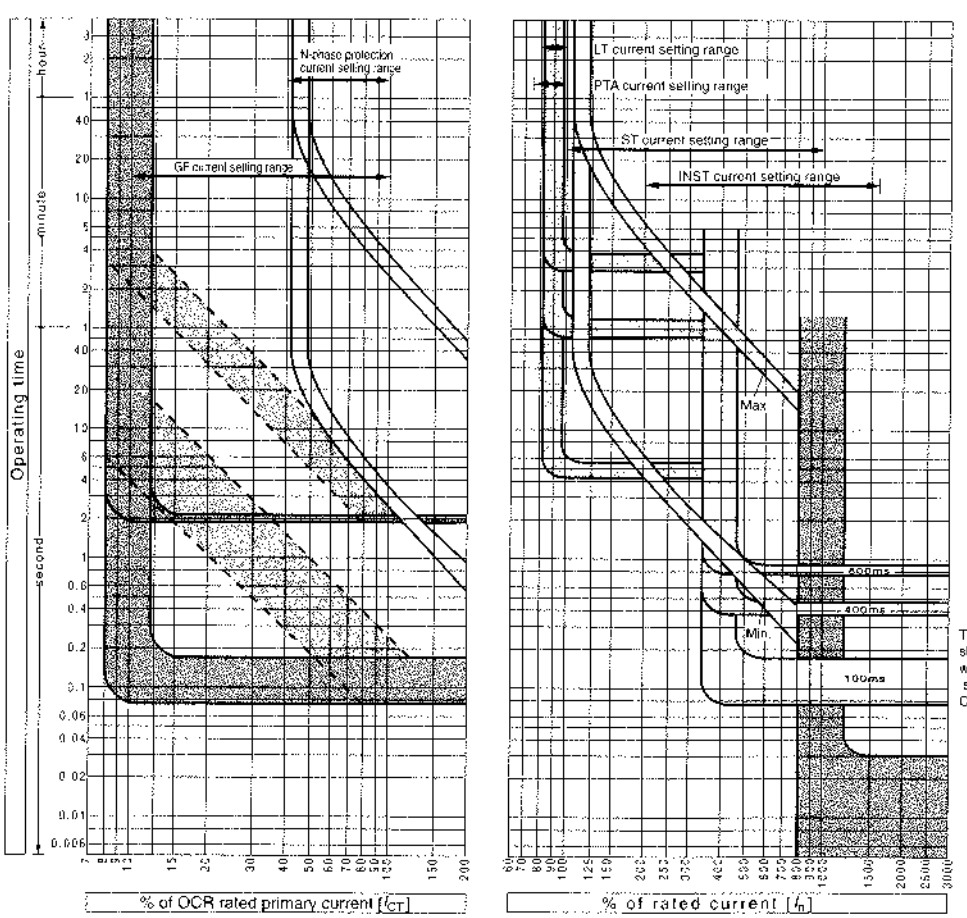
Type	Applicable [I_{CT}] (A)	Rated current [I_n](A) [I_{CT}]×0.5	[I_{CT}]×0.63	[I_{CT}]×0.8	[I_{CT}]×1.0
AR220S	**400**	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
	1600	800	1000	1250	1600
	2000	1000	1250	1600	2000
AR325S	**2500**	1250	1600	2000	2500
AR332S	**3200**	1600	2000	2500	3200
AR440S	**4000**	2000	2500	3200	4000

Type	Applicable [I_{CT}] (A)	Rated current [I_n](A) [I_{CT}]×0.5	[I_{CT}]×0.63	[I_{CT}]×0.8	[I_{CT}]×1.0
AR212H	**200**	100	125	160	200
	400	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
AR216H	**1600**	800	1000	1250	1600
AR220H	**2000**	1000	1250	1600	2000
AR316H	**200**	100	125	160	200
	400	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
	1600	800	1000	1250	1600
AR320H	**2000**	1000	1250	1600	2000
AR325H	**2500**	1250	1600	2000	2500
AR332H	**3200**	1600	2000	2500	3200

Front face of over-current release (OCR)



Protection characteristics



The ST trip characteristic shown in the figure applies when the ramp characteristic select switch is in the OFF position.

4 Specifications

R-characteristic for general feeder circuits (Type AGR-11R, 21R, 22R)

Setting range of protection functions

Protection functions	Setting range
■ Adjustable long time-delay trip characteristics	Select one from among $I^{0.02}t$, It, I^2t, I^3t, and I^4t by selector switch.
LT	
Pick-up current [I_R] (A)	[I_n]×(0.8 – 0.85 – 0.9 – 0.95 – 1.0 – NON) ; 6 graduations
	• Non tripping when load current ≦ ([I_R]×1.05). • Tripping when ([I_R]×1.05) < load current ≦ ([I_R]×1.2)
Time-delay [t_R] (s)	(1 – 2 – 3 – 4 – 5 – 6 – 7 – 8 – 10 – 13) at 300% of [I_R]; 10 graduations
Time-delay setting tolerance (%)	±20% +150ms – 0ms
■ Adjustable short time-delay trip characteristics	
ST	
Pick-up current [I_{sd}] (A)	[I_n]×(1 – 1.5 – 2 – 2.5 – 3 – 4 – 6 – 8 – 10 – NON) ; 10 graduations
Current setting tolerance (%)	±15%
Time-delay [t_{sd}] (ms) Relay time	[50] [100] [200] [400] [600] [800] ; 6 graduations
Resettable time (ms)	25 75 175 375 575 775
Max. total clearing time (ms)	120 170 270 470 670 870
■ Adjustable instantaneous trip characteristics	
INST or MCR	
Pick-up current [I_i] (A)	[I_n]×(2 – 4 – 6 – 8 – 10 – 12 – 14 – 16 – NON) ; 9 graduations
Current setting tolerance (%)	±20%
■ Adjustable pre-trip alarm characteristics	
PTA	
Pick-up current [I_{P1}] (A)	[I_n]×(0.75 – 0.8 – 0.85 – 0.9 – 0.95 – 1.0) ; 6 graduations
Current setting tolerance (%)	±7.5%
Time-delay [I_{P1}] (s)	(5 – 10 – 15 – 20 – 40 – 60 – 80 – 120 – 160 – 200) at [I_{P1}] or more; 10 graduations
Time-delay setting tolerance (%)	±15% +100ms – 0ms
■ Adjustable ground fault trip characteristics	
GF	Note: Set [I_g] to 1200A or less.
Pick-up current [I_g] (A)	[I_{CT}]×(0.1 – 0.2 – 0.3 – 0.4 – 0.6 – 0.8 – 1.0 – NON) ; 8 graduations
Current setting tolerance (%)	±20%
Time-delay [I_g] (ms) Relay time	[100] [200] [300] [500] [1000] [2000] ; 6 graduations
Resettable time (ms)	75 175 275 475 975 1975
Max. total clearing time (ms)	170 270 370 570 1070 2070
■ N-phase protection characteristics	
NP	
Pick-up current [I_N] (A)	[I_{CT}]×(0.4 – 0.5 – 0.63 – 0.8 – 1.0) ; Factory set to a user-specified value.
	• Non tripping when load current ≦ ([I_N]×1.05). • Tripping when ([I_N]×1.05) < load current ≦ ([I_N]×1.2)
Time-delay [t_N] (s)	Tripping at 300% of [I_N] with [LT] time-delay [t_R]
Current setting tolerance (%)	±20% +150ms – 0ms
■ Undervoltage trip characteristics	
UVT (AGR-21,22 only)	
Pick-up voltage (V)	UVT rated supply voltage [U_c]×(0.8 – 0.85 – 0.9 – 0.95) ; 4 graduations
Time-delay [time] (s)	0 – 0.1 – 0.2 – 0.3 – 0.4 – 0.5 – 0.6 – 0.7 – 0.8 – 1.0 ; 10 graduations
■ Control power	AC100 – 120V / AC200 – 240V Common DC100 – 125V / DC200 – 250V Common DC24V / DC48V Common
	Power consumption: 5 VA

__ : Default setting

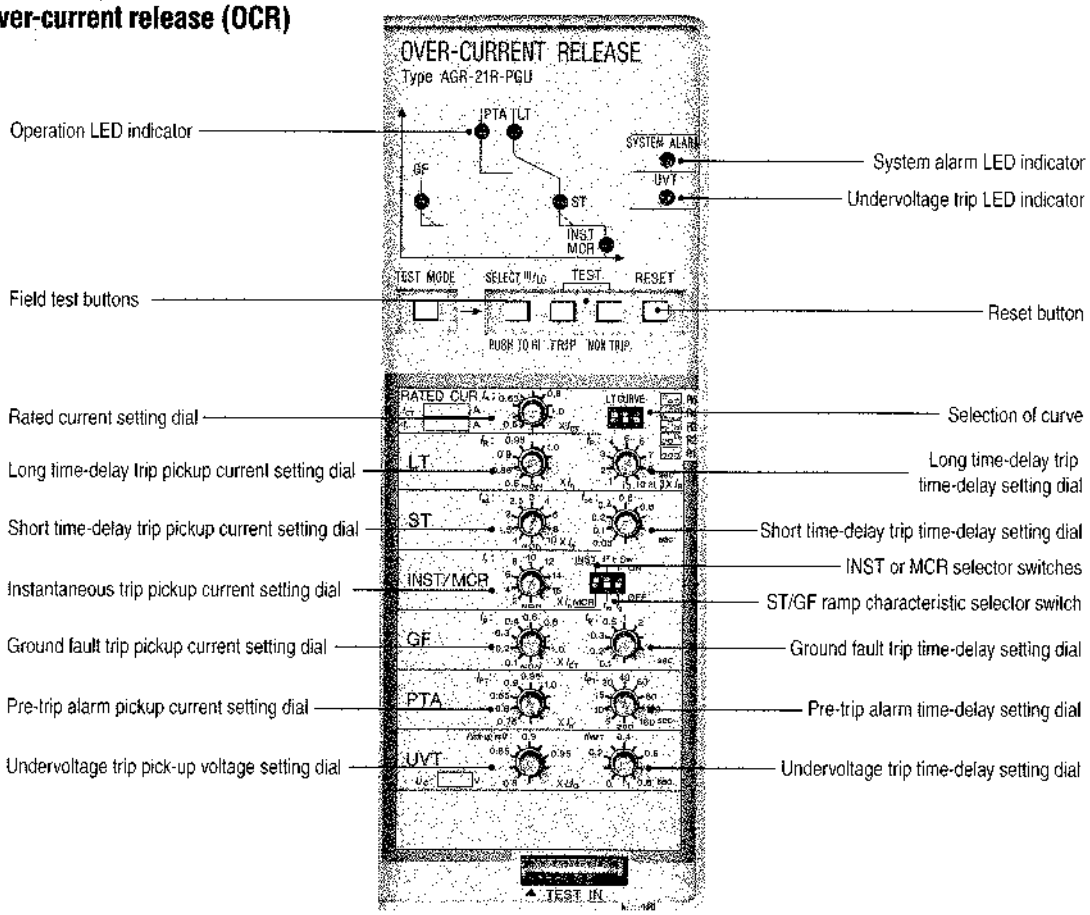
■ Values of [I_{CT}] and [I_n]

Type	Applicable [I_{CT}] (A)	Rated current [I_n](A) [I_{CT}] ×0.5	[I_{CT}] ×0.63	[I_{CT}] ×0.8	[I_{CT}] ×1.0
AR208S	**200**	100	125	160	200
	400	200	250	320	400
	800	400	500	630	800
AR212S	**400**	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
AR216S	**400**	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
	1600	800	1000	1250	1600

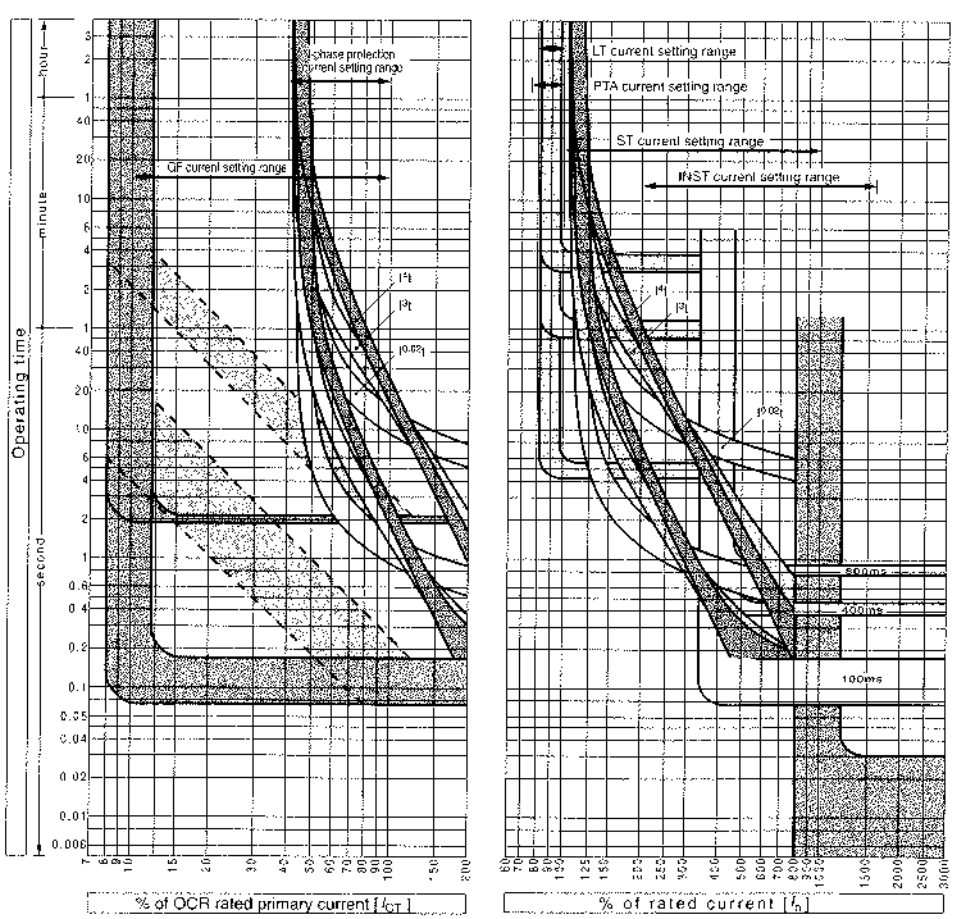
Type	Applicable [I_{CT}] (A)	Rated current [I_n](A) [I_{CT}] ×0.5	[I_{CT}] ×0.63	[I_{CT}] ×0.8	[I_{CT}] ×1.0
AR220S	**400**	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
	1600	800	1000	1250	1600
	2000	1000	1250	1600	2000
AR325S	**2500**	1250	1600	2000	2500
AR332S	**3200**	1600	2000	2500	3200
AR440S	**4000**	2000	2500	3200	4000

Type	Applicable [I_{CT}] (A)	Rated current [I_n](A) [I_{CT}] ×0.5	[I_{CT}] ×0.63	[I_{CT}] ×0.8	[I_{CT}] ×1.0
AR212H	**200**	100	125	160	200
	400	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
AR216H	**1600**	800	1000	1250	1600
AR220H	**2000**	1000	1250	1600	2000
AR316H	**200**	100	125	160	200
	400	200	250	320	400
	800	400	500	630	800
	1250	630	800	1000	1250
	1600	800	1000	1250	1600
AR320H	**2000**	1000	1250	1600	2000
AR325H	**2500**	1250	1600	2000	2500
AR332H	**3200**	1600	2000	2500	3200

Front face of over-current release (OCR)



Protection characteristics



The ST trip characteristic shown in the figure applies when the ramp characteristic select switch is in the OFF position.

4 Specifications

S-characteristic for generator protection (Type AGR-11S, 21S, 22S)

Setting range of protection functions

Protection functions	Setting range
■ Adjustable long time-delay trip characteristics	
LT	
Pick-up current [I_R] (A)	[I_n]×(0.8 – 1.0 – 1.05 – 1.1 – 1.15 – NON) ; 6 graduations
Current setting tolerance (%)	±5%
Time-delay [t_R] (s)	(15 – 20 – 25 – 30 – 40 – 50 – 60) at 120% of [I_R]; 7 graduations
Time-delay setting tolerance (%)	±15% +150ms – 0ms
■ Adjustable short time-delay trip characteristics	
ST	
Pick-up current [I_{sd}] (A)	[I_n]×(2 – 2.5 – 2.7 – 3 – 3.5 – 4 – 4.5 – 5 – NON) ; 9 graduations
Current setting tolerance (%)	±10%
Time-delay [t_{sd}] (ms) Relay time	100 / 200 / 300 / 400 / 600 / 800 ; 6 graduations
Resettable time (ms)	75 / 175 / 275 / 375 / 575 / 775
Max. total clearing time (ms)	170 / 270 / 370 / 470 / 670 / 870
■ Adjustable instantaneous trip characteristics	
INST or MCR	
Pick-up current [I_i] (A)	[I_n]×(2 – 4 – 6 – 8 – 10 – 12 – 14 – 16 – NON) ; 9 graduations
Current setting tolerance (%)	±20%
■ Adjustable pre-trip alarm characteristics	
PTA	
Pick-up current [I_{P1}] (A)	[I_n]×(0.75 – 0.8 – 0.85 – 0.9 – 0.95 – 1.0 – 1.05) ; 7 graduations
Current setting tolerance (%)	±5%
Time-delay [t_{P1}] (s)	(10 – 15 – 20 – 25 – 30) at 120% of [I_{P1}]; 5 graduations
Time-delay setting tolerance (%)	±15% +100ms – 0ms
PTA 2 (AGR-21,22 only)	
Pick-up current [I_{P2}] (A)	[I_n]×(0.75 – 0.8 – 0.85 – 0.9 – 0.95 – 1.0 – 1.05) ; 7 graduations
Current setting tolerance (%)	±5%
Time-delay [t_{P2}] (s)	1.5 [t_{P1}] at 120% of [I_{P2}]
Time-delay setting tolerance (%)	±15% +100ms – 0ms
■ Adjustable reverse power trip characteristics	
RPT (AGR-21,22 only)	
Pick-up power [P_R] (kW)	Rated power [P_n]×(0.04 – 0.05 – 0.06 – 0.07 – 0.08 – 0.09 – 0.1 – NON) ; 8 graduations
Power setting tolerance (%)	+0 – 20%
Time-delay [time] (s)	(2.5 – 5 – 7.5 – 10 – 12.5 – 15 – 17.5 – 20) at 100% of [P_R]; 8 graduations
Time-delay setting tolerance (%)	±20%
■ Undervoltage trip characteristics	
UVT (AGR-21,22 only)	
Pick-up voltage (V)	UVT and RPT rated supply voltage [U_c]×(0.8 – 0.85 – 0.9 – 0.95) ; 4 graduations
Time-delay [time] (s)	0 – 0.1 – 0.2 – 0.3 – 0.4 – 0.5 – 0.6 – 0.7 – 0.8 – 1.0 ; 10 graduations
■ Control power	AC100 – 120V / AC200 – 240V Common ; DC100 – 125V / DC200 – 250V Common ; DC24V / DC48V Common
	Power consumption: 5 VA

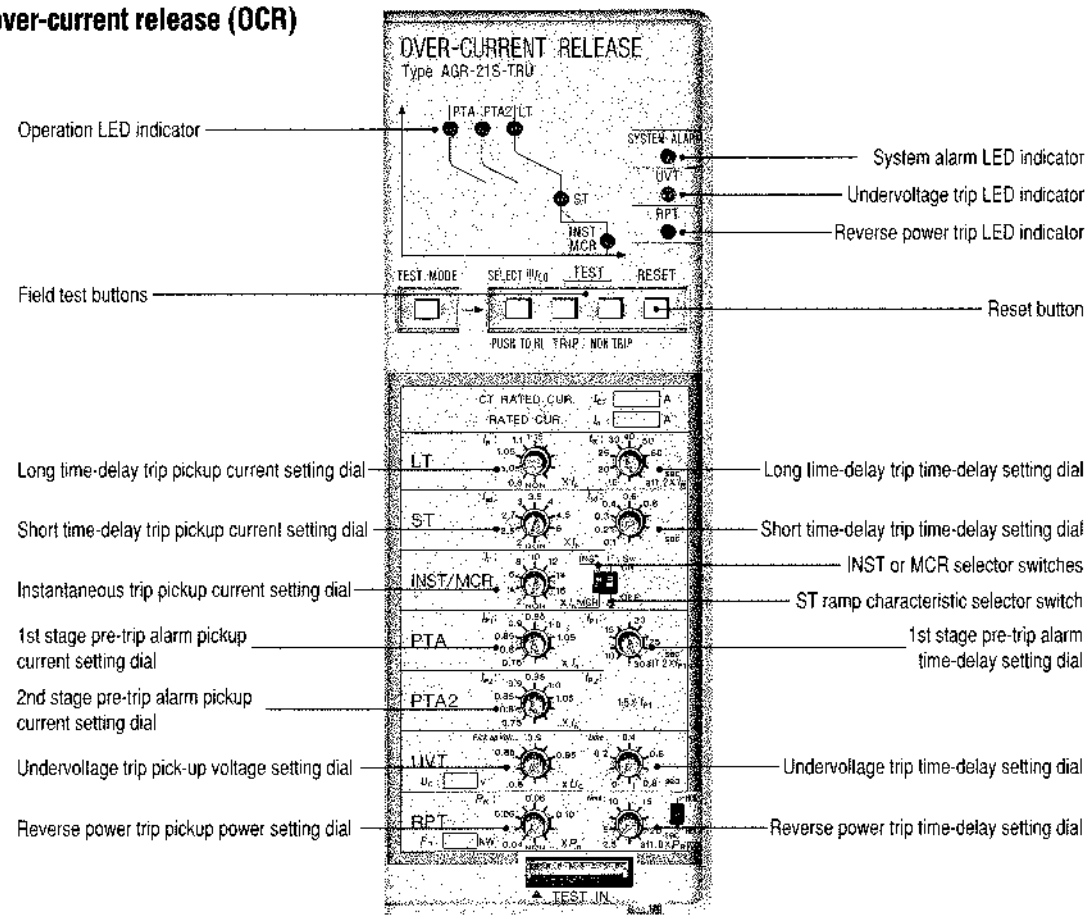
__ : Default setting

Applicable range of generator rated current [I_n]

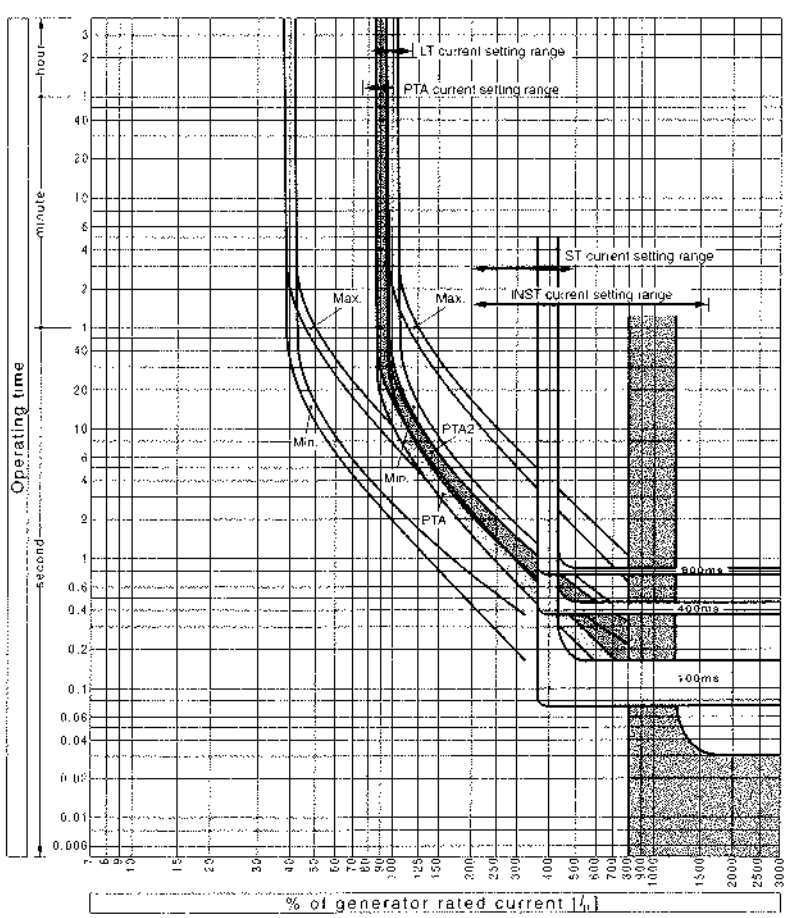
Type	OCR rated primary current [I_{CT}](A)	Applicable range of generator rated current [I_n] (A)
AR208S	200	100≦[I_n]≦200
	400	200<[I_n]≦400
	800	400<[I_n]≦800
AR212S	400	200≦[I_n]≦400
	800	400<[I_n]≦800
	1250	630<[I_n]≦1250
AR216S	400	200≦[I_n]≦400
	800	400<[I_n]≦800
	1250	630<[I_n]≦1250
	1600	800≦[I_n]≦1600
AR220S	400	200≦[I_n]≦400
	800	400<[I_n]≦800
	1250	630<[I_n]≦1250
	1600	800≦[I_n]≦1600
	2000	1250≦[I_n]≦2000
AR325S	2500	1250≦[I_n]≦2500
AR332S	3200	1600≦[I_n]≦3200
AR440S	4000	2000≦[I_n]≦4000

Type	OCR rated primary current [I_{CT}](A)	Applicable range of generator rated current [I_n] (A)
AR212H	200	100≦[I_n]≦200
	400	200<[I_n]≦400
	800	400<[I_n]≦800
	1250	630<[I_n]≦1250
AR216H	1600	800≦[I_n]≦1600
AR220H	2000	1000≦[I_n]≦2000
AR316H	200	100≦[I_n]≦200
	400	200<[I_n]≦400
	800	400<[I_n]≦800
	1250	630<[I_n]≦1250
	1600	800<[I_n]≦1600
AR320H	2000	1000≦[I_n]≦2000
AR325H	2500	1250≦[I_n]≦2500
AR332H	3200	1600≦[I_n]≦3200

Front face of over-current release (OCR)



Protection characteristics

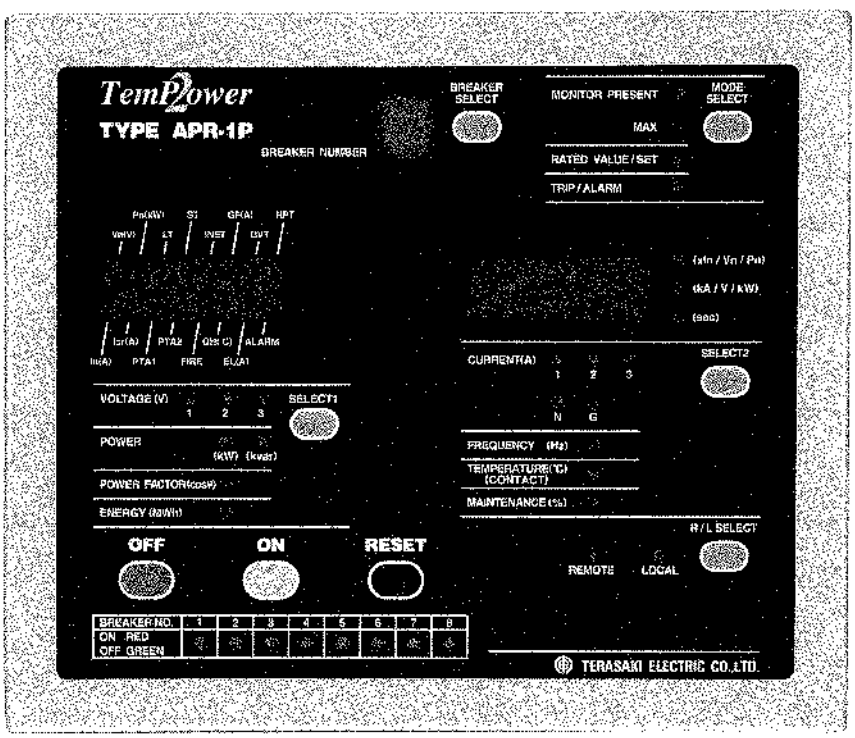


The ST trip characteristic shown in the figure applies when the ramp characteristic select switch is in the OFF position.

4 Specifications

7 Other Accessories

Operation panel, type APR-1P (For AGR-21 only)



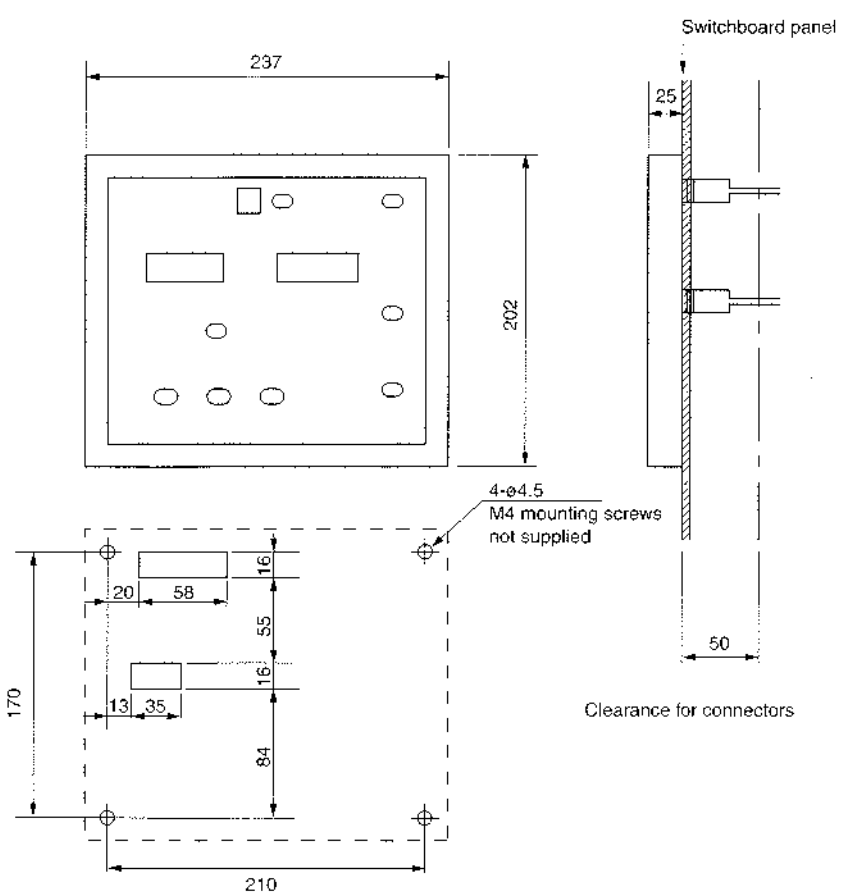
The operation panel, which is an integrated monitoring and control tool, has functions and capabilities of watt-hour meters, wattmeters, voltmeters, ammeters, switches, and indicators, allowing the operator to remotely monitor and control up to eight ACBs via serial communications.

Two large LED monitors on the panel can read two kinds of data simultaneously in real time.

The operation panel can be installed up to 50 m away from the ACBs.

Specifications and functions

- Power supply:
  DC12V (supplied from ACB)
- Dimensions (in mm):
  202 (H) × 237 (W) × 25 (D)
- Weight: 1.65 kg
- Operation:
  Selecting an ACB, turning it ON/OFF, resetting OCR indications, etc. are allowed from a remote site.
- Monitoring:
  Items monitored include the present or demand values of the following:
  Line voltage (V12, V23, V31)
  Active power (kW) and reactive power (kvar)
  Power factor
  Active electric energy (MWh)
  Phase current (I1, I2, I3, IN) and ground fault current (IG)
  Frequency
  ACB main contact temperature (°C)
  ACB main contact wear (%)
- Fault indication:
  Fault trip current
  System alarm



Panel cutout
(front view)

OCR checker, type ANU-1

The OCR checker allows easy checking of the long time-delay trip, short time-delay trip, instantaneous trip, ground fault trip functions and the pre-trip alarm function of the OCR in the field.



• Ratings and specifications

Power supply	• AC100–110V, 50/60Hz or AC100–240V, 50/60Hz with type C plug • 4×AA alkaline cells
Power consumption	7VA
Dimensions	101 (W) × 195 (H) × 44 (D) mm
Weight	400 g

Current transformer for neutral line (separate type)

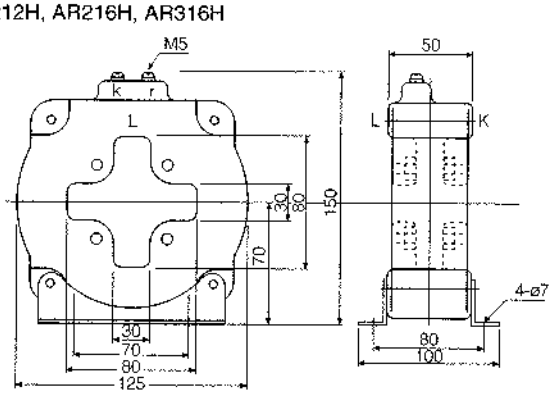
When using a 3-pole ACB with the ground fault protection function to protect a 3-phase, 4-wire system against ground fault, install an appropriate current transformer (CT) to the neutral line of the system.

TERASAKI can provide this neutral line CT as an option.

For the 4-pole ACB, a measuring CT instead of the neutral line CT is already built into the neutral phase of the ACB when the ground fault protection is fitted.

• Outline dimension of CT for neutral line

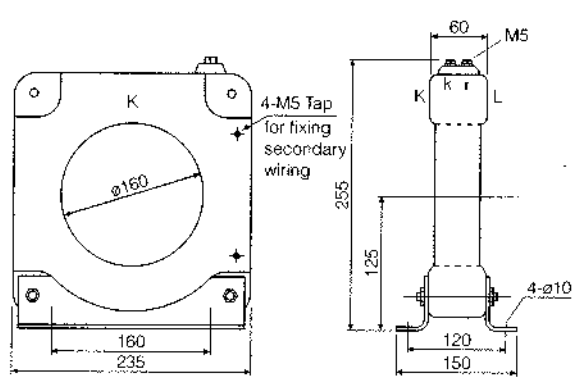
AR208S, AR212S, AR216S
AR212H, AR216H, AR316H



Type	CW80-40LS	
Rated Primary Current (A)	200	1250
	400	1600
	800	

Rated secondary current is 5A

AR220S, AR325S, AR332S, AR440S
AR220H, AR320H, AR325H, AR332H



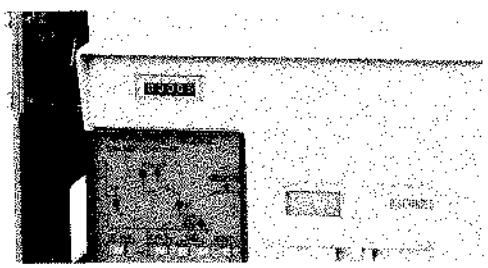
Type	EC160-40LS	
Rated Primary Current (A)	1600	3200
	2000	4000
	2500	

Rated secondary current is 5A

4 Specifications

ON-OFF cycle counter

The ON-OFF cycle counter is a mechanical 5-digit readout that shows the number of ON-OFF cycles of the ACB.
Counter readings serve as a guide for maintenance or inspection.



Auxiliary switches

The auxiliary switches operate during the ACB ON/OFF operation.
Connections to the switches are made via tab terminals. Screw terminal type is available as an option.
The auxiliary switches for draw-out type ACBs operate in the CONNECTED and TEST positions.
The auxiliary switches for ACBs conforming to classification society's rules operate in the CONNECTED position only.
The auxiliary switches have change-over contacts and are available for general service and for microload.

Type	For general service	For microload ※※
※AXR-004	4c	—
AXR-007	7c	—
AXR-304	4c	3c
AXR-010	10c	—
AXR-307	7c	3c

※The standard contact arrangement of the auxiliary switches is 4c. (Form c: Change-over, single gap, three terminals)

※※Suited to electronic circuits

Auxiliary switch ratings

Category	For general service		For microload ※※		
Voltage	Resistive load (A)	Inductive load (A) AC: cos ø≧ 0.3 DC: L/R ≦0.01	Resistive load (A)	Inductive load (A) AC: cos ø≧ 0.6 DC: L/R ≦0.007	Min. applicable load
AC100-250V	5	5	0.1	0.1	DC5V 1mA
AC251-500V	5	5	—	—	
DC30V	1	1	0.1	0.1	
DC125-250V	1	1	—	—	

Note 1: The chattering of b-contacts due to ON-OFF operation of the ACB lasts for less than 20 ms.
Note 2: Do not supply different voltages to contacts of a switch.

Manual reset device (Contact TERASAKI for details)

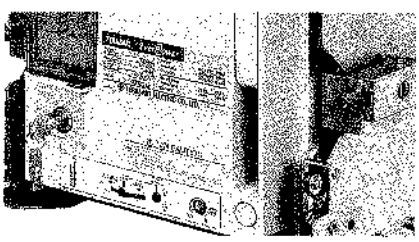
The manual reset device holds the ACB open that was tripped by the OCR, and provides a mechanical indication that the ACB is in the tripped state.
To close the ACB again, the operator needs to manually reset the indication after making sure the cause of tripping has been removed.

Note 1: The manual reset device is not applicable when AGR-11 OCR is equipped.
Note 2: The manual reset device is not applicable when the OCR is equipped with the UVT function.
Note 3: When the OCR is equipped with the manual reset device, a continuous-rated shunt trip device is necessary for remote OFF operation of the ACB.

Key lock

The key lock is available in two types: the lock-in ON type that locks the ACB in the closed position, and the lock-in OFF type that locks the ACB in the open position.

When the ACB is fitted with a key lock, the operator cannot operate the ACB unless using a matched key.



Key interlock

The key interlock is a system of interlocking between ACBs, each fitted with a key lock of lock-in OFF type.

- A key must be inserted to release the lock before the ACB can be closed.
- The ACB must be opened and locked in the OFF position before the key can be removed.

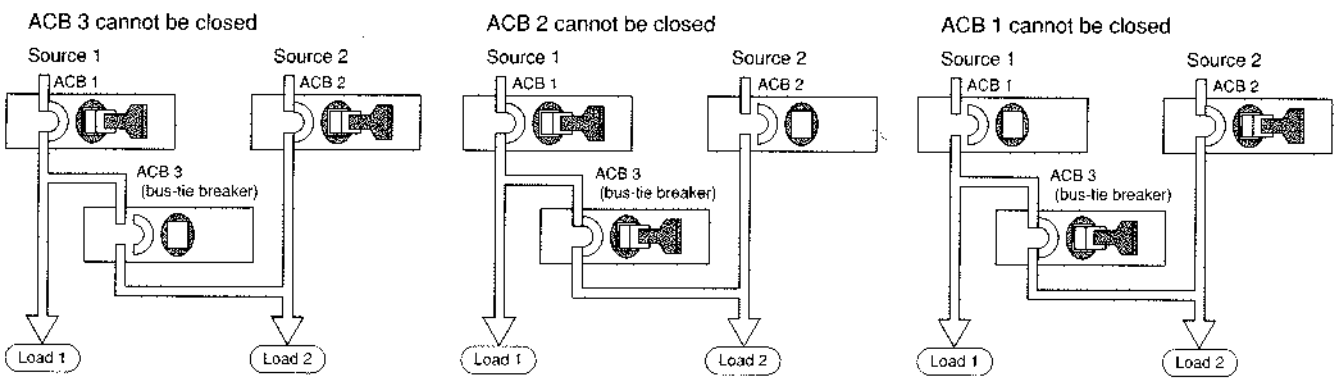
By utilizing the lock-in OFF type key lock feature, and then a limited number of keys by default provides an effective and reliable interlock system.

Using the same keys also allows interlocking between an ACB and other devices (such as a switchboard door).

ACBs are supplied with a cylinder lock or with a provision for type FS-2 Castell lock (with angular movement 90° clockwise to trap key).

The Castell lock is not supplied.

Example: Interlock for prevention of parallel feeding from two sources



4 Specifications

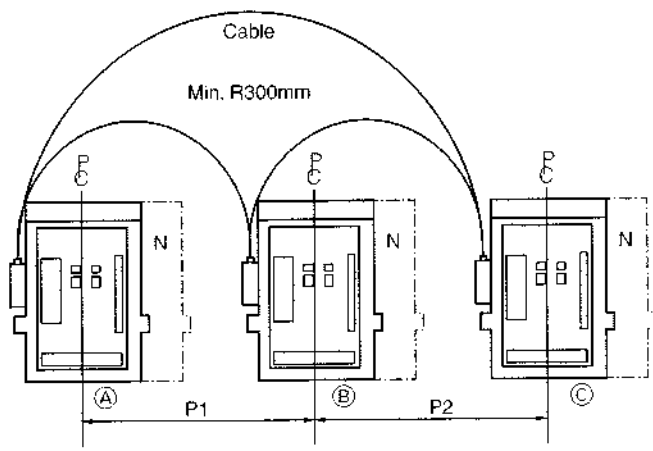
Mechanical interlock (Contact TERASAKI for details)

Mechanical interlocks for interlocking 2 or 3 ACBs in either horizontal (Draw-out type and Fixed type) or vertical (Draw-out type only) arrangements are available.
Interlocking is possible between any frame size within the TemPower2 range.
In conjunction with an electrical interlock, it will enhance safety and reliability of power distribution systems.

1 Horizontal type

This table shows the standard pitch between left side ACB Ⓐ and right side ACB Ⓑ, or between left side ACB Ⓑ and right side ACB Ⓒ.

		Pitch of ACB P (mm) (PC line to PC line)		
Right ACB / Left ACB		AR208S~AR220S AR212H~AR220H	AR325S~AR332S AR316H~AR332H	AR440S
		3P, 4P	3P, 4P	3P, 4P
AR208S~AR220S AR212H~AR220H	3P	500, 600, 700	600, 700, 800	500, 600, 700
	4P	600, 700, 800	700, 800, 900	600, 700, 800
AR325S~AR332S AR316H~AR332H	3P	600, 700, 800	700, 800, 900	600, 700, 800
	4P	700, 800, 900	800, 900, 1000	700, 800, 900
AR440S	3P	800, 900, 1000	900, 1000, 1100	800, 900, 1000
	4P	1000, 1100, 1200	1000, 1100, 1200	1000, 1100, 1200



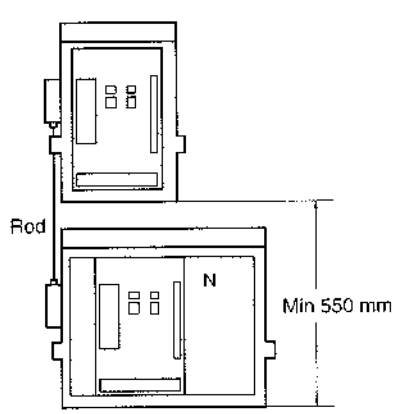
For the ordering, select the required pitch for P1 and P2 from the above table, and specify the type and Number of poles for ACB Ⓐ, ACB Ⓑ and ACB Ⓒ if exists.

Example,

P1: 700 mm
P2: 800 mm
ACB Ⓐ: Type AR212H 3 poles
ACB Ⓑ: Type AR332H 3 poles
ACB Ⓒ: Type AR216H 3 poles

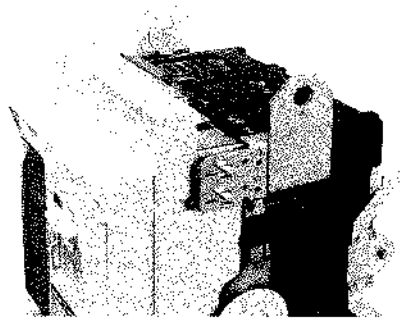
2 Vertical Type

Minimum pitch (550mm) is possible.
Specify the reguired pitch when order.
Maximum is 1200mm.
Contact TERASAKI for the details of vertical type with 3 ACBs.



Lifting plate

Lifting plates are detachable tools that can be used to lift a breaker body out of a draw-out cradle.



ON-OFF button cover ※

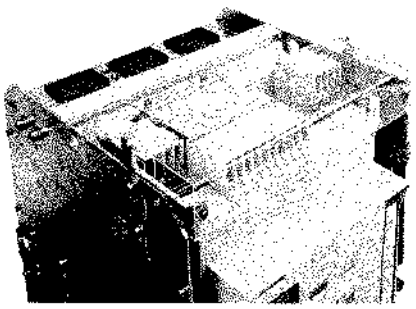
※: Standard equipment

An ON-OFF button cover prevents inadvertent or unauthorized operation of the ON or OFF button. It can be locked with up to three padlocks with ø6 hasp. Padlocks are not supplied.



Control circuit terminal cover

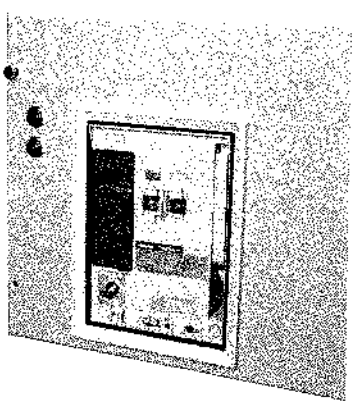
A control circuit terminal cover protects the terminal blocks for auxiliary switches, position switches, and control circuits from being accidentally touched, thus enhancing safety.

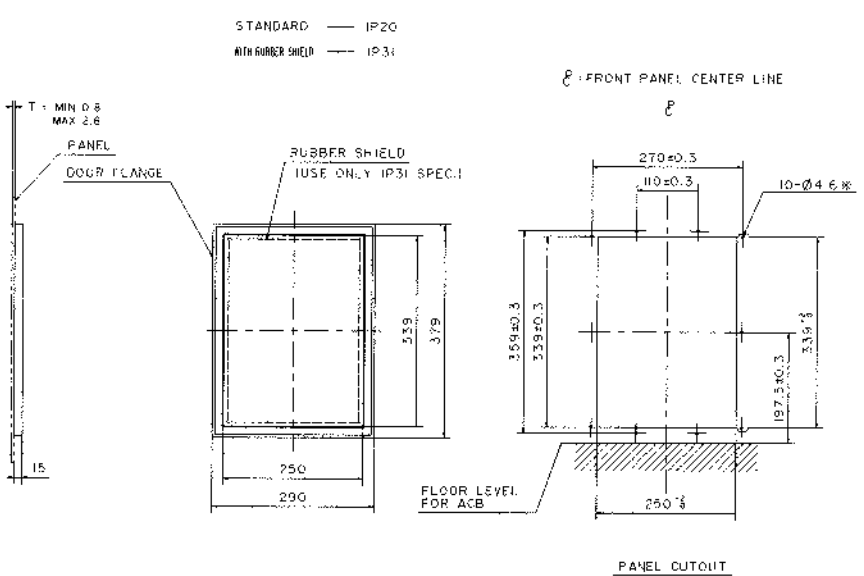


Door flange

A door flange can be used as a decoration panel that covers the cutout on the switchboard panel, and provides IP20 protection. For IP31 protection please specify the door flange with a gasket.

Note: Door flange can not be specified with Door interlock.





※ : Mount IP20 door flange through 6 mounting holes and IP31 door flange through 10 mounting holes.

4 Specifications

OFF padlock

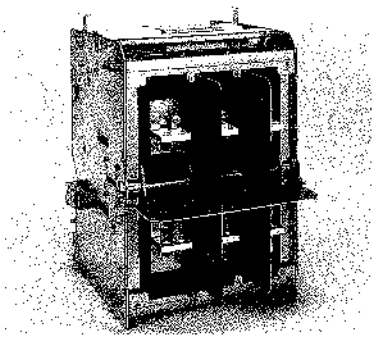
Permits the ACB to be padlocked in the OFF position. Max. three padlocks with ø6 hasp can be fitted. Padlocking is possible only when ON-OFF indicator shows OFF. When the ACB is padlocked in the OFF position both manual and electrial closing become inoperative, but the charging of the closing spring by manual or motor is still possible.

Note1: OFF padlock facility cannot be fitted with key lock or key interlock.

Inter-pole barrier

An inter-pole barrier prevents a possible short-circuit due to foreign objects entering between the poles of the main circuit terminals or between the line and load ends, thus enhancing operational reliability of the ACB.

This barrier cannot be applied to ACBs that are supplied with front connections or a reverse power trip function.



Earthing device

There is a growing demand in L.V. distribution for greater protection against electric shock particularly during periods when maintenance work is being carried out on the main busbars or cables. A safe and economical way to meet this requirement is to apply system earthing via the normal service breaker. Earthing devices on *TemPower2* ACBs comprises; Permanent parts which are factory fitted by Terasaki and are mounted on the ACB chassis and body to enable the ACB to receive the portable parts. Portable parts are supplied in loose kit form and are fitted on to the ACB body by the customer's engineer.

This converts the ACB from a normal service device to an earthing device.

When the ACB is converted to the earthing device mode, the over-current release and the other electrical tripping devices are automatically disabled to prevent the remote opening of the ACB.

It is recommended that the ON-OFF operating buttons be padlocked to prevent manual opening of the ACB when used in the earthing mode.

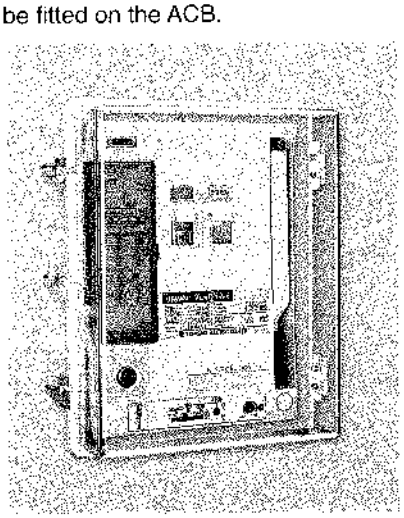
UVT function can not be applied to the earthing device.

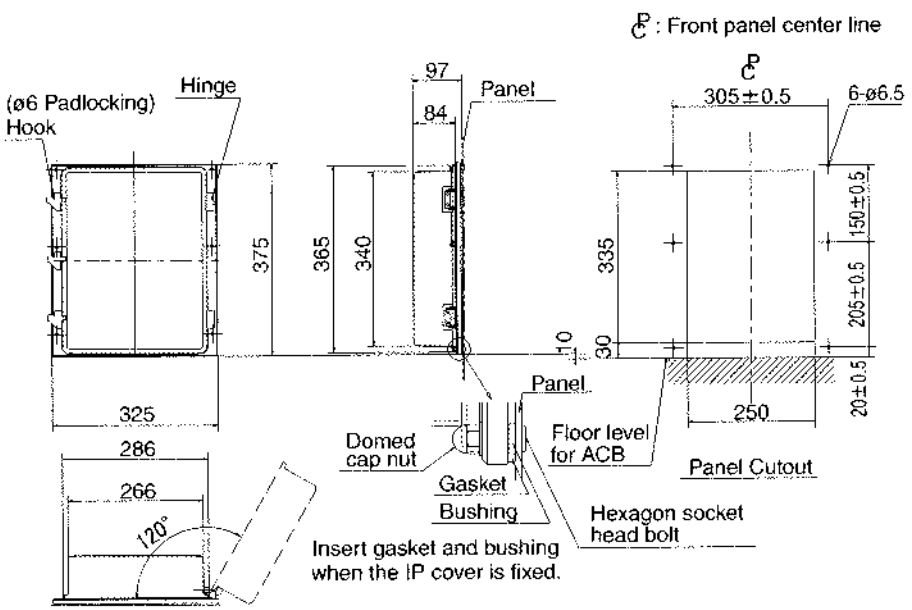
For further information contact Terasaki for details.

IP cover

An IP cover provides an IP55 grade of protection as defined in IEC 60529.

Even if the breaker body is on the ISOLATED position, IP cover can still be fitted on the ACB.





Operation Environments

Standard environment

The standard environment for ACBs is as follows:

Ambient temperature	–5°C to +40°C The average temperature for 24 hours must not exceed 35°C.
Relative humidity	45% to 85%
Attitude	Below 2000 m
Atmosphere	Excessive water vapor, oil vapor, smoke, dust, or corrosive gases must not exist. Sudden change in temperature, condensation, or icing must not occur.

Special environment

Tropicalization (Fungus and moisture treatment)

Specify this treatment when the ACB is used under high-temperature and high-humidity conditions.

Conditions: Max. permissible ambient temperature 60°C
Max. permissible humidity 95% rel.
No condensation

Cold climate treatment

Specify this treatment when the ACB is used in cold areas.

Conditions: Min. permissible storage temperature –40°C
Min. permissible operating temperature –25°C
No condensation

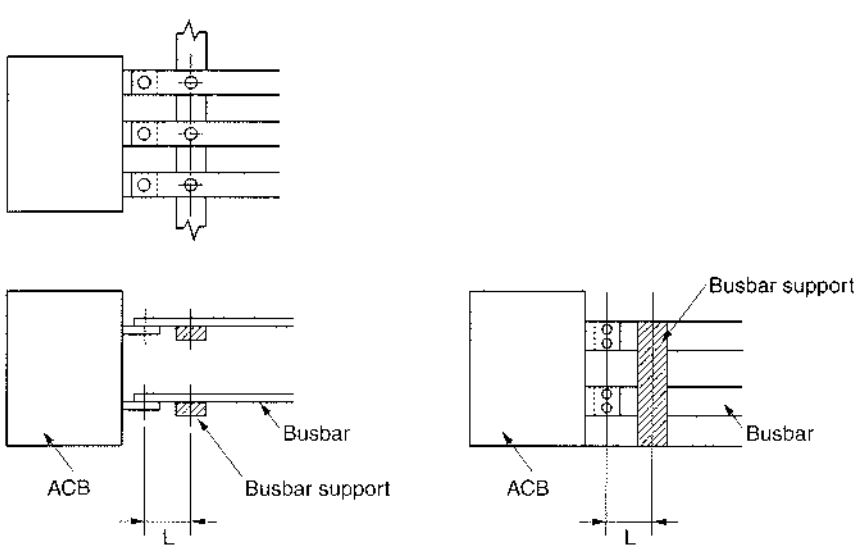
Anti-corrosion treatment

Specify this treatment when the ACB is used in a corrosive atmosphere.

Contact Terasaki for details.

Recommendation for Busbars connection

The busbars to the ACB should be firmly supported near the ACB terminal. Fault current flow through the busbars develops a large electromagnetic force between the busbars, and the support must be strong enough to withstand such forces. The ACB should not be relied on as a single support.



The maximum distance of the connection point of ACB to the first busbar support

Short-circuit current (kA)		30	50	65	80	100
Distance L (mm)	Type AR2	300	250	150	150	—
	Type AR3,AR4	350	300	250	150	150

5 Outline Dimensions

• Type AR208S, AR212S, AR216S, AR220S, AR212H, AR216H, AR220H Draw-out type

℄: Front panel centre line

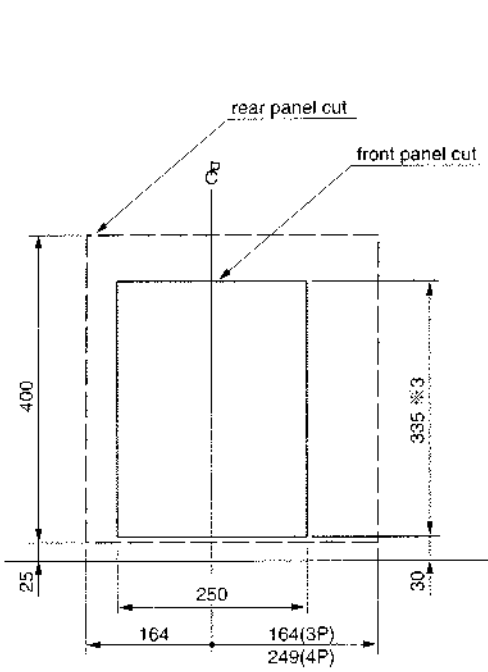
Terminal size

Type	ⓣ1	ⓣ2	ⓣ3	W
AR208S	10	10	15	17.5
AR212S	10	10	15	17.5
AR216S	20	15	25	22.5
AR220S	20	15	25	—
AR212H	20	15	—	—
AR216H	20	15	—	—
AR220H	20	15	—	—

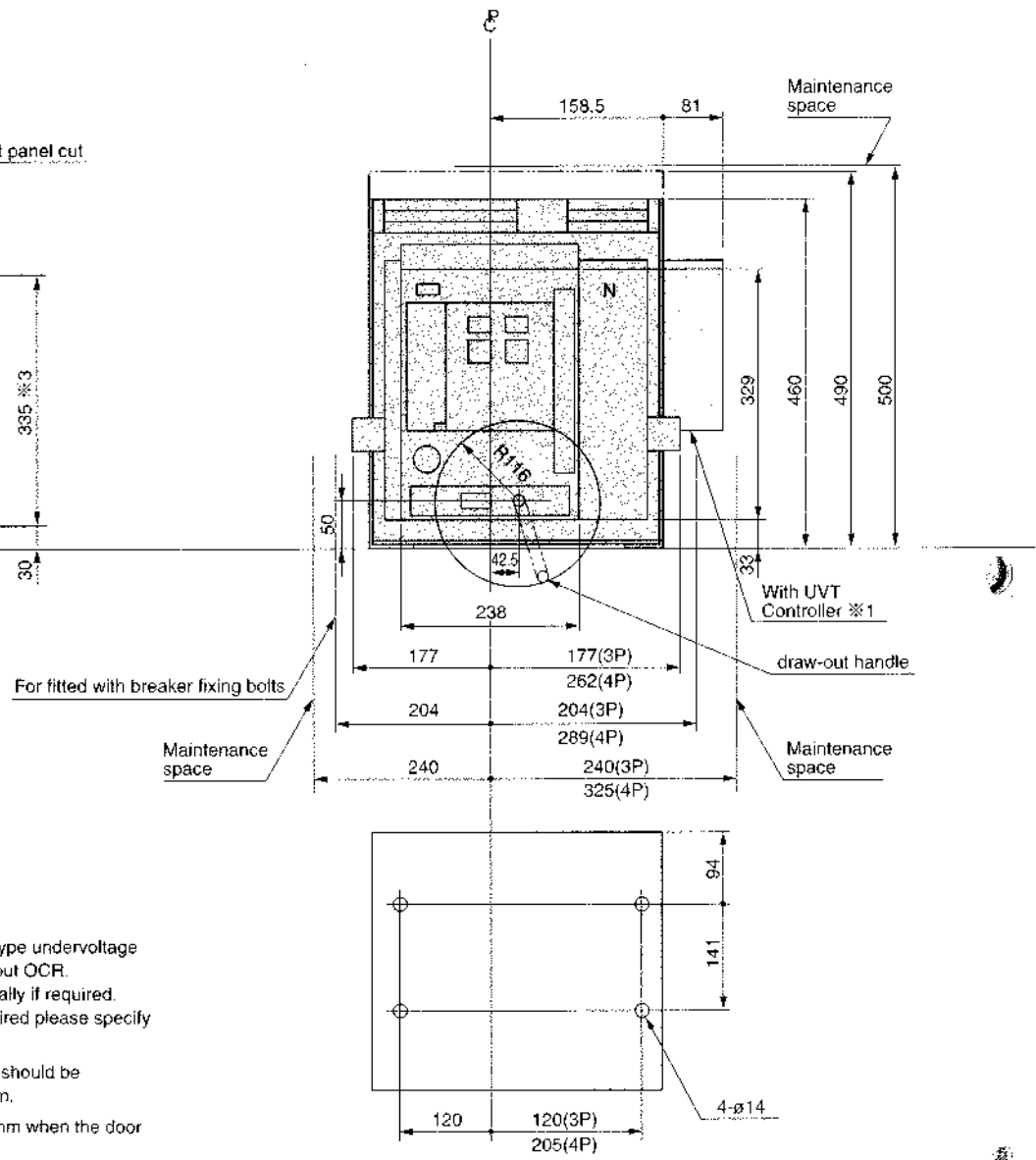
• With reverse power trip function, the length of the line side main terminals become 55 mm longer, and the applicable ACBs depend on the connection method of main terminals.

Type	Front connection	Vertical terminal	Horizontal terminal
AR208S	○	○	○
AR212S	○	○	○
AR216S	—	○	○
AR220S	—	○	○
AR212H		○	○
AR216H		○	○
AR220H		○	○

○ : Available
— : Not available



panel cut-out



Mounting holes

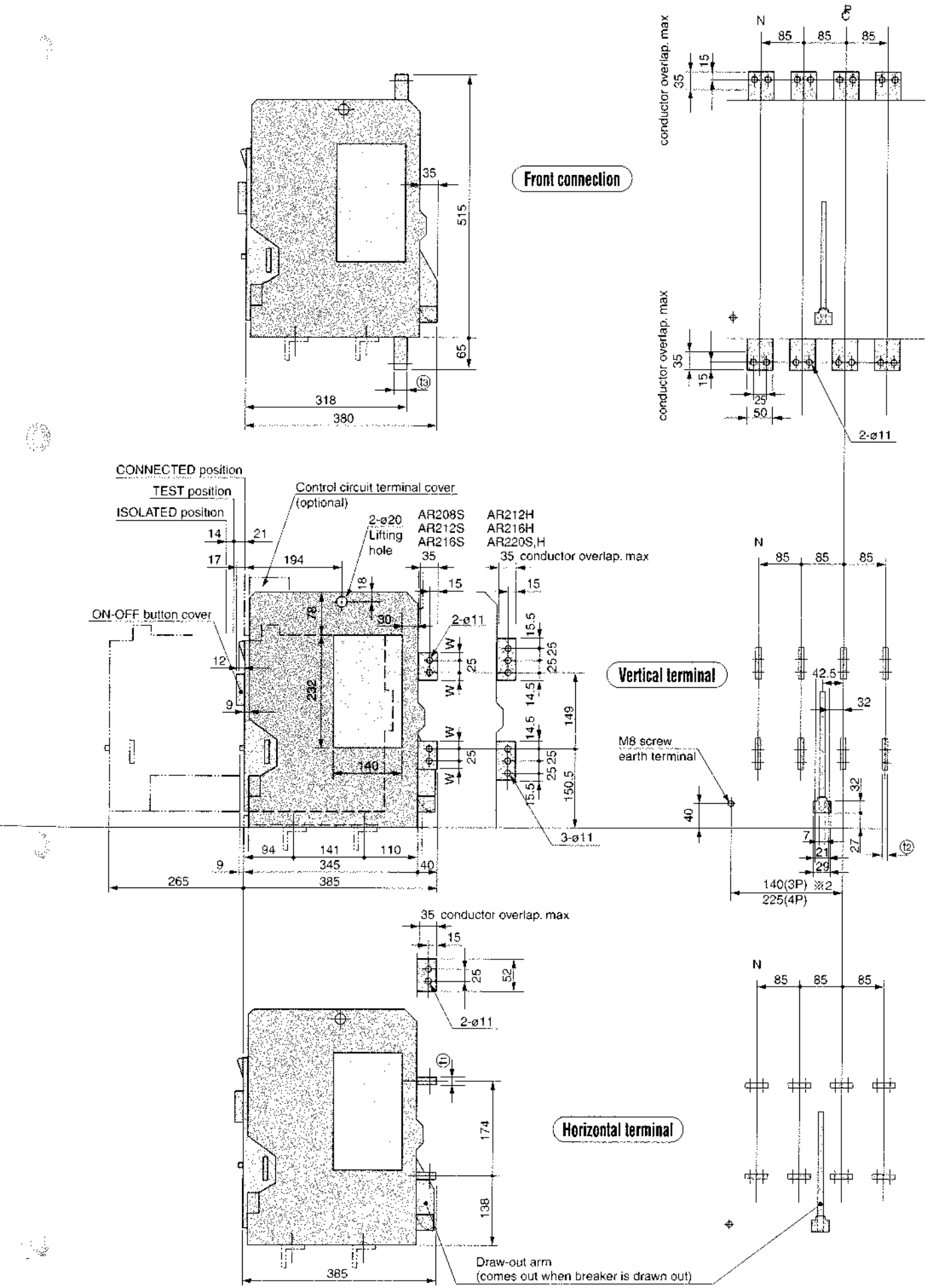
※1: UVT controller is required when fixed type undervoltage trip is fitted with AGR-11 OCR or Without OCR. UVT controller can be mounted externally if required. If externally mounted controller is required please specify on order.

※2: Conductors including connecting bolts should be separated min-7mm from Draw-out arm.

※3: Panel cut should be 339 mm not 335 mm when the door flange is used. Refer to page 43.

• N represents the neutral pole of 4-pole ACBs.

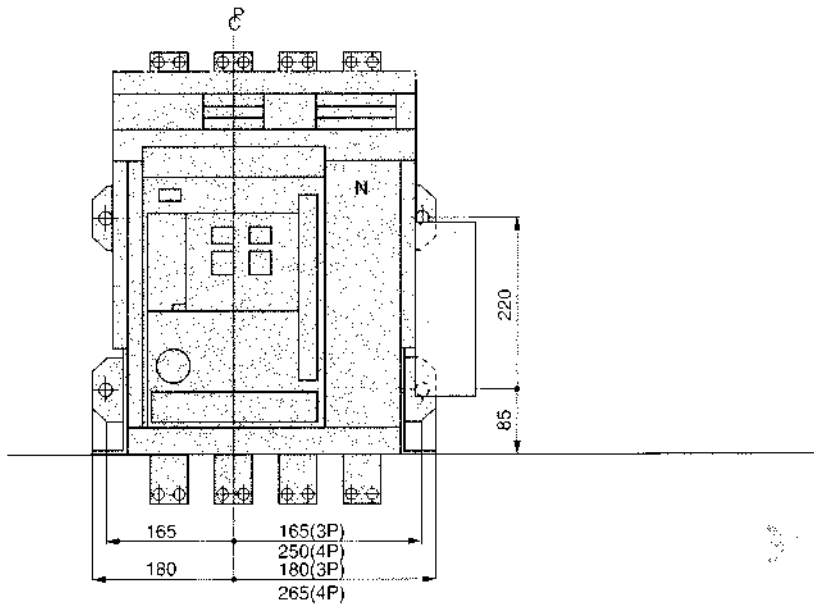
• For High fault series vertical terminal is standard and horizontal terminal is optional, and front connection is not available.

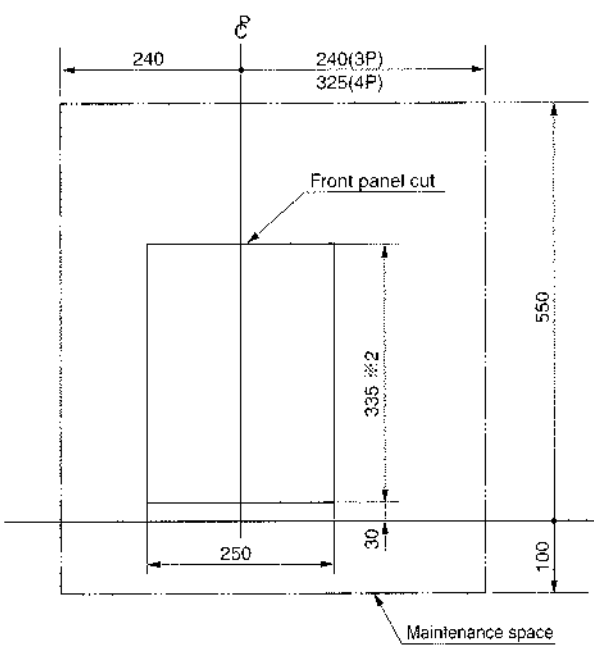

Front connection
conductor overlap. max
35
15
N
85
85
85
515
65
318
380
2-ø11
CONNECTED position
TEST position
ISOLATED position
Control circuit terminal cover
(optional)
2-ø20
Lifting
hole
AR208S
AR212S
AR216S
AR212H
AR216H
AR220S,H
35 conductor overlap. max
ON-OFF button cover
Vertical terminal
M8 screw
earth terminal
2-ø11
3-ø11
140(3P) ※2
225(4P)
Horizontal terminal
174
138
Draw-out arm
(comes out when breaker is drawn out)

5 Outline Dimensions

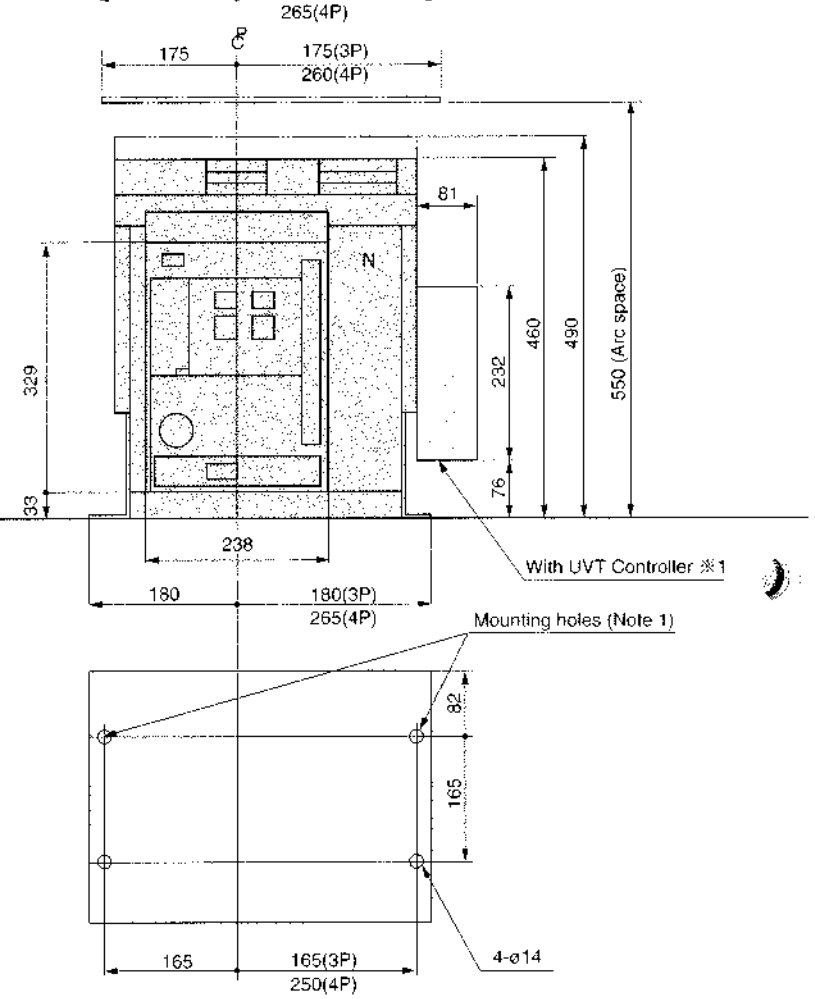
• Types: AR208S, AR212S, AR216S, AR220S Fixed type

℄: Front panel centre line





Panel cutout



Mounting holes

Terminal size

Type	ⓣ1	ⓣ2	ⓣ3	W
AR208S	10	10	15	17.5
AR212S	10	10	15	17.5
AR216S	20	15	25	22.5
AR220S	20	15	25	—

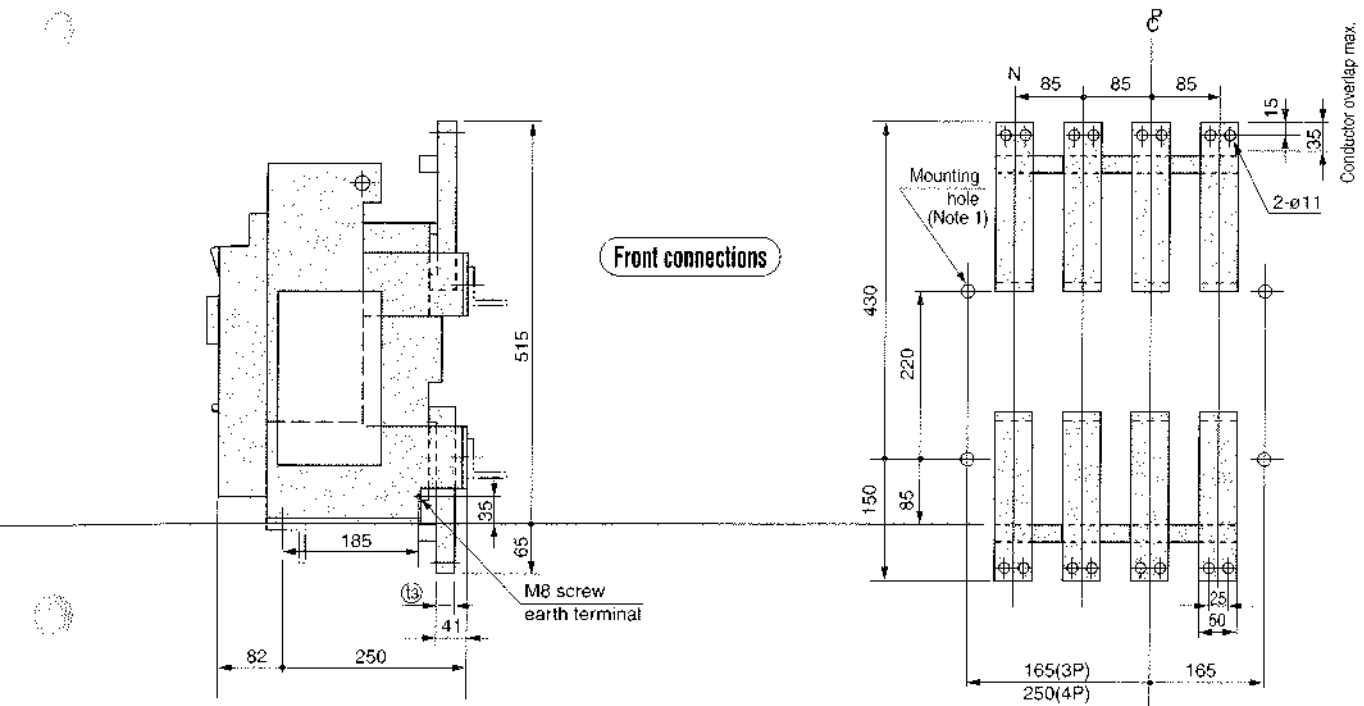
※1: UVT controller is required when fixed type undervoltage trip is fitted with AGR-11 OCR or Without OCR. UVT controller can be mounted externally if required. If externally mounted controller is required please specify on order.

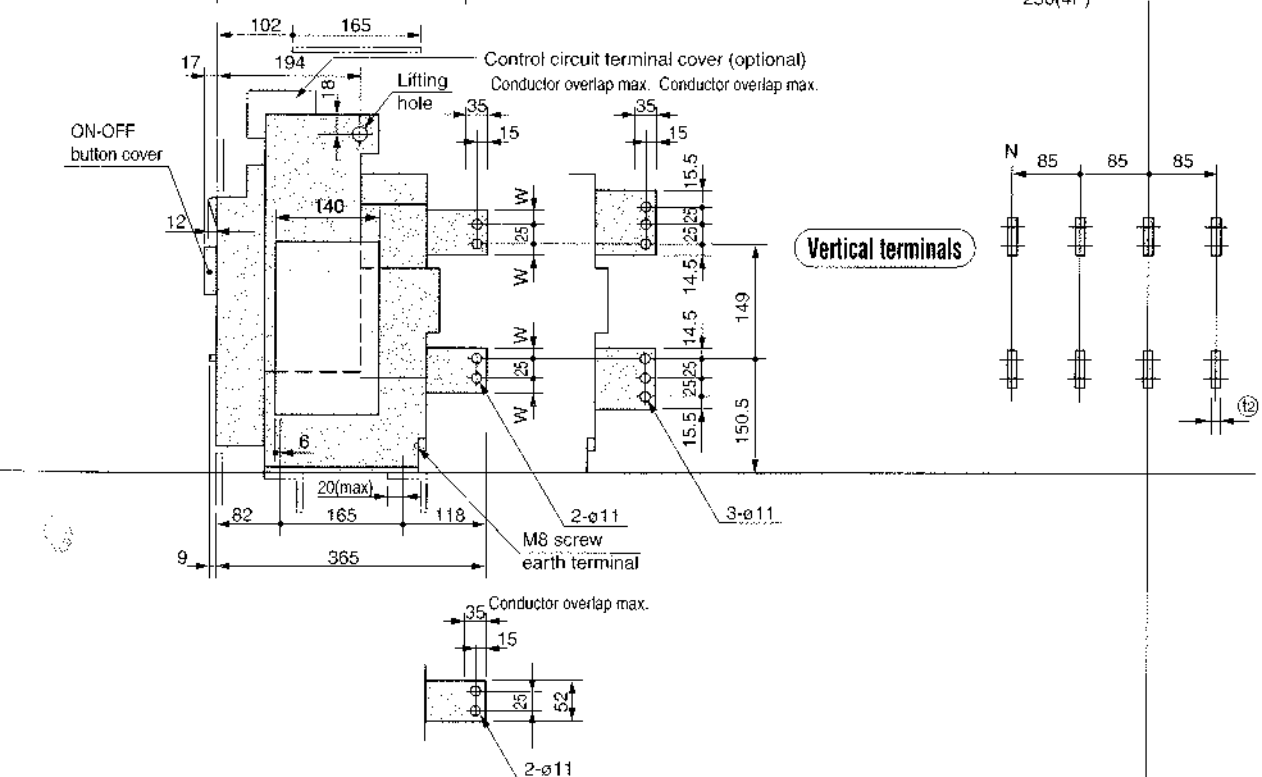
※2: Panel cut should be 339 mm not 335 mm when the door flange is used. Refer to page 43.

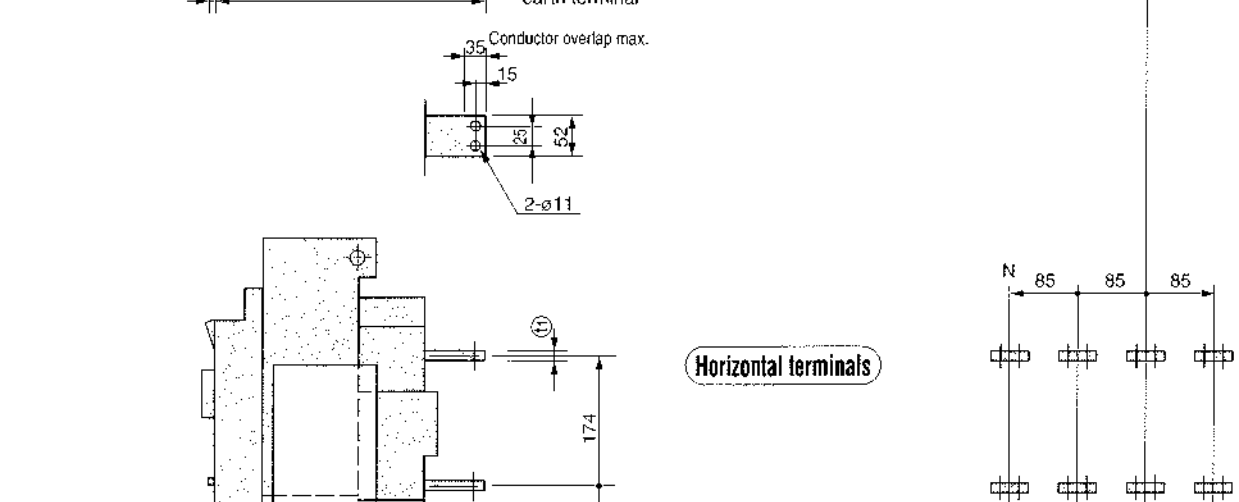
• N represents the neutral pole of 4-pole ACBs.

• Reverse power trip function is not available for Fixed type.

Note 1: The top 2 mounting holes should be only used for horizontal or vertical type connections.


Front connections
515
185
35
65
M8 screw
earth terminal
41
82
250
N
85
85
85
15
35
Conductor overlap max.
Mounting
hole
(Note 1)
2-ø11
430
220
150
85
25
50
165(3P)
250(4P)
165


102
165
17
194
Control circuit terminal cover (optional)
Conductor overlap max. Conductor overlap max.
18
Lifting
hole
35
15
ON-OFF
button cover
12
140
W
25
15.5
14.5
149
150.5
6
20(max)
82
165
118
9
365
2-ø11
3-ø11
M8 screw
earth terminal
Vertical terminals
N
85
85
85
⑫


Conductor overlap max.
35
15
25
52
2-ø11
Horizontal terminals
⑪
174
138
82
165
118
365
M8 screw
earth terminal
N
85
85
85

5 Outline Dimensions

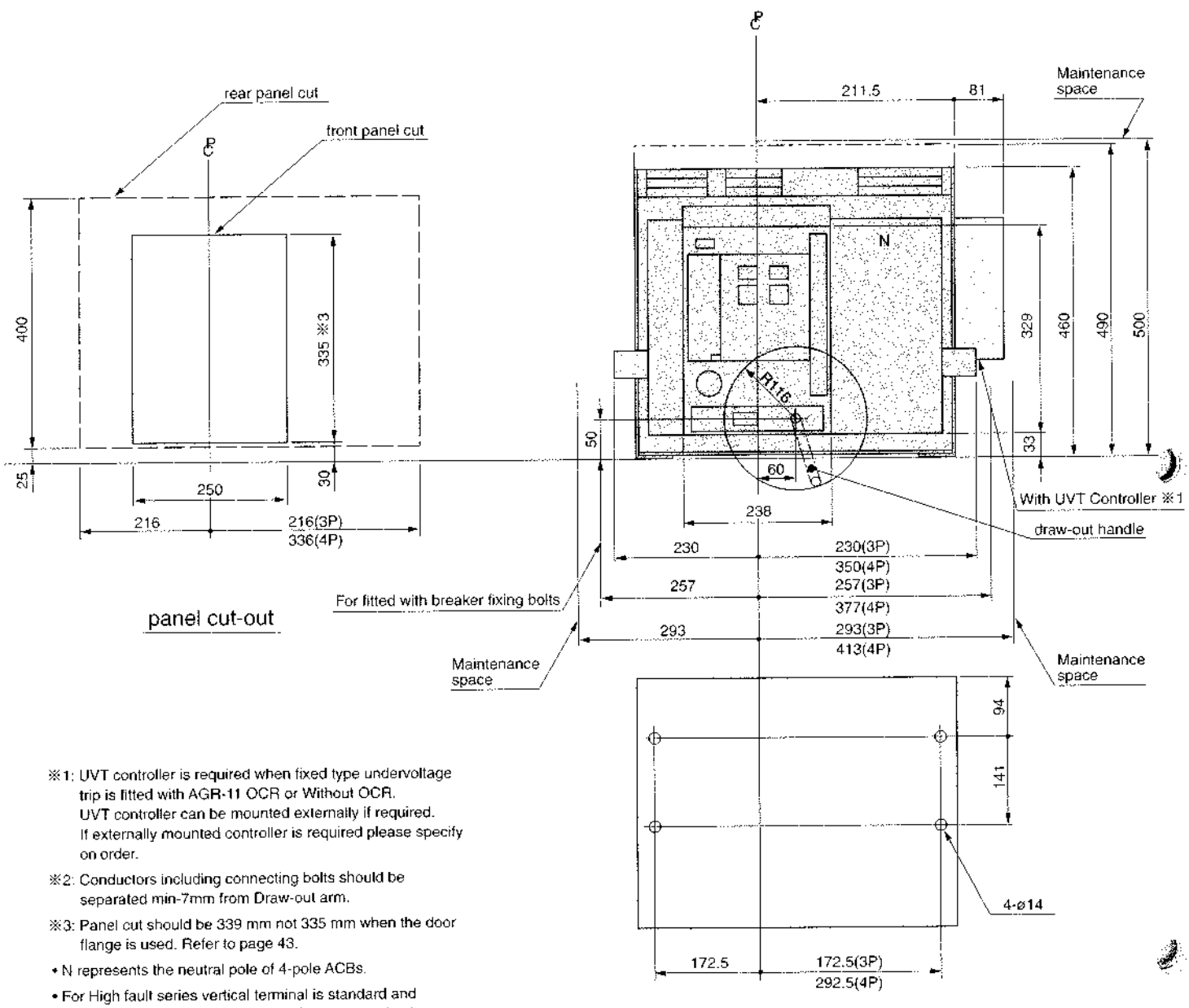
• Type AR325S, AR332S, AR316H, AR320H, AR325H, AR332H Draw-out type

℄: Front panel centre line

- With reverse power trip function, the length of the line side main terminals become 55 mm longer, and the applicable ACBs depend on the connection method of main terminals.

Type	Front connection	Vertical terminal	Horizontal terminal
AR325S	—	○	—
AR332S	—	○	—
AR316H		○	—
AR320H		○	—
AR325H		○	—
AR332H		○	—

○ : Available
— : Not available

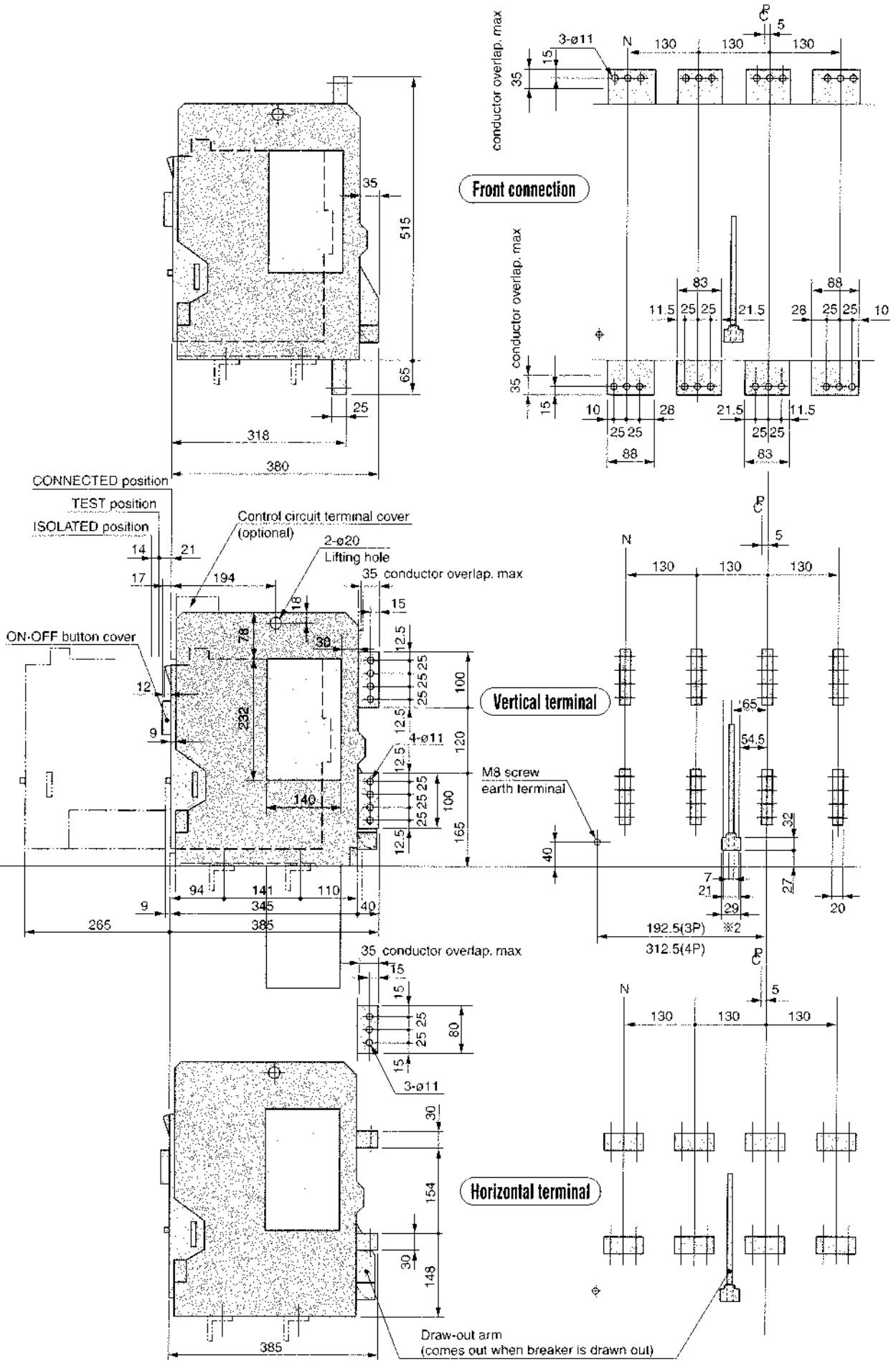


※1: UVT controller is required when fixed type undervoltage trip is fitted with AGR-11 OCR or Without OCR. UVT controller can be mounted externally if required. If externally mounted controller is required please specify on order.

※2: Conductors including connecting bolts should be separated min-7mm from Draw-out arm.

※3: Panel cut should be 339 mm not 335 mm when the door flange is used. Refer to page 43.

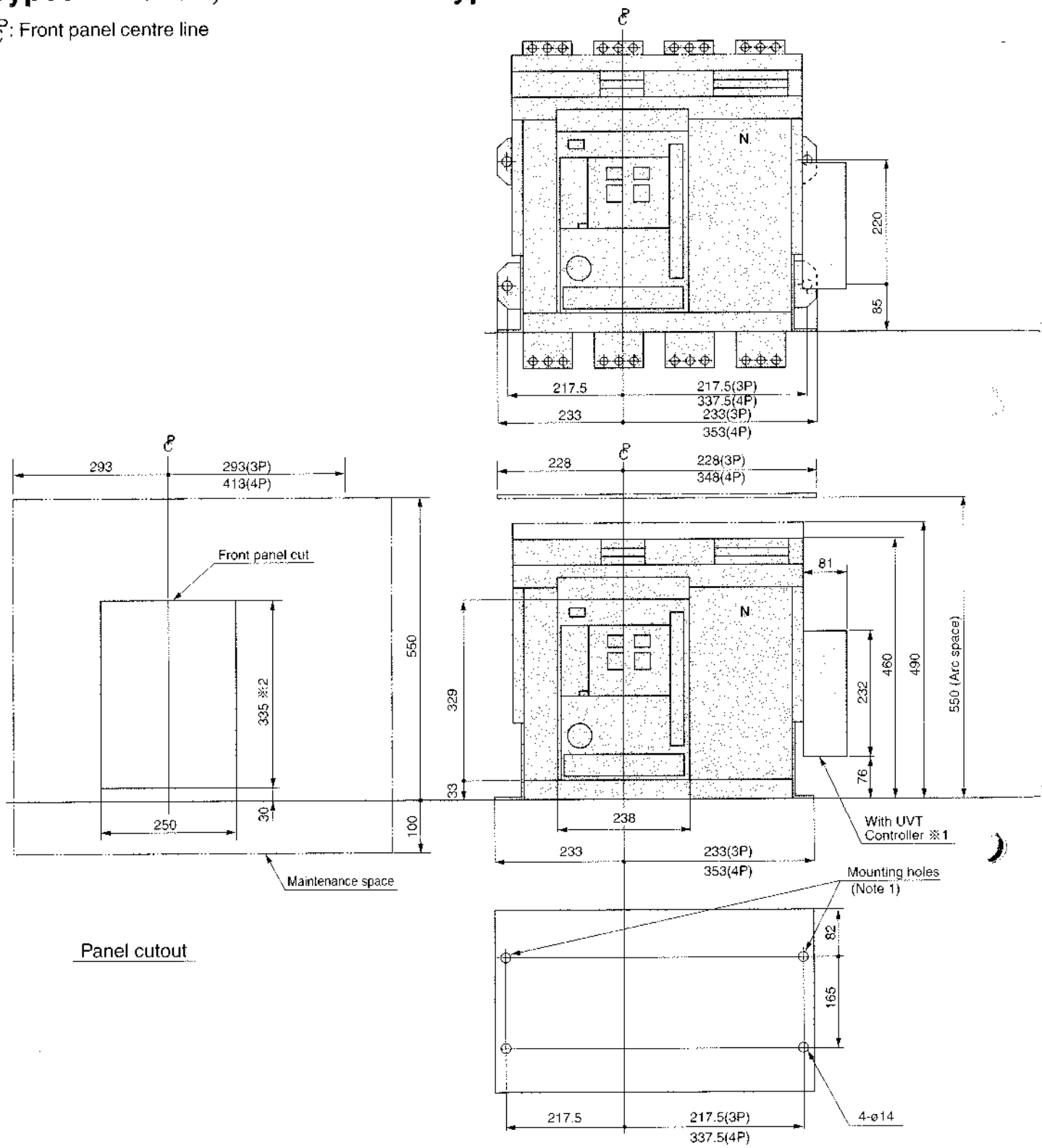
- N represents the neutral pole of 4-pole ACBs.
- For High fault series vertical terminal is standard and horizontal terminal is optional, and front connection is not available.


Front connection
Vertical terminal
Horizontal terminal
CONNECTED position
TEST position
ISOLATED position
Control circuit terminal cover
(optional)
2-ø20
Lifting hole
ON-OFF button cover
35 conductor overlap. max
3-ø11
4-ø11
M8 screw
earth terminal
Draw-out arm
(comes out when breaker is drawn out)
192.5(3P)
312.5(4P)
※2

5 Outline Dimensions

• Types: AR325S, AR332S Fixed type

℄: Front panel centre line



Panel cutout

Mounting holes

※1: UVT controller is required when fixed type undervoltage trip is fitted with AGR-11 OCR or Without OCR. UVT controller can be mounted externally if required. If externally mounted controller is required please specify on order.

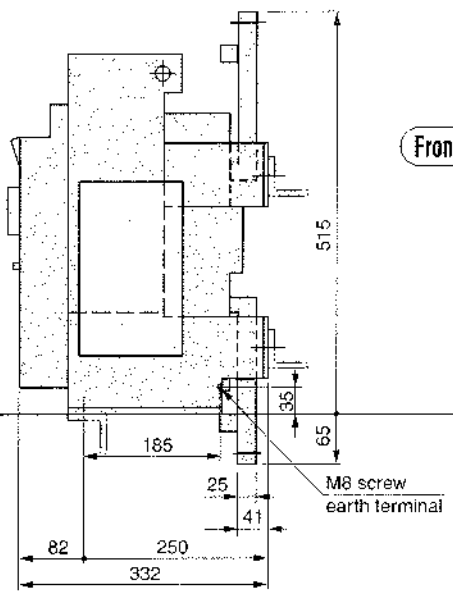
※2: Panel cut should be 339 mm not 335 mm when the door flange is used. Refer to page 43.

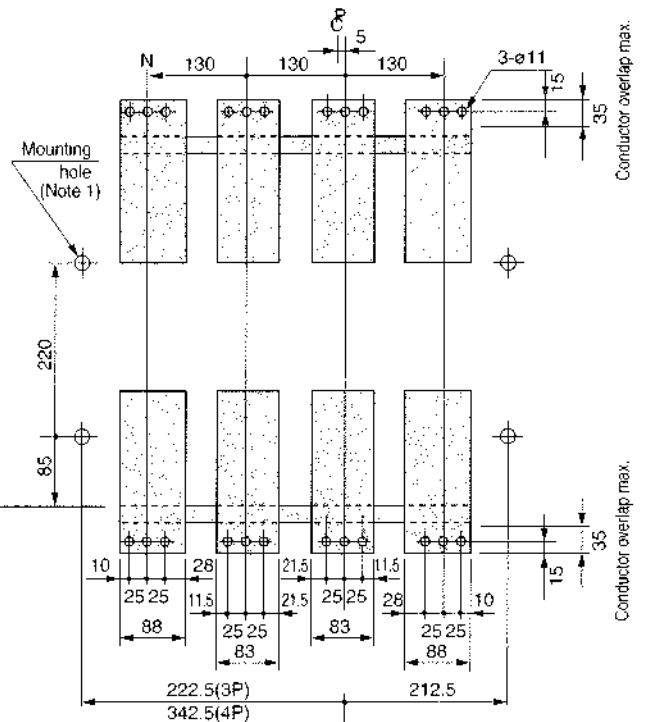
• N represents the neutral pole of 4-pole ACBs.

• Reverse power trip function is not available for Fixed type.

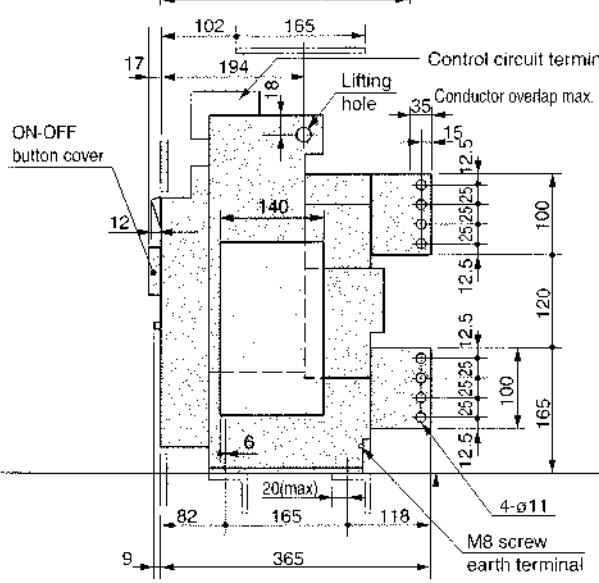
Note 1: The top 2 mounting holes should be only used for horizontal or vertical type connections.

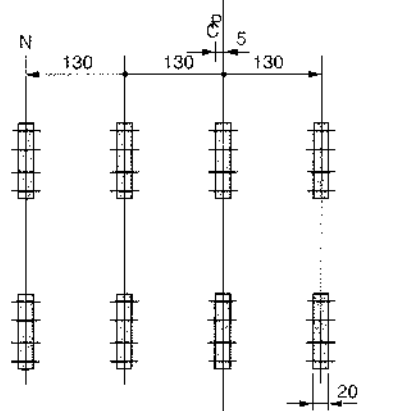
Front connections

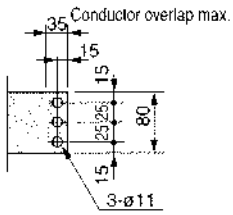




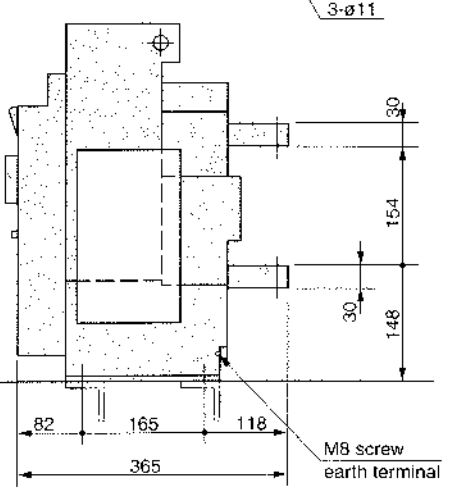
Vertical terminals

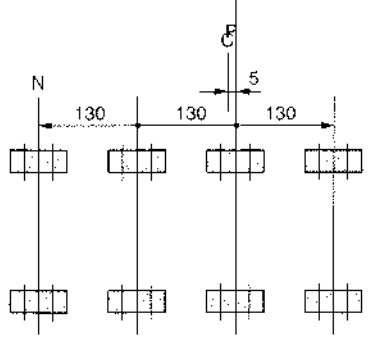






Horizontal terminals

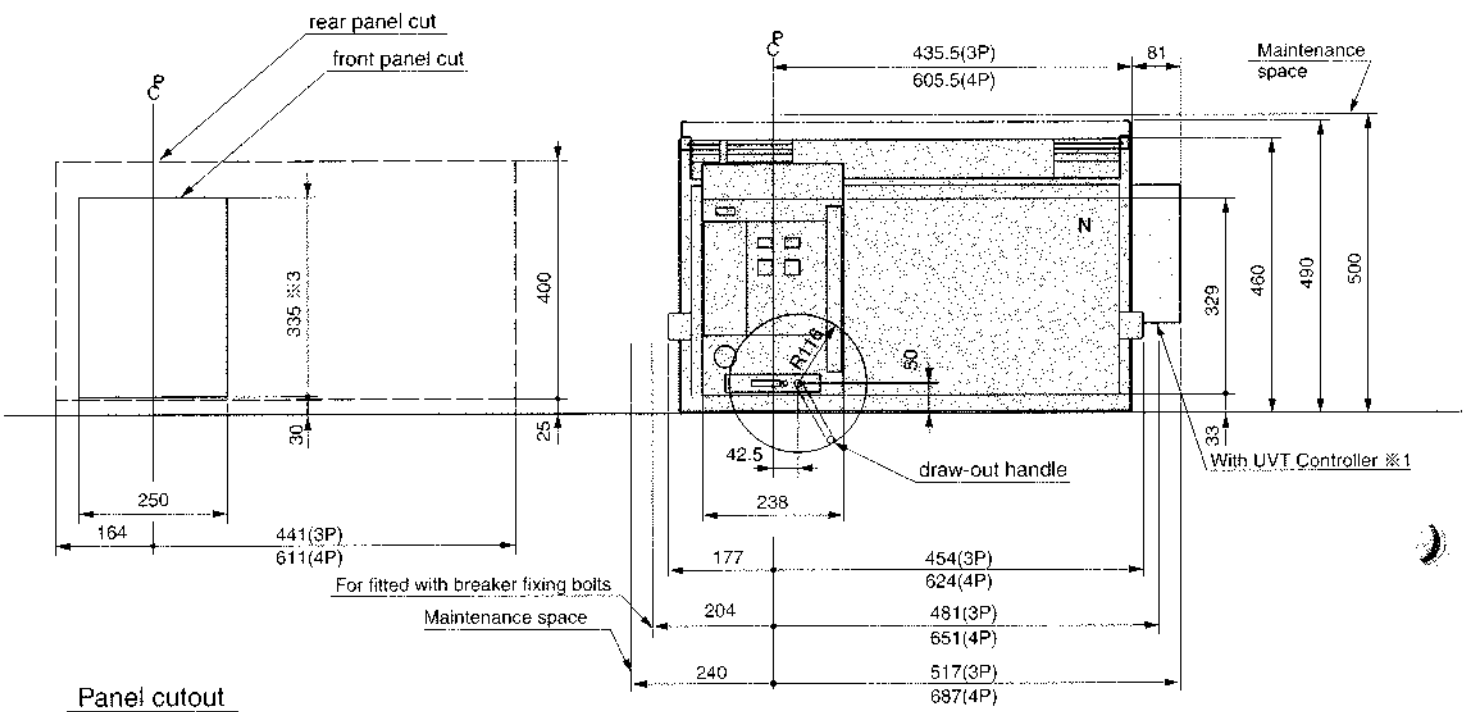




5 Outline Dimensions

• Types: AR440S Draw-out type

℄: Front panel centre line



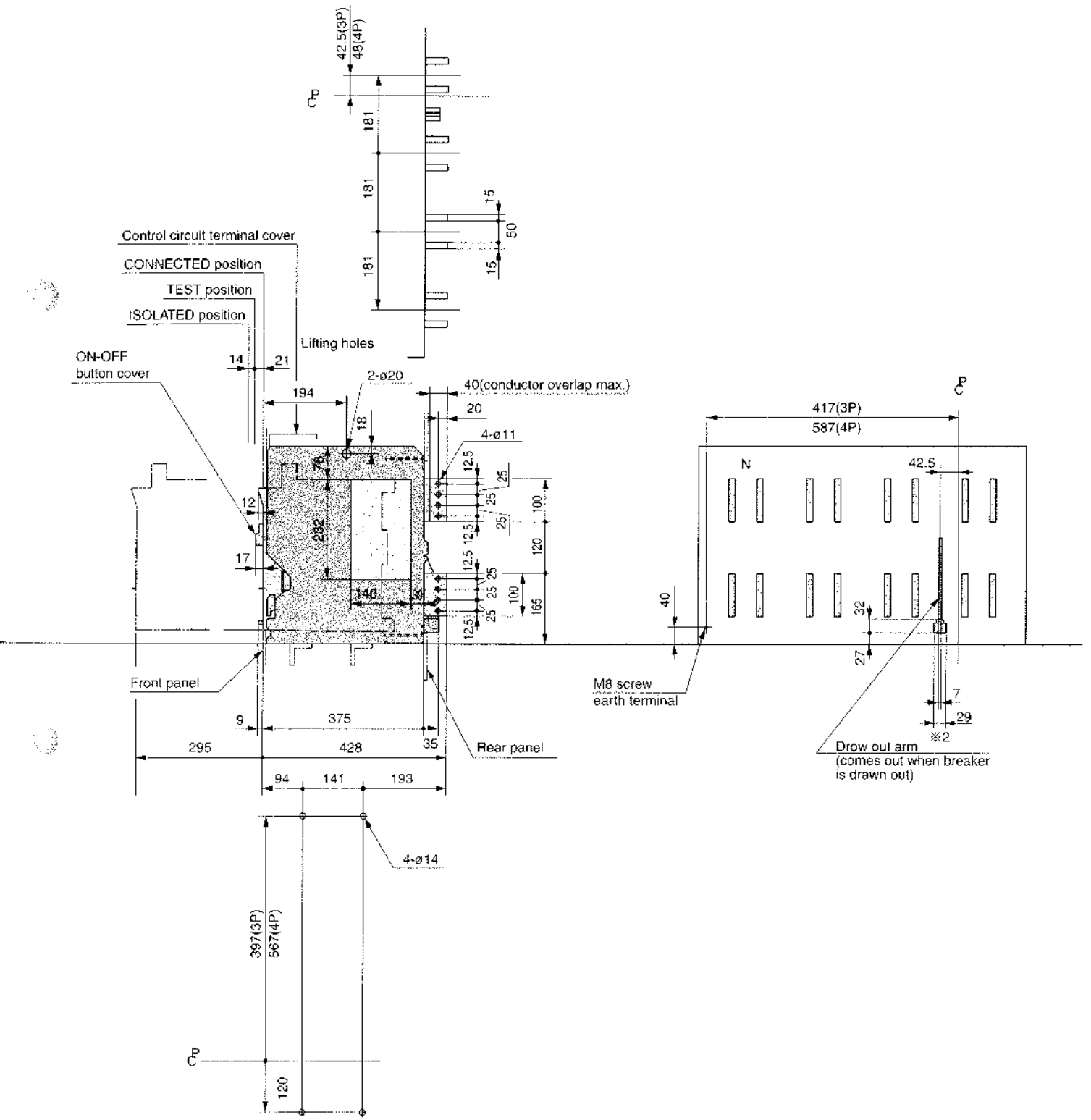
Panel cutout

※1: UVT controller is required when fixed type undervoltage trip is fitted with AGR-11 OCR or Without OCR. UVT controller can be mounted externally if required. If externally mounted controller is required please specify on order.

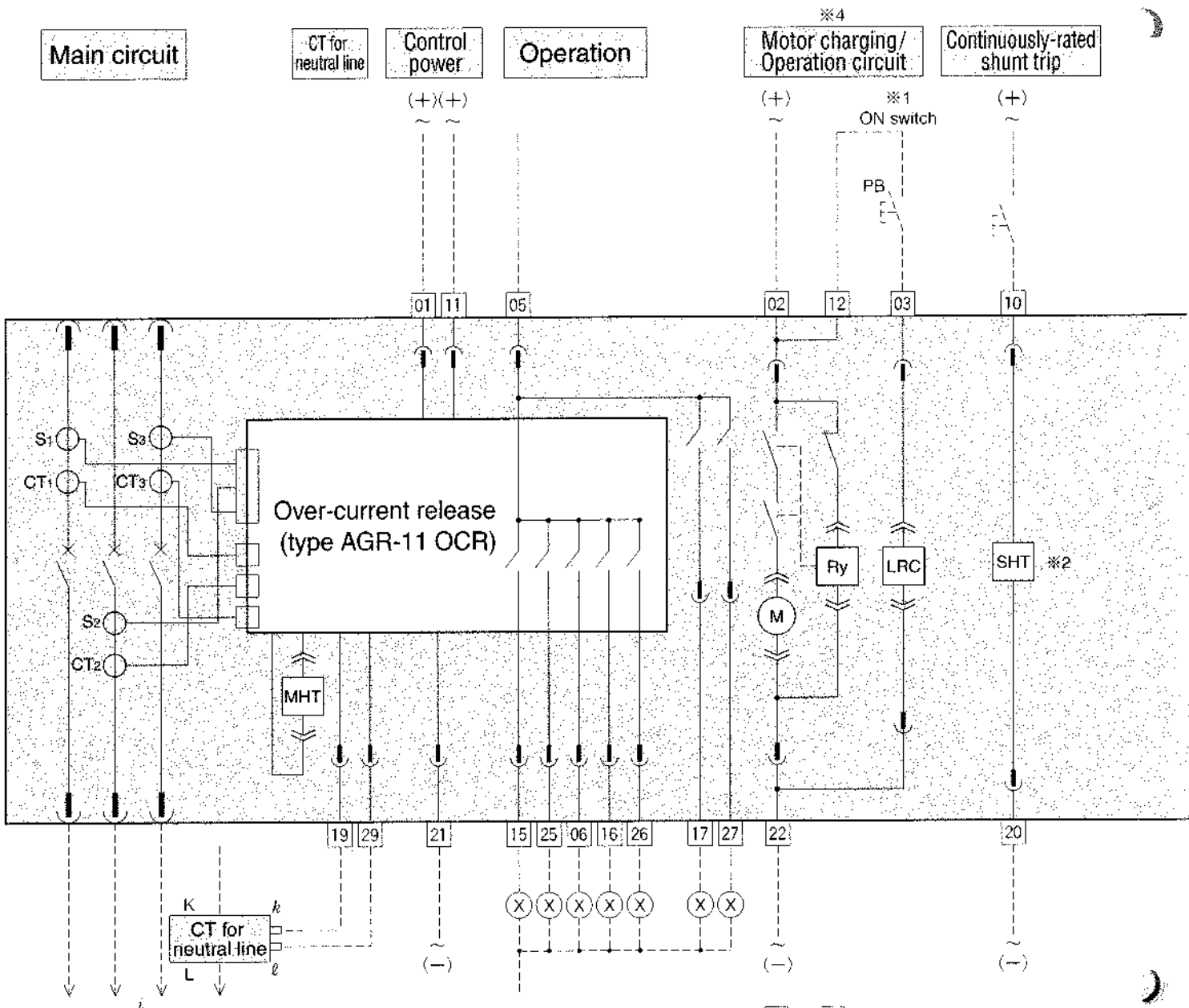
※2: Conductors including connecting bolts should be separated min-7mm from Draw-out arm.

※3: Panel cut should be 339 mm not 335 mm when the door flange is used. Refer to page 43.

• N represents the neutral pole of 4-pole ACBs.


42.5(3P)
48(4P)
181
181
181
15
50
15
Control circuit terminal cover
CONNECTED position
TEST position
ISOLATED position
Lifting holes
ON-OFF
button cover
14
21
194
2-ø20
40(conductor overlap max.)
20
18
4-ø11
12.5
25
25
25
100
120
12.5
12.5
25
25
25
100
165
12.5
25
79
282
12
17
140
30
Front panel
9
375
295
428
35
Rear panel
94
141
193
4-ø14
397(3P)
567(4P)
120
417(3P)
587(4P)
N
42.5
40
32
27
M8 screw
earth terminal
7
29
※2
Drow out arm
(comes out when breaker
is drawn out)

6 Circuit Diagram (with AGR-11 OCR or without OCR)



For single-contact indication only 05 and 15

Terminal description

Check OCR voltage before connecting.

01 21 Control power supply AC200 - 240V, DC200 - 250V, DC48V 01 11 Control power supply AC100 - 120V 11 21 Control power supply DC100 - 125V, DC24V

02 22 Operation power supply AC100 - 240V, DC100 - 220V, DC24V, DC48V 12 Operation switch, common 03 ON switch

05 Operation indication terminal, common 15 LT trip indication or single-contact indication 25 ST/INST trip indication 06 PTA indication

16 GF trip indication 26 System alarm indication 17 Trip indication 27 Spring charge indicator 10 20 Continuously-rated shunt trip

19 Separate CT for neutral line (k) 29 Separate CT for neutral line (ℓ) 08, 18, 28 UVT power supply 09 UVT power supply common

UVT power supply

Term. No	AC 100V coil	AC 200V coil	AC 400V coil
08 — 09	100V	200V	380V
18 — 09	110V	220V	415V
28 — 09	120V	240V	440V

Symbols for accessories

CT1 - CT3 : Power CTs
S1 - S3 : Current sensors
M : Charging motor
LRC : Latch release coil
MHT : Magnetic Hold Trigger
Isolating terminal connector (for draw-out type)
Manual connector
User wiring
Relay or indicator lamp

※1: Do not connect "b"contact of auxiliary switch to ON switch in series, otherwise, pumping may occur.

※2: See P. 21 for the circuit diagram of the continuously-rated shunt trip device with capacitor trip device.

※3: Use "a" contact of auxiliary switch of ACB.

※4: For motor split circuit, terminals 02, 22 and 03, 04 are used for charging and closing operation respectively.

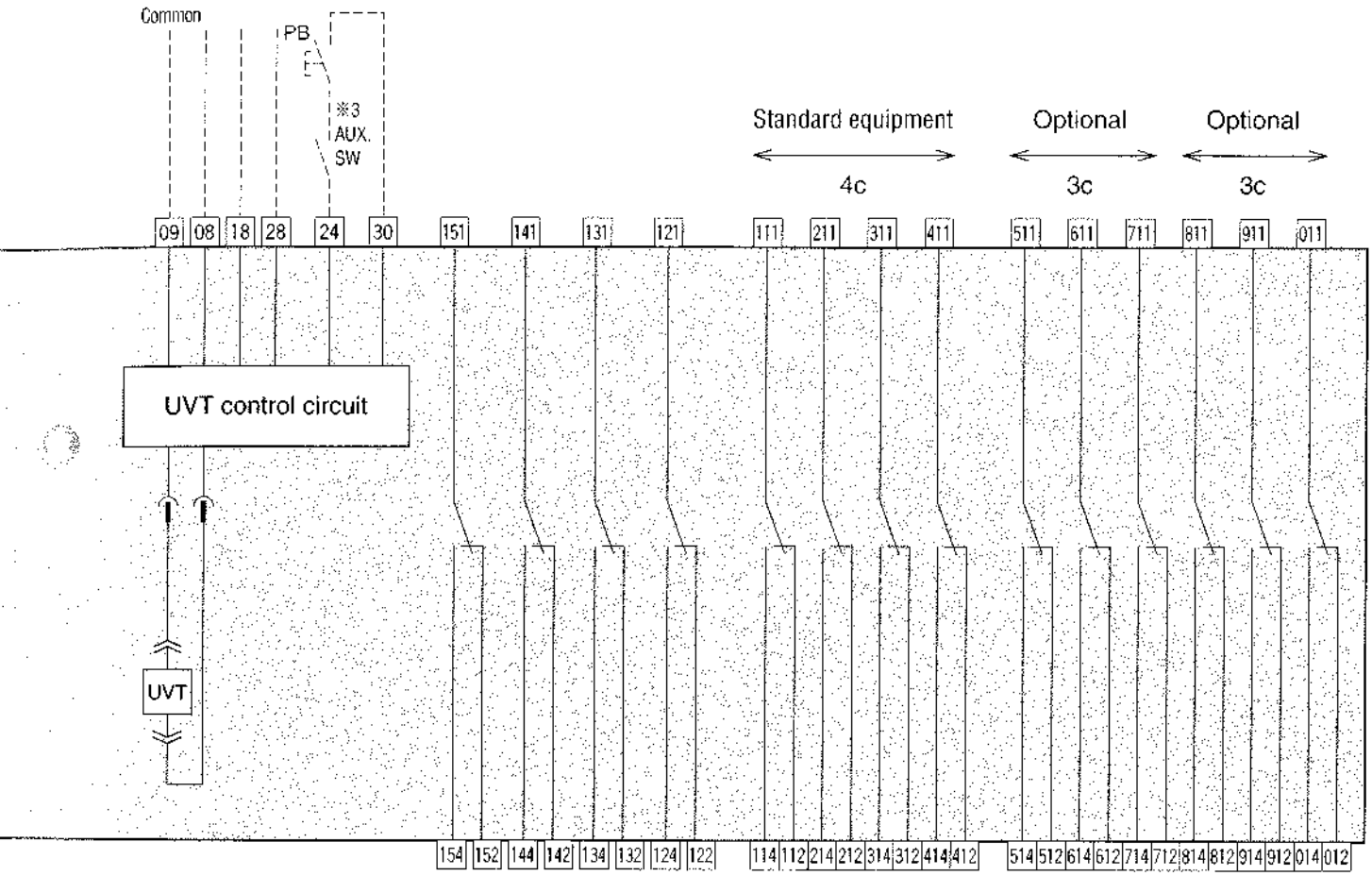
Designation of terminals for auxiliary and position switches

1: Common, 2: b-contact, 4: a-contact

1: Auxiliary switch
2: Position switch (for CONNECTED)
3: Position switch (for TEST)
4: Position switch (for ISOLATED)
5: Position switch (for INSERT)

1 – 0: Switch numbers
A, B, C: Auxiliary switches for microload

Fixed type UVT | Position switches | Auxiliary switches



Position switches

Top	151	141	131	121
Middle	154	144	134	124
Bottom	152	142	132	122

Operation/control circuits

01	02	03	04	05	06	07	08	09	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Auxiliary switches

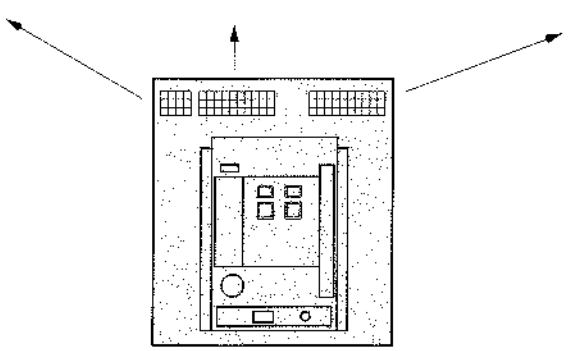
111	211	311	411	511	611	711	811	911	011
114	214	314	414	514	614	714	814	914	014
112	212	312	412	512	612	712	812	912	012

(Standard 4c + optional 6c arrangement)

Top	131	121
Middle	134	124
Bottom	132	122

111	211	311	411
114	214	314	414
112	212	312	412

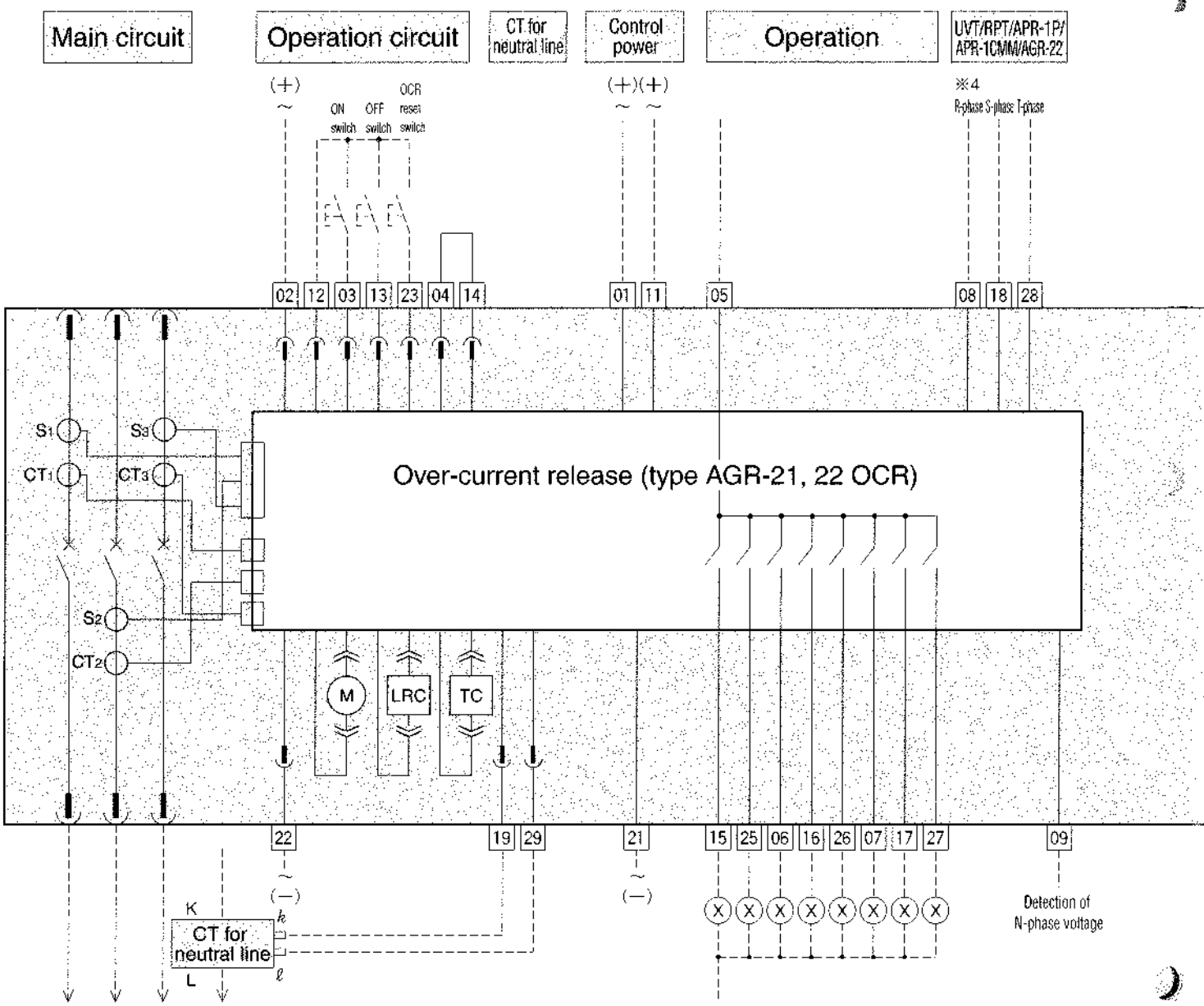
(Standard 4c arrangement)



CONNECTED position : 121–124 ON
121–122 OFF
TEST position : 131–134 ON
131–132 OFF
ISOLATED position : 141–144 ON
141–142 OFF
INSERT position : 151–154 ON
151–152 OFF

For operation sequence of position switches, see page 17.

6 Circuit Diagram (with AGR-21, 22 OCR)



Terminal description

Check OCR voltage before connecting.

01 21 Control power supply AC200 - 240V, DC200 - 250V, DC48V 01 11 Control power supply AC100 - 120V 11 21 Control power supply DC100 - 125V, DC24V

02 22 Operation power supply AC100 - 240V, DC100 - 250V, DC24V, DC48V 12 Operation switch, common 03 ON switch ※1 13 OFF switch ※1 23 OCR reset switch ※1

04 Operation switch for signal separation ※2 14 Operation switch for signal separation ※2 24 —— 05 Operation indication terminal, common

15 LT trip indication or single-contact indication 25 ST/INST trip indication 06 PTA indication 16 GF, RPT or ELT trip indication 26 System alarm indication 07 HEAT indication

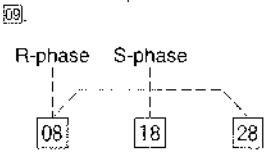
17 UVT indication ※3 27 Spring charge indicator or PTA2 08 18 28 UVT/RPT power supply R.S.T. (Max. AC460V)

09 N-phase voltage detection 19 Separate CT for neutral line (k) 29 Separate CT for neutral line (ℓ) 10 20 Continuously-rated shunt trip 30 ——

Symbols for accessories

CT1 - CT3 : Power CTs
S1 - S3 : Current sensors
M : Charging motor
LRC : Latch release coil
TC : Tripping coil
⟵ Isolating terminal connector (for draw-out type)
⟵ Manual connector
--- User wiring
ⓧ Relay or indicator lamp

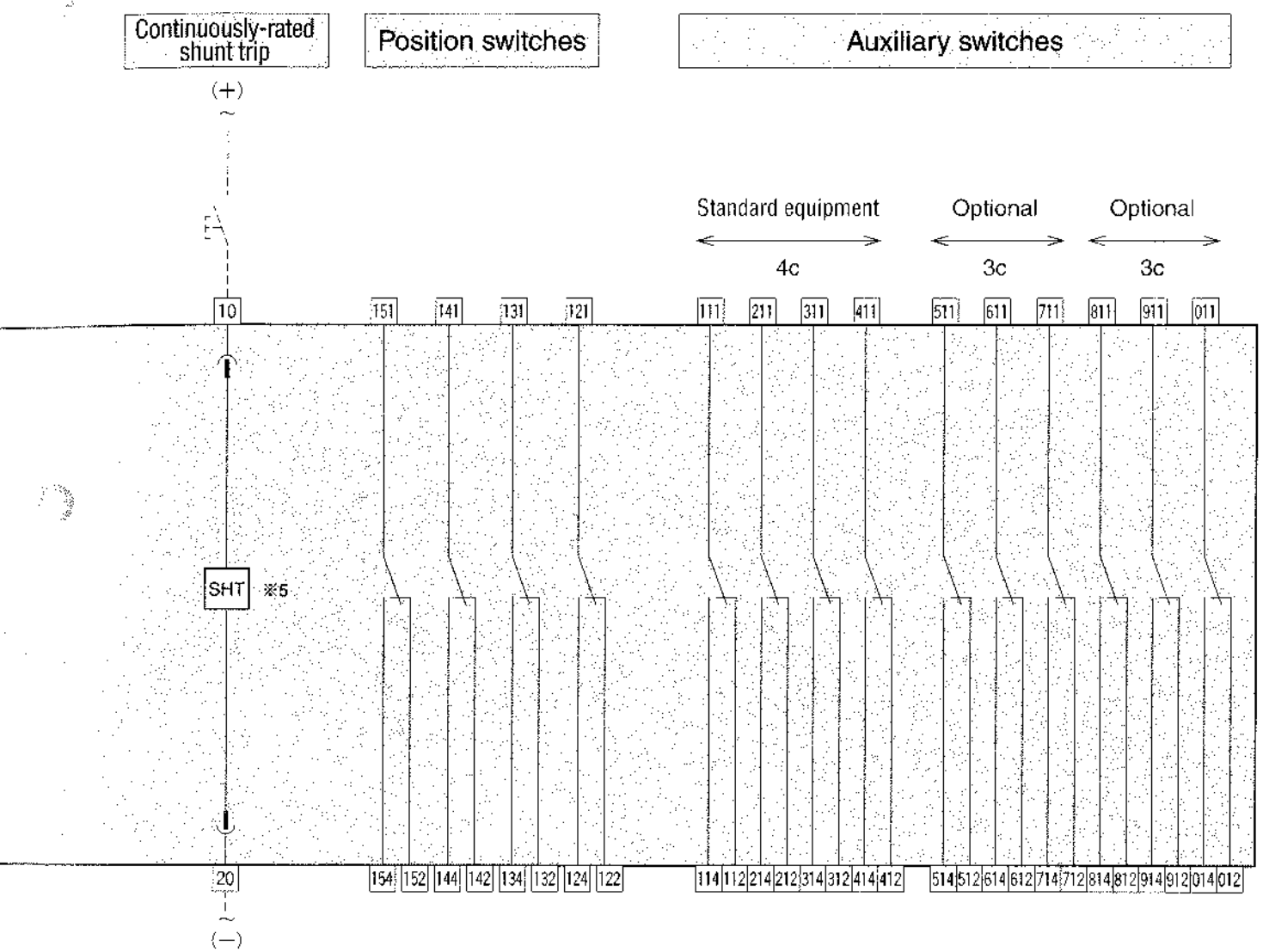
※1: Operation input signal is rated at DC40V 5mA.
※2: Used for separation of operation input signals.
※3: Can be used for trip indicator in place of UVT indication.
※4: For AGR-22 OCR connect the measured power source to the terminals, 08, 18, 28, 09.
In case of no reverse power trip function with AGR-21 OCR, UVT can be used with single phase power supply as right.



※5: See P. 21 for the circuit diagram of the continuously-rated shunt trip device with capacitor trip device.

Designation of terminals for auxiliary and position switches

1: Common, 2: b-contact, 4: a-contact
1: Auxiliary switch
2: Position switch (for CONNECTED)
3: Position switch (for TEST)
4: Position switch (for ISOLATED)
5: Position switch (for INSERT)
1 – 0: Switch numbers
A, B, C: Auxiliary switches for microload



	Position switches			
Top	151	141	131	121
Middle	154	144	134	124
Bottom	152	142	132	122

Operation/control circuits									
01	02	03	04	05	06	07	08	09	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30

Auxiliary switches

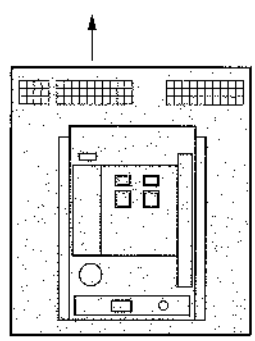
111	211	311	411	511	611	711	811	911	011
114	214	314	414	514	614	714	814	914	014
112	212	312	412	512	612	712	812	912	012

(Standard 4c + optional 6c arrangement)

Top	131	121
Middle	134	124
Bottom	132	122

111	211	311	411
114	214	314	414
112	212	312	412

(Standard 4c arrangement)



CONNECTED position : 121–124 ON
121–122 OFF
TEST position : 131–134 ON
131–132 OFF
ISOLATED position : 141–144 ON
141–142 OFF
INSERT position : 151–154 ON
151–152 OFF

For operation sequence of position switches, see page 17.

7 Technical Data

Dielectric strength

Circuit			Withstand voltage (at 50/60 Hz)		Rated Impulse withstand voltage U_{imp}
Main circuit			Between terminals, terminal group to earth	AC3500V for 1 minute	12kV
Control circuits	Auxiliary switches	For general service	Terminal group to earth	AC2500V for 1 minute	6kV
		For microload	Terminal group to earth	AC2000V for 1 minute	4kV
	Position switches		Terminal group to earth	AC2000V for 1 minute	4kV
	Over-current release (OCR)		Terminal group to earth	AC2000V for 1 minute	4kV
	Power supply for undervoltage/ reverse power trip function		Terminal group to earth	AC2500V for 1 minute	6kV
Other accessories			Terminal group to earth	AC2000V for 1 minute	4kV

Note: The values shown above are those measured on phase connections and cannot be applied to control terminals on the ACB.

Internal resistance and power consumption

• Standard Series

Type	AR208S	AR212S	AR216S	AR220S	AR325S	AR332S	AR440S
Rated current (A)	800	1250	1600	2000	2500	3200	4000
DC internal resistance per pole (mΩ)	0.030	0.030	0.028	0.024	0.014	0.014	0.014
AC power consumption for 3 poles (W)	170	310	350	490	600	780	1060

• High fault Series

Type	AR212H	AR216H	AR220H	AR316H	AR320H	AR325H	AR332H
Rated current (A)	1250	1600	2000	1600	2000	2500	3200
DC internal resistance per pole (mΩ)	0.024	0.024	0.024	0.014	0.014	0.014	0.014
AC power consumption for 3 poles (W)	260	350	490	310	430	600	780

Derating

• Standard Series

Based Standards	Ambient temperature (°C)	Type	AR208S	AR212S	AR216S	AR220S	AR325S	AR332S	AR440S
		Connecting bar sizes	2×50×5t	2×80×5t	2×100×5t	3×100×5t	2×100×10t	3×100×10t	4×150×6t
IEC60947-2 EN 60947-2 AS3947.2 JIS C8201-2	40 (Standard ambient temperature)		800	1250	1600	2000	2500	3200	4000
	45		800	1250	1600	2000	2500	3200	4000
	50		800	1250	1600	2000	2500	3200	4000
	55		800	1250	1600	1820	2500	2990	4000
	60		800	1250	1460	1740	2400	2850	3760
NEMA, SG-3 ANSI C37.13	40 (Standard ambient temperature)		800	1250	1540	2000	2500	3200	3700
	45		800	1240	1470	1960	2500	3010	3580
	50		800	1180	1390	1860	2440	2860	3470
	55		800	1110	1310	1750	2300	2690	3350
	60		800	1040	1230	1640	2150	2520	3150
JIS C8372	40 (Standard ambient temperature)		800	1250	1600	2000	2500	3200	3700
	45		800	1250	1600	1900	2470	2900	3580
	50		800	1250	1540	1820	2400	2800	3470
	55		800	1250	1460	1740	2310	2710	3350
	60		800	1230	1390	1650	2230	2610	3230

Note: The values are applicable for both Draw-out type and Fixed type.
The values of AR208S, AR212S and AR216S are for horizontal terminals on both line and load side.
The values of AR220S, AR325S, AR332S and AR440S are for vertical terminals on both line and load side.
Above figures are subject to the design of the enclosure and rating of busbar.

• High fault Series

Based Standards	Ambient temperature (°C)	Type	AR212H	AR216H	AR220H	AR316H	AR320H	AR325H	AR332H
		Connecting bar sizes	2×80×5t	2×100×5t	3×100×5t	2×100×5t	3×100×5t	2×100×10t	3×100×10t
IEC60947-2 EN 60947-2 AS3947.2 JIS C8201-2	40 (Standard ambient temperature)		1250	1600	2000	1600	2000	2500	3200
	45		1250	1600	2000	1600	2000	2500	3200
	50		1250	1600	2000	1600	2000	2500	3200
	55		1250	1600	1820	1600	2000	2500	2990
	60		1250	1550	1740	1600	2000	2400	2850
NEMA, SG-3 ANSI C37.13	40 (Standard ambient temperature)		※	1600	2000	※	※	2500	3200
	45		※	1560	1960	※	※	2500	3010
	50		※	1480	1860	※	※	2440	2860
	55		※	1390	1750	※	※	2300	2690
	60		※	1300	1640	※	※	2150	2520
JIS C8372	40 (Standard ambient temperature)		1250	1600	2000	1600	2000	2500	3200
	45		1250	1600	1900	1600	2000	2500	2900
	50		1250	1600	1820	1600	2000	2500	2800
	55		1250	1550	1740	1600	2000	2400	2710
	60		1250	1480	1650	1600	1900	2280	2610

Note: The values are for vertical terminals on both line and load side.
Above figures are subject to the design of the enclosure and rating of busbar.
※: Contact Terasaki for details.

8 TemPower Order Form (With AGR-11 OCR or Without OCR)

For general feeder circuits (L/R-characteristic)

Please check boxes and fill in underlined spaces as appropriate.

Your company name: _____ Order Number: _____

Quantity _____ Delivery time required _____

Your specifications

1 Type
☐ AR208S ☐ AR212S ☐ AR216S ☐ AR220S ☐ AR325S ☐ AR332S ☐ AR440S
☐ AR212H ☐ AR216H ☐ AR220H ☐ AR316H ☐ AR320H ☐ AR325H ☐ AR332H

2 Number of poles
☐ 3-pole ☐ 4-pole
For the requirement of 2-pole type, specify 3-pole type and use 2 poles on both sides.

3 Circuit voltage and frequency
AC_____V. _____Hz. DC_____V. ☐ 3ø3W ☐ 3ø4W

4 Applicable standard and ambient temperature
Applicable standard _____
☐ 40°C ☐ 45°C

5 Type of mounting
☐ Fixed type
☐ Draw-out type
☐ Draw-out handle _____ pcs.
☐ Draw-out storage handle _____ pcs. ※1
☐ Main circuit safety shutter
☐ Padlocking unit
☐ Control circuit safety shutter
☐ Test jumper (lead wire 5m) _____ sets
☐ Breaker fixing bolts
☐ Mal-insertion prevention device
Code _____ pcs. Code _____ pcs, Code _____ pcs
☐ Position switches type ALR-_____P
☐ Door interlock
☐ Lifting plates
☐ Earthing device
☐ Inter-pole barrier

Line side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections
Load side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections

Control circuit terminals: ☐Tab terminals ☐Screw terminals

6 Type of spring charged operation
☐ Manual charging
☐ Motor charging Supply voltage AC_____V, DC_____V
☐ Step-down transformer _____sets

☐ Automatic closing spring release
☐ Spring charge indicator

7 Over-current release (OCR)
(1) OCR type AGR-11☐-☐☐☐
N: N-phase protection
(2) Control power
☐ AC100–120V / AC200–240V Common ☐ DC100–125V / DC200–250V Common ☐ DC24V / DC48V Common
(3) Rated primary current [I_{CT}] _____A
(4) Rated current [I_n] _____A
(5) LT [I_R] _____A ([I_n] × _____%) [t_R] _____s at 600% [I_R] for L-char. / at 300% [I_R] for R-char.
(6) ST [I_{sd}] _____A ([I_n] × _____%) [t_{sd}] _____ms
(7) ☐ INST ☐ MCR [I_i] _____A ([I_n] × _____%) ※2
(8) PTA [I_{P1}] _____A ([I_n] × _____%) [t_{P1}] _____s at [I_{P1}] or more
(9) GF [I_g] _____A ([I_{CT}] × _____%) [t_g] _____ms
☐ CT for neutral line
(10) NP [I_N] _____A ([I_{CT}] × _____%) (Factory set to a fixed value)

8 Electrical tripping devices
☐ Continuously-rated shunt trip device AC_____V, DC_____V ☐ Capacitor trip device
☐ Fixed type Undervoltage Trip AC_____V, DC_____V ※3, ☐ AUR-1BS ☐ AUR-1BD

9 Other accessories
☐ ON-OFF cycle counter
☐ Auxiliary switches type AXR-_____
☐ Key lock (☐ Lock-in OFF ☐ Lock-in ON)
☐ Key interlock (☐ Cylinder lock ☐ Castell lock) (Castell lock not supplied)
☐ Mechanical interlock
P1: _____ mm P2: _____ mm
ACB Ⓐ: Type _____ _____ poles
ACB Ⓑ: Type _____ _____ poles
ACB Ⓒ: Type _____ _____ poles
☐ Control circuit terminal cover
☐ IP55 cover
☐ OFF padlock
☐ Door flange (☐ IP20 ☐ IP31)
☐ Trip indicator

10 Special environment specification
☐ Not required
☐ Tropicalization (fungus and moisture treatment) ☐ Cold climate treatment ☐ Anti-corrosion treatment

11 Spare parts
☐ Not required ☐ Required (Contact Terasaki for recommended spare parts)

12 Test report
☐ English _____ copies

13 Other
☐ Lifter
☐ OCR checker with AC100–110V power supply ☐ OCR checker with AC100–240V power supply + Type C plug

※1: When you require the Draw-out storage handle, please specify with ACBs on order.
※2: When the AR-H High fault series ACBs are used without Instantaneous trip function MCR should be set to work.
The rated breaking capacity will reduce to the level of the latching current without MCR function.
※3: Fixed type Undervoltage Trip can not be fitted with shunt trip device. However, Instantaneously rated shunt trip can be used together with fixed type undervoltage trip with special specification. Contact terasaki for details.

8 TemPower Order Form (With AGR-21,22 OCR)

For general feeder circuits (L/R-characteristic)

Please check boxes and fill in underlined spaces as appropriate.

Your company name: _____ Order Number: _____

Quantity _____ Delivery time required _____

Your specifications

1 Type
☐ AR208S ☐ AR212S ☐ AR216S ☐ AR220S ☐ AR325S ☐ AR332S ☐ AR440S
☐ AR212H ☐ AR216H ☐ AR220H ☐ AR316H ☐ AR320H ☐ AR325H ☐ AR332H

2 Number of poles
☐ 3-pole ☐ 4-pole
For the requirement of 2-pole type, specify 3-pole type and use 2 poles on both sides.

3 Circuit voltage and frequency
AC_____V. _____Hz. DC_____V. ☐ 3ø3W ☐ 3ø4W

4 Applicable standard and ambient temperature
Applicable standard _____
☐ 40°C ☐ 45°C

5 Type of mounting
☐ Fixed type

☐ Draw-out type
☐ Draw-out handle _____ pcs.
☐ Draw-out storage handle _____ pcs. ※1
☐ Main circuit safety shutter
☐ Padlocking unit
☐ Control circuit safety shutter
☐ Test jumper (lead wire 5m) _____ sets
☐ Breaker fixing bolts
☐ Mal-insertion prevention device
Code _ _ __ pcs, Code _ _ __ pcs, Code _ _ __ pcs
☐ Position switches type ALR-_____P
☐ Door interlock
☐ Lifting plates
☐ Earthing device
☐ Inter-pole barrier

Line side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections
Load side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections

Control circuit terminals: ☐Tab terminals ☐Screw terminals

6 Type of spring charged operation
☐ Manual charging ☐ Motor charging Supply voltage AC_____V, DC_____V
☐ Step-down transformer _____sets

☐ Automatic closing spring release

7 Over-current release (OCR)
(1) OCR type AGR-2☐☐-☐☐☐☐☐☐☐☐
C : Communication function (MODBUS)
P : Operation panel ※3
O : Contact temperature monitoring 155°C ※3
N : N-phase protection
AGR-22
(Contact TERASAKI for details)

(2) Control power
☐ AC100–120V / AC200–240V Common ☐ DC100–125V / DC200–250V Common ☐ DC24V / DC48V Common

(3) Rated primary current [I_{CT}] _____A
(4) Rated current [I_n] _____A
(5) UVT rated supply voltage [U_c] _____V
(6) LT [I_R] _____A ([I_n] × _____%) [t_R] _____s at 600% [I_R] for L-char. / at 300% [I_R] for R-char.
(7) ST [I_{sd}] _____A ([I_n] × _____%) [t_{sd}] _____ms
(8) ☐ INST ☐ MCR [I_i] _____A ([I_n] × _____%) ※4
(9) PTA [I_{PT}] _____A ([I_n] × _____%) [t_{P1}] _____s at [I_{P1}] or more
(10) GF [I_g] _____A ([I_{CT}] × _____%) [t_g] _____ms
☐ CT for neutral line
(11) NP [I_N] _____A ([I_{CT}] × _____%) (Factory set to a fixed value)
(12) ELT [$I_{\Delta R}$] _____A [$t_{\Delta R}$] _____ms
(13) UVT Pick-up voltage setting _____V ([Uc] × _____%) Time setting ____s

(14) Power supply unit for communication
☐ AC100–120V, 200–240V DC100–125V, 200–250V
☐ DC24V
☐ DC48V

8 Electrical tripping devices
☐ Tripping coil TC ※2 ☐ Continuously-rated shunt trip device AC_____V, DC_____V
☐ Capacitor trip device

9 Other accessories
☐ Operation panel
☐ ON-OFF cycle counter
☐ Auxiliary switches type AXR-____
☐ Manual reset device (Contact TERASAKI for details)
☐ Key lock (☐ Lock-in OFF ☐ Lock-in ON)
☐ Key interlock (☐ Cylinder lock ☐ Castell lock) (Castell lock not supplied)
☐ Mechanical interlock
P1: _____ mm P2: _____ mm
ACB Ⓐ: Type _____ ____ poles
ACB Ⓑ: Type _____ ____ poles
ACB Ⓒ: Type _____ ____ poles
☐ Control circuit terminal cover
☐ IP55 cover
☐ OFF padlock
☐ Door flange (☐ IP20 ☐ IP31)

10 Special environment specification
☐ Not required
☐ Tropicalization (fungus and moisture treatment) ☐ Cold climate treatment ☐ Anti-corrosion treatment

11 Spare parts
☐ Not required ☐ Required (Contact Terasaki for recommended spare parts)

12 Test report
☐ English ____ copies

13 Other
☐ Lifter
☐ OCR checker with AC100–110V power supply ☐ OCR checker with AC100–240V power supply + Type C plug

※1: When you require the Draw-out storage handle, please specify with ACBs on order. ※2: The tripping coil comes standard with ACBs equipped with OCR.
※3: Available for AGR-21 only ※4: When the AR-H High fault series ACBs are used without Instantaneous trip function MCR should be set to work. The rated breaking capacity will reduce to the level of the latching current without MCR function.

8 TemPower Order Form (With AGR-11 OCR or Without OCR)

For generator protection (S-characteristic)

Please check boxes and fill in underlined spaces as appropriate.

Your company name: _____ Order Number: _____

Quantity _____ Delivery time required _____

Your specifications

1 Type
☐ AR208S ☐ AR212S ☐ AR216S ☐ AR220S ☐ AR325S ☐ AR332S ☐ AR440S
☐ AR212H ☐ AR216H ☐ AR220H ☐ AR316H ☐ AR320H ☐ AR325H ☐ AR332H

2 Number of poles
☐ 3-pole ☐ 4-pole
For the requirement of 2-pole type, specify 3-pole type and use 2 poles on both sides.

3 Circuit voltage and frequency
AC_____V. _____Hz. DC_____V. ☐ 3ø3W ☐ 3ø4W

4 Applicable standard and ambient temperature
Applicable standard _____
☐ 40°C ☐ 45°C

5 Type of mounting
☐ Fixed type

☐ Draw-out type
- ☐ Draw-out handle _____ pcs.
- ☐ Draw-out storage handle _____ pcs. ※1
- ☐ Main circuit safety shutter
- ☐ Padlocking unit
- ☐ Control circuit safety shutter
- ☐ Test jumper (lead wire 5m) _____ sets
- ☐ Breaker fixing bolts
- ☐ Mal-insertion prevention device
  Code _ _ _ pcs, Code _ _ _ pcs, Code _ _ _ pcs
- ☐ Position switches type ALR-_____P
- ☐ Door interlock
- ☐ Lifting plates
- ☐ Earthing device
- ☐ Inter-pole barrier

Line side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections
Load side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections

Control circuit terminals: ☐Tab terminals ☐Screw terminals

6 Type of spring charged operation
☐ Manual charging
☐ Motor charging Supply voltage AC_____V, DC_____V
☐ Step-down transformer _____ sets

☐ Automatic closing spring release
☐ Spring charge indicator

7 Over-current release (OCR)
(1) OCR type AGR-11S-☐☐
(2) Control power
☐ AC100–120V / AC200–240V Common ☐ DC100–125V / DC200–250V Common ☐ DC24V / DC48V Common
(3) Rated primary current [I_{CT}] _____A
(4) Generator rated current [I_n] _____A
(5) LT [I_R] _____A ([I_n] × _____%) [t_R] _____s at 120% [I_R]
(6) ST [I_{sd}] _____A ([I_n] × _____%) [t_{sd}] _____ms
(7) ☐ INST ☐ MCR [I_i] _____A ([I_n] × _____%) ※3
(8) PTA [I_{P1}] _____A ([I_n] × _____%) [t_{P1}] _____s at [I_{P1}] or more

8 Electrical tripping devices
☐ Continuously-rated shunt trip device AC_____V, DC_____V ☐ Capacitor trip device
☐ Fixed type Undervoltage Trip AC_____V, DC_____V ※2, ☐ AUR-1BS ☐ AUR-1BD

9 Other accessories
☐ ON-OFF cycle counter
☐ Auxiliary switches type AXR-_____
☐ Key lock (☐ Lock-in OFF ☐ Lock-in ON)
☐ Key interlock (☐ Cylinder lock ☐ Castell lock) (Castell lock not supplied)
☐ Mechanical interlock
P1: _____ mm P2: _____ mm
ACB Ⓐ: Type _____ ____ poles
ACB Ⓑ: Type _____ ____ poles
ACB Ⓒ: Type _____ ____ poles
☐ Control circuit terminal cover
☐ IP55 cover
☐ OFF padlock
☐ Door flange (☐ IP20 ☐ IP31)
☐ Trip indicator

10 Special environment specification
☐ Not required
☐ Tropicalization (fungus and moisture treatment) ☐ Cold climate treatment ☐ Anti-corrosion treatment

11 Spare parts
☐ Not required ☐ Required (Contact Terasaki for recommended spare parts)

12 Test report
☐ English _____ copies

13 Other
☐ Lifter
☐ OCR checker with AC100–110V power supply ☐ OCR checker with AC100–240V power supply + Type C plug

※1: When you require the Draw-out storage handle, please specify with ACBs on order.
※2: Fixed type Undervoltage Trip can not be fitted with shunt trip device. However, Instantaneously rated shunt trip can be used together with fixed type undervoltage trip with special specification. Contact terasaki for details.
※3: When the AR-H High fault series ACBs are used without Instantaneous trip function MCR should be set to work. The rated breaking capacity will reduce to the level of the latching current without MCR function.

TemPower Order Form (With AGR-21,22 OCR)

For generator protection (S-characteristic)

Please check boxes and fill in underlined spaces as appropriate.

Your company name: _____ Order Number: _____

Quantity _____ Delivery time required _____

Your specifications

1 Type
☐ AR208S ☐ AR212S ☐ AR216S ☐ AR220S ☐ AR325S ☐ AR332S ☐ AR440S
☐ AR212H ☐ AR216H ☐ AR220H ☐ AR316H ☐ AR320H ☐ AR325H ☐ AR332H

2 Number of poles
☐ 3-pole ☐ 4-pole
For the requirement of 2-pole type, specify 3-pole type and use 2 poles on both sides.

3 Circuit voltage and frequency
AC_____V, _____Hz, DC_____V. ☐ 3ø3W ☐ 3ø4W

4 Applicable standard and ambient temperature
Applicable standard _____
☐ 40°C ☐ 45°C

5 Type of mounting
☐ Fixed type

☐ Draw-out type
☐ Draw-out handle _____ pcs.
☐ Draw-out storage handle _____ pcs. ※1
☐ Main circuit safety shutter
☐ Padlocking unit
☐ Control circuit safety shutter
☐ Test jumper (lead wire 5m) _____ sets
☐ Breaker fixing bolts
☐ Mal-insertion prevention device
Code __ __ pcs, Code __ __ pcs, Code __ __ pcs
☐ Position switches type ALR-_____P
☐ Door interlock
☐ Lifting plates
☐ Earthing device
☐ Inter-pole barrier

Line side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections
Load side: ☐Horizontal terminals ☐Vertical terminals ☐Front connections

Control circuit terminals: ☐Tab terminals ☐Screw terminals

6 Type of spring charged operation
☐ Manual charging
☐ Motor charging Supply voltage AC_____V, DC_____V
☐ Step-down transformer _____sets

☐ Automatic closing spring release

7 Over-current release (OCR)
(1) OCR type AGR-2☐S-☐☐☐☐☐☐☐
AGR-22
(Contact TERASAKI for details)
C : Communication function (MODBUS)
P : Operation panel ※2
O : Contact temperature monitoring 155°C ※2

(2) Control power
☐ AC100–120V / AC200–240V } Common ☐ DC100–125V / DC200–250V } Common ☐ DC24V / DC48V } Common
(3) Rated primary current [I_{CT}] _____A
(4) Generator rated current [I_n] _____A
(5) RPT/UVT rated supply voltage [U_c] _____V
(6) LT [I_R] _____A ([I_n] × _____%) [t_R] _____s at 120% [I_R]
(7) ST [I_{sd}] _____A ([I_n] × _____%) [t_{sd}] _____ms
(8) ☐ INST ☐ MCR [I_i] _____A ([I_n] × _____%) ※3
(9) PTA [I_{P1}] _____A ([I_n] × _____%) [t_{P1}] _____s at [I_{P1}] or more
(10) PTA2 [I_{P2}] _____A ([I_n] × _____%)
(11) RPT [P_R] _____kW ([P_n] × _____%) Time setting _____s at [P_R] ※4
(12) UVT Pick-up voltage setting _____V ([Uc] × _____%) Time setting ____s

(13) Power supply unit for communication
☐ AC100–120V, 200–240V
☐ DC100–125V, 200–250V
☐ DC24V
☐ DC48V

8 Electrical tripping devices
☐ Tripping coil TC ※5 ☐ Continuously-rated shunt trip device AC_____V, DC_____V
☐ Capacitor trip device

9 Other accessories
☐ Operation panel
☐ ON-OFF cycle counter
☐ Auxiliary switches type AXR-_____
☐ Manual reset device (Contact TERASAKI for details)
☐ Key lock (☐ Lock-in OFF ☐ Lock-in ON)
☐ Key interlock (☐ Cylinder lock ☐ Castell lock) (Castell lock not supplied)
☐ Mechanical interlock
P1: _____ mm P2: _____ mm
ACB Ⓐ: Type _____ ____ poles
ACB Ⓑ: Type _____ ____ poles
ACB Ⓒ: Type _____ ____ poles
☐ Control circuit terminal cover
☐ IP55 cover
☐ OFF padlock
☐ Door flange (☐ IP20 ☐ IP31)

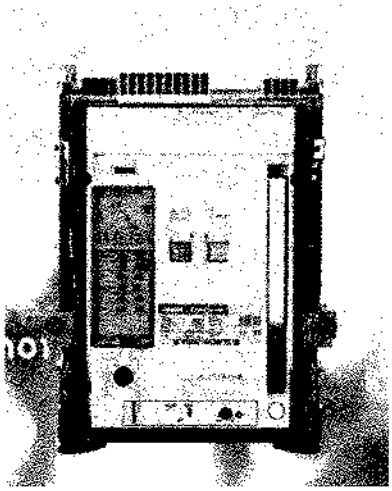
10 Special environment specification
☐ Not required
☐ Tropicalization (fungus and moisture treatment) ☐ Cold climate treatment ☐ Anti-corrosion treatment

11 Spare parts
☐ Not required ☐ Required (Contact Terasaki for recommended spare parts)

12 Test report
☐ English ____ copies

13 Other
☐ Lifter
☐ OCR checker with AC100–110V power supply ☐ OCR checker with AC100–240V power supply + Type C plug

※1: When you require the Draw-out storage handle, please specify with ACBs on order.
※2: Available for AGR-21 only
※3: When the AR-H High fault series ACBs are used without Instantaneous trip function MCR should be set to work.
The rated breaking capacity will reduce to the level of the latching current without MCR function.
※4: CT for RPT is not provided in the case of AR440S.
※5: The tripping coil comes standard with ACBs equipped with OCR.



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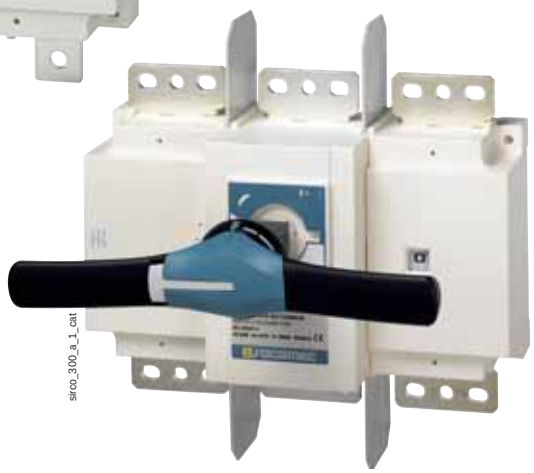
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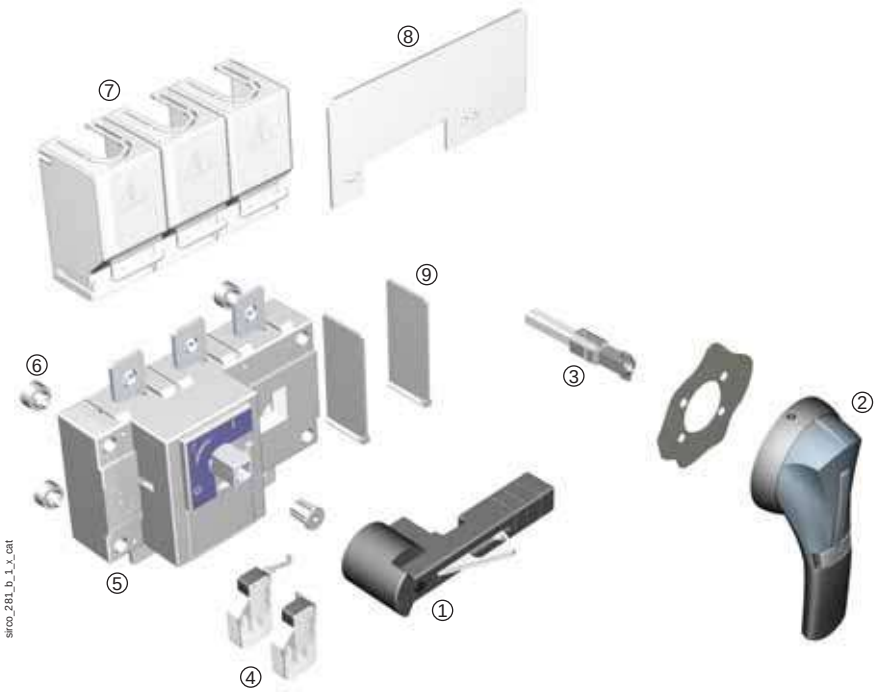
Ratings and specifications in this catalogue may be subject to change without notice

SIRCO
40 to 4000 A

Functions
References
Accessories
Characteristics
Dimensions







Overview (for further details, please see the installation instructions supplied with each device).

1. Direct front operation
2. External front operation
3. Shaft extension
4. IP2 auxiliary contacts
5. Switch body
6. Spacers
7. IP2 terminal shrouds
8. Terminal screens
9. Inter phase barrier

Functions

SIRCO switches are manually operated or motorised multipolar load break switches. They break on and off under load and provide safety isolation for any low voltage circuit.

Conformity to standards

- IEC 60947-3
- EN 60947-3
- VDE 0660 Part 107 (1992)
- NBN EN 60947-3
- BS EN 60947-3

Approvals and certifications

- Bureau Véritas
- Lloyd's Register of Shipping
- CEBEC (Belgium)
- FI (Finland)
- ASEFA
- KEMA
- CCA
- GOST (Russia)
- BBJ Poland (attestation of verification)
- PSA E03.15.605.G
- RENAULT EB03.15.613

(1) In progress for certain ratings.

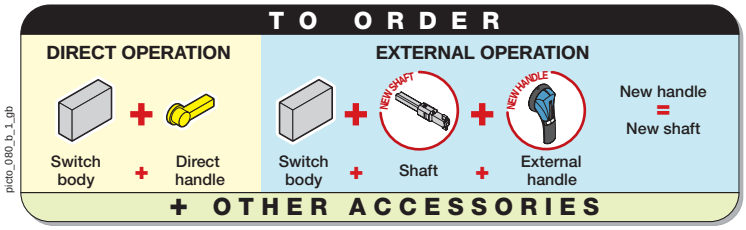
General characteristics

- Fully visible breaking
- High thermal and dynamic withstand
- Severe utilisation categories (AC-22 and AC-23)
- Good electrical and mechanical endurance
- High resistance to humidity (supplied "tropicalised")

Available on request

- Early break auxiliaries
- SIRCO 9 and 12 poles up to 1600 A
- 3 pole + solid neutral
- Early break advanced neutral for networks charged with harmonics
- Conducting neutral
- Neutral earthing stud
- Connection terminals bolts not supplied from 800 to 4000 A.
- Double rated Neutral.

This document is not a contract. SOCOMEC reserves the right to modify features without prior notice in view of continued improvement. 2006-2007



References





Switches

	40 A	63 A	80 A	100 A
Front operation switch (switch body only)				
No. of poles	References	References	References	References
3 pole	2600 **3004**	2600 **3006**	2600 **3008**	2600 **3010**
4 pole	2600 **4004**	2600 **4006**	2600 **4008**	2600 **4010**
6 pole	(1)	(1)	(1)	(1)
8 pole	(1)	(1)	(1)	(1)

Accessories

		40 A	63 A	80 A	100 A
Direct front operation handle					
Black		2699 **5012**	2699 **5012**	2699 **5012**	2699 **5012**
Red		2699 **5013**	2699 **5013**	2699 **5013**	2699 **5013**
Door interlocked external front operation(2)					
Black		2699 **5125***	2699 **5125***	2699 **5125***	2699 **5125***
Red		2699 **5123**	2699 **5123**	2699 **5123**	2699 **5123**
Shaft extensions for external operation (for dimensions, see “Accessories” pages)					
200 mm		2699 **3003***	2699 **3003***	2699 **3003***	2699 **3003***
300 mm		2699 **3023**	2699 **3023**	2699 **3023**	2699 **3023**
400 mm		2699 **3013**	2699 **3013**	2699 **3013**	2699 **3013**
Auxiliary contacts					
2 AC	NO/NC changeover	2999 **0012**	2999 **0012**	2999 **0012**	2999 **0012**
Terminal shrouds (1 set)					
3 / 4 pole	top / bottom	included	included	2994 **4008**	2994 **4008**
Terminal screens (1 set)					
3 / 4 pole	top / bottom	2998 **3008**	2998 **3008**	2998 **3008**	2998 **3008**
Shrouded distribution block(3)					
3 / 4 pole		5420 **4108**	5420 **4108**	5420 **4108**	5420 **4108**
Cage terminals					
3 / 4 pole		included	included		

** Standard*
(1) See “SIRCO VM” pages.
(2) S type handle not suitable for SIRCO 40 to 100 A and 2000 to 4000 A ratings. For additionnal features i.e. defeatable facility or higher IP ratings, please see COMO M (page A.6) or SIRCO VM ranges (page A.40)
(3) For dimensions and characteristics, see page C.80 “Distribution blocks” in the family “Mounting and cabling accessories”.

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SIRCO
40 to 4000 A

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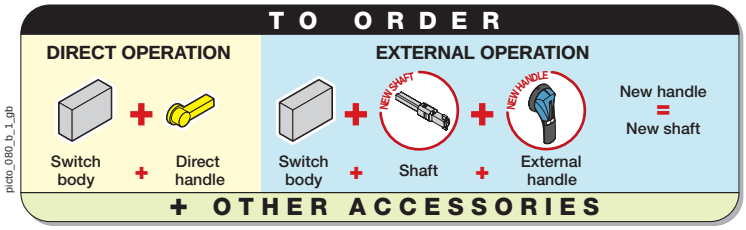




Switches				125 A	160 A	200 A	250 A
Front operation switch (switch body only)							
No. of poles				References	References	References	References
3 pole				2600 **3014**	2600 **3017**	2600 **3021**	2600 **3026**
4 pole				2600 **4014**	2600 **4017**	2600 **4021**	2600 **4026**
6 pole				2601 **6013**	2601 **6016**		2601 **6025**
8 pole				2601 **8013**	2601 **8016**		2601 **8025**
Accessories							
Direct front operation handle							
Black		3/4 pole		2699 **5042**	2699 **5042**	2699 **5052**	2699 **5052**
Red		3/4 pole		2699 **5043**	2699 **5043**	2699 **5053**	2699 **5053**
Black		6/8 pole		4199 **5012**	4199 **5012**		2799 **7052**
Red		6/8 pole					2799 **7053**
Door interlocked external front operation							
Black	S2 type	3/4 pole	IP55	1421 **2111***	1421 **2111***	1421 **2111***	1421 **2111***
Black	S2 type	3/4 pole	IP65	1423 **2111**	1423 **2111**	1423 **2111**	1423 **2111**
Red / Yellow	S2 type	3/4 pole	IP65	1424 **2111**	1424 **2111**	1424 **2111**	1424 **2111**
Black	S2 type	6/8 pole	IP55	1421 **2111**	1421 **2111**		1433 **3111**(1)*
Red / Yellow	S2 type	6/8 pole	IP65	1424 **2111**	1424 **2111**		1434 **3111**
Shaft extensions for external operation (for dimensions, see “Accessories” pages)							
200 mm	S type	3/4 pole		1400 **1020**	1400 **1020**	1400 **1020**	1400 **1020**
200 mm	S type	6/8 pole		1400 **1020**	1400 **1020**		1401 **1520**
320 mm	S type	3/4 pole		1400 **1032***	1400 **1032***	1400 **1032***	1400 **1032***
320 mm	S type	6/8 pole		1400 **1032***	1400 **1032***		1401 **1532***
400 mm	S type	6/8 pole					1401 **1540**
500 mm	S type	3/4/6/8 pole		1400 **1050**	1400 **1050**	1400 **1050**	1400 **1050**
Auxiliary contact							
1st AC	NO/NC changeover	3/4 pole		2699 **0031**	2699 **0031**	2699 **0031**	2699 **0031**
2nd AC	NO/NC changeover	3/4 pole		2699 **0032**	2699 **0032**	2699 **0032**	2699 **0032**
1st AC	NO/NC changeover	6/8 pole		2699 **0061**	2699 **0061**		2699 **0061**
2nd AC	NO/NC changeover	6/8 pole		2699 **0062**	2699 **0062**		2699 **0062**
Terminal shrouds (1 set)							
3 / 6 pole		top / bottom		2694 **3014**	2694 **3014**	2694 **3021**	2694 **3021**
4 / 8 pole		top / bottom		2694 **4014**	2694 **4014**	2694 **4021**	2694 **4021**
Terminal screens (1 set)							
3 pole		top / bottom		2698 **3012**	2698 **3012**	2698 **3020**	2698 **3020**
4 pole		top / bottom		2698 **4012**	2698 **4012**	2698 **4020**	2698 **4020**
Inter phase barriers							
3 pole				2998 **0033**	2998 **0033**	2998 **0023**	2998 **0023**
4 pole				2998 **0034**	2998 **0034**	2998 **0024**	2998 **0024**
Shrouded distribution block							
3 / 4 pole				5420 **4112**(2)	5420 **4016**(2)		
Bottom distribution kit							
3 pole				5411 **3016**(2)	5411 **3016**(2)	5411 **3025**(2)	5411 **3025**(2)
4 pole				5411 **4016**(2)	5411 **4016**(2)	5411 **4025**(2)	5411 **4025**(2)
Cage terminals							
3 pole				5400 **3016**	5400 **3016**	5400 **3025**	5400 **3025**
4 pole				5400 **4016**	5400 **4016**	5400 **4025**	5400 **4025**

** Standard*
(1) S3 type handle, IP65
(2) For dimensions and characteristics, see page C.80 “Distribution blocks” in the family “Mounting and cabling accessories”.

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picto_080_b_1_gb

References


sirco_294_a_2_cat


sirco_295_a_2_cat

Switches

	315 A	400 A	500 A	630 A
Front operation switch (switch body only)				
No. of poles	References	References	References	References
3 pole	2600 **3032**	2600 **3041**	2600 **3051**	2600 **3064**
4 pole	2600 **4032**	2600 **4041**	2600 **4051**	2600 **4064**
6 pole		2601 **6040**		2601 **6063**
8 pole		2601 **8040**		2601 **8063**

Accessories

				315 A	400 A	500 A	630 A
Direct front operation handle							
Black		3/4 pole		2699 **5052**	2699 **5052**	2699 **5052**	2699 **5052**
Red		3/4 pole		2699 **5053**	2699 **5053**	2699 **5053**	2699 **5053**
Black		6/8 pole			2799 **7052**		2799 **7052**
Red		6/8 pole			2799 **7053**		2799 **7053**
Door interlocked external front operation							
Black	S2 type	3/4 pole	IP55	1421 **2111***	1421 **2111***	1421 **2111***	1421 **2111***
Black	S2 type	3/4 pole	IP65	1423 **2111**	1423 **2111**	1423 **2111**	1423 **2111**
Red / Yellow	S2 type	3/4 pole	IP65	1424 **2111**	1424 **2111**	1424 **2111**	1424 **2111**
Black	S3 type	6/8 pole	IP65		1433 **3111***		1433 **3111***
Red / Yellow	S3 type	6/8 pole	IP65		1434 **3111**		1434 **3111**
Shaft extensions for external operation (for dimensions, see “Accessories” pages)							
200 mm	S type	3/4 pole		1400 **1020**	1400 **1020**	1400 **1020**	1400 **1020**
320 mm	S type	3/4 pole		1400 **1032***	1400 **1032***	1400 **1032***	1400 **1032***
500 mm	S type	3/4 pole		1400 **1050**	1400 **1050**	1400 **1050**	1400 **1050**
200 mm	S type	6/8 pole			1401 **1520**		1401 **1520**
320 mm	S type	6/8 pole			1401 **1532***		1401 **1532***
Auxiliary contact							
1st AC	NO/NC changeover	3/4 pole		2699 **0031**	2699 **0031**	2699 **0031**	2699 **0031**
2nd AC	NO/NC changeover	3/4 pole		2699 **0032**	2699 **0032**	2699 **0032**	2699 **0032**
1st AC	NO/NC changeover	6/8 pole			2699 **0061**		2699 **0061**
2nd AC	NO/NC changeover	6/8 pole			2699 **0062**		2699 **0062**
Terminal shrouds (1 set)							
3 pole		top / bottom		2694 **3051**	2694 **3051**	2694 **3051**	2694 **3051**
4 pole		top / bottom		2694 **4051**	2694 **4051**	2694 **4051**	2694 **4051**
Terminal screens (1 set)							
3 pole		top / bottom		2698 **3050**	2698 **3050**	2698 **3050**	2698 **3050**
4 pole		top / bottom		2698 **4050**	2698 **4050**	2698 **4050**	2698 **4050**
Inter phase barriers							
3 pole				2998 **0013**	2998 **0013**	2998 **0013**	2998 **0013**
4 pole				2998 **0014**	2998 **0014**	2998 **0014**	2998 **0014**
Bottom distribution kit							
3 pole				5411 **3040**(1)	5411 **3040**(1)	5411 **3063**(1)	5411 **3063**(1)
4 pole				5411 **4040**(1)	5411 **4040**(1)	5411 **4063**(1)	5411 **4063**(1)
Cage terminals							
3 pole				5400 **3040**	5400 **3040**	5400 **3063**	5400 **3063**
4 pole				5400 **4040**	5400 **4040**	5400 **4063**	5400 **4063**

Handle key interlocking accessories (see “Accessories” pages)

** Standard*
(1) For dimensions and characteristics, see page C.80 “Distribution blocks” in the family “Mounting and cabling accessories”.

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40 to 4000 A

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Switches	800 A	1000 A	CD 1250 A	1250 A	1600 A
Front operation switch (switch body only)					
No. of poles	References	References	References	Reference	References
3 pole	2600 **3081**	2600 **3099**	2600 **3119**	2600 **3121**	2600 **3161**
4 pole	2600 **4081**	2600 **4099**	2600 **4119**	2600 **4121**	2600 **4161**
6 pole	2600 **6080**	2600 **6100**		2600 **6120**	2600 **6160**
8 pole	2600 **8080**	2600 **8100**		2600 **8120**	2600 **8160**

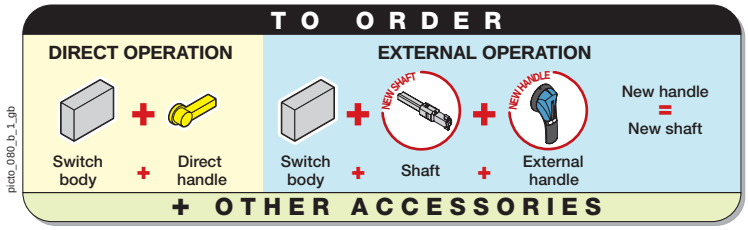
Accessories

Direct front operation handle								
Black				2799 **7012**	2799 **7012**	2799 **7012**	2799 **7012**	2799 **7012**
Red				2799 **7013**	2799 **7013**	2799 **7013**	2799 **7013**	2799 **7013**
Door interlocked external front operation								
Black	S4 type	3/4 pole	IP65	1443 **3111***	1443 **3111***	1443 **3111***	1443 **3111***	1443 **3111***
Red / Yellow	S4 type	3/4 pole	IP65	1444 **3111**	1444 **3111**	1444 **3111**	1444 **3111**	1444 **3111**
Black		6/8 pole	IP65	2799 **7135**(1)*	2799 **7135**(1)*		2799 **7135**(1)*	2799 **7135**(1)*
Red / Yellow		6/8 pole	IP65	2799 **7133**(1)	2799 **7133**(1)		2799 **7133**(1)	2799 **7133**(1)
Shaft extensions for external operation (for dimensions, see “Accessories” pages)								
200 mm	S type	3/4 pole		1401 **1520**	1401 **1520**	1401 **1520**	1401 **1520**	1401 **1520**
320 mm	S type	3/4 pole		1401 **1532***	1401 **1532***	1401 **1532***	1401 **1532***	1401 **1532***
400 mm	S type	3/4 pole		1401 **1540**	1401 **1540**	1401 **1540**	1401 **1540**	1401 **1540**
200 mm	S type	6/8 pole		2799 **3015***	2799 **3015***		2799 **3015***	2799 **3015***
Auxiliary contact								
1st AC	NO/NC changeover	3/4/6/8 pole		2699 **0031**	2699 **0031**	2699 **0031**	2699 **0031**	2699 **0031**
2nd AC	NO/NC changeover	3/4/6/8 pole		2699 **0032**	2699 **0032**	2699 **0032**	2699 **0032**	2699 **0032**
Terminal screens (1 set)								
3/6 pole	top / bottom			2698 **3080**	2698 **3080**	2698 **3080**	2698 **3120**	2698 **3120**
4/8 pole	top / bottom			2698 **4080**	2698 **4080**	2698 **4080**	2698 **4120**	2698 **4120**
Inter phase barriers								
3 / 4 pole				standard	standard	standard	standard	standard

Handle key interlocking accessories (see “Accessories” pages)

** Standard*
(1) S type handle not suitable for SIRCO 2000 to 4000 A ratings and SIRCO 800 to 1600 A 6/8 pole ratings.

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References









Switches

	1800 A	2000 A	2500 A	3150 A	4000 A
Front operation switch (switch body only)					
No. of poles	References	References	References	References	References
3 pole	2600 **3181**	2600 **3210**	2600 **3260**	2600 **3310**	2600 **3400**
4 pole	2600 **4181**	2600 **4210**	2600 **4260**	2600 **4310**	2600 **4400**

Accessories

			1800 A	2000 A	2500 A	3150 A	4000 A
Direct front operation handle							
Black			2799 **7012**	2799 **7012**	2799 **7012**	2799 **7012**	2799 **7062**
Red			2799 **7013**	2799 **7013**	2799 **7013**	2799 **7013**	2799 **7063**
Door interlocked external front operation							
Black	3/4 pole	IP65	1443 **3111**(1)*	2799 **7135**(2)*	2799 **7135**(2)*	2799 **7135**(2)*	2799 **7145**(2)*
Red / Yellow	3/4 pole	IP65	1444 **3111**(1)	2799 **7133**(2)	2799 **7133**(2)	2799 **7133**(2)	consult us
Shaft extensions for external operation (for dimensions, see "Accessories" page)							
200 mm			1401 **1520**	2799 **3015**	2799 **3015**	2799 **3015**	
320 mm			1401 **1532***	2799 **3018***	2799 **3018***	2799 **3018***	2799 **3018***
400 mm			1401 **1540**				
450 mm				2799 **3019**	2799 **3019**	2799 **3019**	
Auxiliary contact							
1st AC	NO/NC changeover	3/4 pole	2699 **0031**	2699 **0031**	2699 **0031**	2699 **0031**	standard
2nd AC	NO/NC changeover	3/4 pole	2699 **0032**	2699 **0032**	2699 **0032**	2699 **0032**	standard
Terminal screens (1 set)							
3 pole	top / bottom		2698 **3120**	standard	standard	standard	standard
4 pole	top / bottom		2698 **4120**	standard	standard	standard	standard
Inter phase barriers							
3 pole			standard	2998 **0003**(3)	2998 **0003**(3)	on request	on request
4 pole			standard	2998 **0004**(3)	2998 **0004**(3)	on request	on request

Handle key interlocking accessories (see "Accessories" pages)

** Standard*
(1) S4 type handle.
(2) S type handle not suitable for SIRCO 2000 to 4000 A ratings.
(3) Use 2 sets.

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Accessories

Direct operation handles


acces_128_a_1_cat


acces_129_a_1_cat

References

Rating (A)	No. of poles	Handle colour	References
40 … 100	3/4	Black	2699 **5012**
40 … 100	3/4	Red	2699 **5013**
125 … 160	3/4	Black	2699 **5042**
125 … 160	3/4	Red	2699 **5043**
125 … 160	6/8	Black	4199 **5012**
200 … 630	3/4	Black	2699 **5052**
200 … 630	3/4	Red	2699 **5053**
250 … 630	6/8	Black	2799 **7052**
250 … 630	6/8	Red	2799 **7053**
800 … 3150	3/4	Black	2799 **7012**
800 … 3150	3/4	Red	2799 **7013**
800 … 1600	6/8	Black	2799 **7012**
800 … 1600	6/8	Red	2799 **7013**
4000	3/4	Black	2799 **7062**
4000	3/4	Red	2799 **7063**

Door interlocked external front operation


acces_150_a_1_cat

S2-type handle


acces_151_a_1_cat

S3-type handle


acces_152_a_2_cat

S4-type handle

Use

- The door interlocked external operation includes a padlockable handle, an escutcheon and must be combined with a shaft extension.
- Door interlocked
- Door interlocked when padlocked.
- Defeatable in on position.

Other specific versions are available: please consult us.

References

Rating (A)	No. of poles	Handle type	Handle colour	External IP(1)	References
40 … 100	3/4	-	Black	IP54	2699 **5125***
40 … 100	3/4	-	Red	IP54	2699 **5123**
125 … 630	3/4	S2	Black	IP55	1421 **2111***
125 … 630	3/4	S2	Black	IP65	1423 **2111**
125 … 630	3/4	S2	Red / Yellow	IP65	1424 **2111**
125 … 160	6/8	S2	Black	IP55	1421 **2111***
125 … 160	6/8	S2	Black	IP65	1423 **2111**
125 … 160	6/8	S2	Red / Yellow	IP65	1424 **2111**
250 … 630	6/8	S3	Black	IP65	1433 **3111***
250 … 630	6/8	S3	Red / Yellow	IP65	1434 **3111**
800 … 1800	3/4	S4	Black	IP65	1443 **3111***
800 … 1800	3/4	S4	Red / Yellow	IP65	1444 **3111**
800 … 1600	6/8	-	Black	IP65	2799 **7135**
800 … 1600	6/8	-	Red	IP65	2799 **7133**
2000 … 3150	3/4	-	Black	IP65	2799 **7135***
2000 … 3150	3/4	-	Red	IP65	2799 **7133**
4000	3/4	-	Black	IP65	2799 **7145***
4000	3/4	-	Red		consult us

** Standard*
(1) IP: protection rating according to IEC 60529 standard.

S-type handle adapter


acces_187_a_1_cat

Use

Enables new S type handles to be mounted using old fixing holes for replacement or retrofit applications.

Dimensions

Adds 12 mm to the depth.

Reference

Handle colour	External IP(1)	Pack qty	Reference
Black	IP65	10	1493 **0000**

(1) IP: protection rating according to IEC 60529 standard.

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Accessories

Alternative S-type handle cover colours


accos_198_a_1_cat

Use

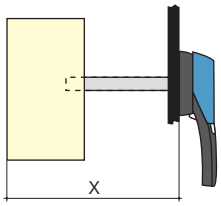
For single lever handles type S1, S2, S3 and for double lever handles S4.
Other colours: please consult us.

References

Handle colour	Pack qty	Handle type	References
Light grey	50	S1, S2, S3	1401 **0001**
Dark grey	50	S1, S2, S3	1401 **0011**
Light grey	50	S4	1401 **0031**
Dark grey	50	S4	1401 **0041**

Shaft extensions for external operation


accos_143_a_1_cat



accos_202_a

Use

For standard length external operation:
- 200 mm
- 250 mm
- 300 mm
- 400 mm
- 500 mm
- 750 mm

Other lengths: please consult us.

References

For 3/4 pole

Rating (A)	Dimension X (mm)	Shaft length (mm)	References
40 … 100	125 … 300	200	2699 **3003***
40 … 100	125 … 400	300	2699 **3023**
40 … 100	125 … 500	400	2699 **3013**
125 … 160	125 … 250	200	1400 **1020**
125 … 160	125 … 300	250	1400 **1025**
125 … 160	125 … 370	320	1400 **1032***
125 … 160	125 … 450	500	1400 **1050**
125 … 160	125 … 700	750	1400 **1075**
200 … 250	135 … 265	200	1400 **1020**
200 … 250	135 … 315	250	1400 **1025**
200 … 250	135 … 385	320	1400 **1032***
200 … 250	135 … 465	500	1400 **1050**
200 … 250	135 … 715	750	1400 **1075**
315 … 630	165 … 295	200	1400 **1020**
315 … 630	165 … 345	250	1400 **1025**
315 … 630	165 … 415	320	1400 **1032***
315 … 630	165 … 495	500	1400 **1050**
315 … 630	165 … 745	750	1400 **1075**
800 … 1800	221 … 343	200	1401 **1520**
800 … 1800	221 … 463	320	1401 **1532***
800 … 1800	221 … 543	400	1401 **1540**
2000 … 3150	415 … 570	200	2799 **3015**
2000 … 3150	415 … 690	320	2799 **3018***
2000 … 3150	415 … 820	450	2799 **3019**
4000	651 … 921	320	2799 **3018***

For 6/8 pole

Rating (A)	Dimension X (mm)	Shaft length (mm)	References
125 … 160	270 … 436	200	1400 **1020**
125 … 160	270 … 556	320	1400 **1032***
125 … 160	270 … 636	500	1400 **1050**
250	221 … 308	200	1401 **1520**
250	221 … 428	320	1401 **1532***
250	221 … 508	400	1401 **1540**
400 … 630	298 … 385	200	1401 **1520**
400 … 630	298 … 505	320	1401 **1532***
800 … 1600	435 … 585	200	2799 **3015***
800 … 1600	435 … 835	450	2799 **3019**

** Standard*

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Accessories

Auxiliary contacts


acces_075_a_1_cat


acces_076_a_1_cat

Use

Pre-break and signalling of positions 0 and I:

- 1 to 2 NO/NC auxiliary contacts
- 1 to 4 NO + NC auxiliary contacts
- 1 to 2 low level NO/NC auxiliary contacts.

Characteristics

NO/NC AC: IP2 with front operation.

Connection to the control circuit

6.35 mm fast-on connection.

Electrical characteristics

30 000 operations.

References

NO/NC contacts for 3/4 pole

Rating (A)	No. of AC	References
40 … 100	2	2999 **0012**
125 … 3150	1st	2699 **0031**
125 … 3150	2nd	2699 **0032**
4000	1st	standard
4000	2nd	standard

NO/NC contacts for 6/8 pole

Rating (A)	No. of AC	References
125 … 630	1st	2699 **0061**
125 … 630	2nd	2699 **0062**
800 … 1600	1st	2699 **0031**
800 … 1600	2nd	2699 **0032**

NO + NC contacts for 3/4 pole

Rating (A)	No. of AC	References
125 … 1800	1st	2699 **0141**
125 … 1800	2nd	2699 **0142**
2000 … 3150	1st	2699 **0005**
2000 … 3150	2nd	2799 **0006**

Low level NO/NC contacts for 3/4 pole

Rating (A)	No. of AC	References
40 … 100	2	2999 **0112**
125 … 1800	1st	2699 **0301**
125 … 1800	2nd	2699 **0302**

Characteristics

Rating (A)	Contact type	Nominal current (A)	Operating current I_e (A)									
			230 VAC		400 VAC		24 VDC			48 VDC		
			AC-12	AC-13/15	AC-12	AC-13/15	DC-12	DC-13	DC-14	DC-12	DC-13	DC-14
40 … 100	NO / NC	6	6	1.2	4	1	6	2	1	0.9	0.5	0.2
125 … 4000	NO / NC	16	16	4	12	3	2.5	2.5	1	2.5	1.2	0.2
125 … 3150	NO + NC	16	16	4	16	3	16	5	1	2.5	1.2	0.2

Door mounting kit

Use

Kit enables door mounting facility for the SIRCO range.

Ordering guide

- Switch + direct handle + door mounting kit.
  Items to be order separetely.
- Terminal screens type 2698 **xxxx** required for door mounted switches.

References

For 3/4 pole direct front operation

Rating (A)	No. of poles	References
125 … 160	3	2699 **3312**
125 … 160	4	2699 **4312**
200 … 250	3	2699 **3420**
200 … 250	4	2699 **4420**

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Accessories

Terminal shrouds


acces_077_a_1_cat

Use

Top or bottom protection against direct contact with terminals or connection parts.

Advantage of the terminal shrouds

Perforations allowing remote thermographic inspection without removal.

The terminal shrouds also provide phase separation SIRCOs from 125 to 630 A.

References

For 3/4 pole

Rating (A)	No. of poles	Position	References
80 … 100	3/4	top / bottom	2994 **4008**
125 … 160	3	top / bottom	2694 **3014**
125 … 160	4	top / bottom	2694 **4014**
200 … 250	3	top / bottom	2694 **3021**
200 … 250	4	top / bottom	2694 **4021**
315 … 630	3	top / bottom	2694 **3051**
315 … 630	4	top / bottom	2694 **4051**

For 6/8 pole

Rating (A)	No. of poles	Position	References
125 … 160	6	top / bottom	2694 **3014**(1)
125 … 160	8	top / bottom	2694 **4014**(1)
250	6	top / bottom	2694 **3021**(1)
250	8	top / bottom	2694 **4021**(1)
400 … 630	6	top / bottom	2694 **3051**(1)
400 … 630	8	top / bottom	2694 **4051**(1)

(1) 2 sets required for front and rear terminals.

Terminal screens


acces_079_a_1_cat

Use

Top or bottom protection against direct contacts with terminals or connection parts.

References

For 3/4 pole

Rating (A)	No. of poles	Position	References
40 … 100	3/4	top / bottom	2998 **3008**
125 … 160	3	top / bottom	2698 **3012**
125 … 160	4	top / bottom	2698 **4012**
200 … 250	3	top / bottom	2698 **3020**
200 … 250	4	top / bottom	2698 **4020**
315 … 630	3	top / bottom	2698 **3050**
315 … 630	4	top / bottom	2698 **4050**
800 … CD 1250	3	top / bottom	2698 **3080**
800 … CD 1250	4	top / bottom	2698 **4080**
1250 … 1800	3	top / bottom	2698 **3120**
1250 … 1800	4	top / bottom	2698 **4120**
2000 … 4000	3/4	top / bottom	standard

For 6/8 pole

Rating (A)	No. of poles	Position	Pack qty	References
125 … 160	6	top / bottom	2	1509 **3012**(1)
125 … 160	8	top / bottom	2	1509 **4012**(1)
250	6	top / bottom	2	1509 **3025**(1)
250	8	top / bottom	2	1509 **4025**(1)
400 … 630	6	top / bottom	2	1509 **3063**(1)
400 … 630	8	top / bottom	2	1509 **4063**(1)
800	6	top / bottom	1	2698 **3080**
800	8	top / bottom	1	2698 **4080**
1000 … 1600	6	top / bottom	1	2698 **3120**
1000 … 1600	8	top / bottom	1	2698 **4120**

(1) One reference = 1 batch.

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Accessories

Shrouded distribution block

repar_027_a_2_cat



Use

Easy connection of several cables, can be clipped onto a symmetric DIN rail.

References

Rating (A)	No. of poles	No of feeders per section (mm²)	References
125	3 / 4	2x25 + 7x10	5420 **4108**
125	3 / 4	2x25 + 2x16 + 9x10	5420 **4112**
160	3 / 4	1x35 + 3x25 + 8x16	5420 **4016**

Bottom distribution kit

repar_017_a_1_cat



Use

Easy connection of several equipotential conductors, mounted top of the SIRCO.

References

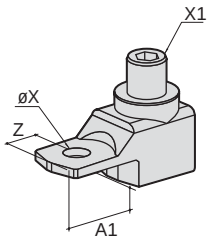
Rating (A)	No. of poles	No of feeders per section (mm²)	References
125 … 160	3	1x95 + 8x25	5411 **3016**
125 … 160	4	1x95 + 8x25	5411 **4016**
200 … 250	3	1x150 + 8x50	5411 **3025**
200 … 250	4	1x150 + 8x50	5411 **4025**
315 … 400	3	1x240 + 8x95	5411 **3040**
315 … 400	4	1x240 + 8x95	5411 **4040**
500 … 630	3	1x300 + 8x150	5411 **3063**
500 … 630	4	1x300 + 8x150	5411 **4063**

Cage terminals

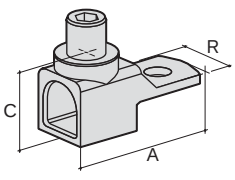
acces_053_a_1_cat



acces_091_a_1_x_cat



acces_092_a_1_x_cat



Use

Connection of bare copper cables onto the terminals (without terminal lugs).

References

Rating (A)	No. of poles	References
125 … 160	3	5400 **3016**
125 … 160	4	5400 **4016**
200 … 250	3	5400 **3025**
200 … 250	4	5400 **4025**
315 … 400	3	5400 **3040**
315 … 400	4	5400 **4040**
500 … 630	3	5400 **3063**
500 … 630	4	5400 **4063**

Connections

Rating (A)	Section flexible cable (mm²)	Section rigid cable (mm²)	Width flexible bar (mm)	Stripped over (mm)
125 … 160	16 … 95	16 … 95	13	22
200 … 250	16 … 185	16 … 185	18	27
315 … 400	50 … 240	50 … 300	20	34
500 … 630	70 … 300	70 … 300	24	34

Dimensions

Rating (A)	A	A1	C	R	ØX	X1	Z
125 … 160	47.5	22.5	25	20	8.5	M12	10
200 … 250	62	31.5	31.5	25	10.5	M16	14
315 … 400	71.5	32	38	32	10.5	M20	15
500 … 630	76.5	37	38	40	12.5	M20	15

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Accessories

Inter phase barriers



Use

Safety isolating separation between the terminals, essential for use at 690 VAC or in a dusty atmosphere.

The terminal shrouds also provide phase separation for SIRCOs from 125 to 630 A.

References

Rating (A)	No. of poles	References
125 … 160	3	2998 **0033**
125 … 160	4	2998 **0034**
200 … 250	3	2998 **0023**
200 … 250	4	2998 **0024**
315 … 630	3	2998 **0013**
315 … 630	4	2998 **0014**
800 … 1800	3/4	standard
2000 … 2500(1)	3	2998 **0003**
2000 … 2500(1)	4	2998 **0004**
3150 … 4000	3/4	consult us

(1) For the SIRCO 2000 and 2500 A, use 2 sets.

Handle key interlocking accessories

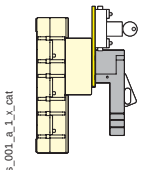


Fig. 1

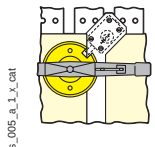


Fig. 2

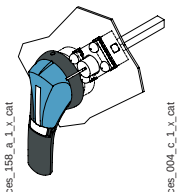


Fig. 3

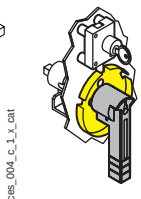


Fig. 4

Use

Locking in position 0 of the front operation handle:

- using a padlock (not supplied) and factory integrated into the handle. From 125 to 1800 A, the padlock on the external front operation handle also locks the door
- using lock (not included): see diagrams opposite.
- using undervoltage coil: the SIRCO can only be closed if the coil is live.

For 6/8 pole, please consult us.

References

Locking using RONIS EL11AP lock (not included)

Rating (A)	No. of poles	Operation	Figure	References
125 … 630	3/4	direct front	1	2699 **6008**(1)
125 … 1800	3/4	external front	3	1499 **7701**
800 … 1800	3/4	direct front	2	2699 **6027**
2000 … 3150	3/4	direct front	2	2699 **7007**
2000 … 4000	3/4	external front	4	2799 **7002**
4000	3/4	direct front	2	2699 **7017**

Locking using CASTELL lock (not included)

Rating (A)	No. of poles	Operation	Lock type	Figure	References
125 … 1800	3/4	external front	FS	3	1499 **7703**
125 … 1800	3/4	external front	K	3	1499 **7702**
2000 … 4000	3/4	external front	K	2	2799 **7703**
125 … 160	6/8	external front	K	2	4109 **8507**
250 … 630	6/8	external front	K	2	2999 **8707**
800 … 1600	6/8	external front	K	2	2799 **7003**

Locking using 230 VAC undervoltage coil (other voltages: please consult us)

Rating (A)	No. of poles	Operation	References
125 … 630	3/4	external front	2699 **9063**(2)
800 … 1800	3/4	direct front	2699 **9315**(2)
2000 … 3150	3/4	direct front	2699 **9310**

(1) Front operation handle included.
(2) The locking system is mounted directly on the device.

Other specific accessories



- Mechanical coupling device for making switches with “n” poles with the same or different ratings
- Mechanical interlocking device.

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Characteristics (according to IEC 60947-3)

Thermal current I_{th} (40°C)		40 A	63 A	80 A	100 A	125 A	160 A	200 A	250 A	315 A	400 A
Rated insulation voltage U_i (V)		690	690	690	690	800	800	800	800	1000	1000
Rated impulse withstand voltage U_{imp} (kV)		6	6	6	6	8	8	8	8	12	12
Rated operational currents I_e (A)											
Rated voltage	Load duty category	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)
400 VAC	AC-21 A / AC-21 B	40/40	63/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	AC-22 A / AC-22 B	40/40	63/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	AC-23 A / AC-23 B	40/40	50/63	80/80	80/100	125/125	160/160	200/200	250/250	315/315	400/400
500 VAC	AC-21 A / AC-21 B	40/40	50/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	AC-22 A / AC-22 B	40/40	50/63	80/80	80/80	125/125	125/125	200/200	250/250	315/315	400/400
	AC-23 A / AC-23 B	25/32	25/32	63/63	63/63	100/100	100/100	160/200	200/250	315/315	315/315
690 VAC (2)	AC-20 A / AC-20 B	40/40	63/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	AC-21 A / AC-21 B	40/40	50/50	80/80	80/80	125/125	160/160	160/200	200/250	315/315	400/400
	AC-22 A / AC-22 B	32/32	32/32	50/50	50/50	125/125	125/125	125/160	125/160	250/315	250/315
	AC-23 A / AC-23 B	25/25	25/25	40/40	40/40	63/80	63/80	80/100	100/125	160/200	160/200
220 VDC	DC-20 A / DC-20 B	40/40	63/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	DC-21 A / DC-21 B	40(3)/40(3)	63(3)/63(3)	80(3)/80(3)	100(3)/100(3)	125/125	160/160	160/200	250/250	315/315	400/400
	DC-22 A / DC-22 B	40(3)/40(3)	63(3)/63(3)	80(3)/80(3)	80(3)/80(3)	125/125	160/160	160/200	250/250	315/315	400/400
	DC-23 A / DC-23 B	40(3)/40(3)	63(3)/63(3)	63(3)/63(3)	63(3)/63(3)	125/125	125/125	160/160	200/200	315/315	400/400
400 VDC	DC-20 A / DC-20 B	40/40	63/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	DC-21 A / DC-21 B	20(3)/20(3)	25(3)/25(3)	32(3)/32(3)	40(3)/40(3)	125(4)/125(4)	160(4)/160(4)	160(4)/200(4)	200(4)/200(4)	315(4)/315(4)	400(4)/400(4)
	DC-22 A / DC-22 B	-/-	-/-	-/-	-/-	125(4)/125(4)	125(4)/125(4)	160(4)/160(4)	200(4)/200(4)	315(4)/315(4)	400(4)/400(4)
	DC-23 A / DC-23 B	-/-	-/-	-/-	-/-	125(3)/125(3)	125(3)/125(3)	160(3)/160(3)	200(3)/200(3)	315(3)/315(3)	400(3)/400(3)
500 VDC	DC-20 A / DC-20 B	40/40	63/63	80/80	100/100	125/125	160/160	200/200	250/250	315/315	400/400
	DC-21 A / DC-21 B	20(3)/20(3)	25(3)/25(3)	32(3)/32(3)	40(3)/40(3)	125(4)/125(4)	125(4)/125(4)	160(4)/200(4)	200(4)/200(4)	315(4)/315(4)	400(4)/400(4)
	DC-22 A / DC-22 B	-/-	-/-	-/-	-/-	125(3)/125(3)	125(3)/125(3)	160(3)/160(3)	200(3)/200(3)	315(3)/315(3)	315(3)/400(3)
	DC-23 A / DC-23 B	-/-	-/-	-/-	-/-	125(3)/125(3)	125(3)/125(3)	160(3)/160(3)	200(3)/200(3)	315(3)/315(3)	315(3)/400(3)
Operational power in AC-23 (kW)(1)(5)											
At 400 VAC without pre-break AC		18.5/18.5	25/30	40/40	40/51	63/63	80/80	100/100	132/132	160/160	220/220
At 500 VAC without pre-break AC		15/18.5	15/18.5	40/40	40/40	63/63	63/63	110/140	140/160	220/220	220/220
At 690 VAC without pre-break AC		22/22	22/22	33/33	33/33	55/75	55/75	75/90	90/110	150/185	150/185
Reactive power (kvar)(5)											
At 400 VAC		18	28	37	45	55	75	90	115	145	185
Fuse protected short-circuit withstand (kA rms prospective)(6)											
Prospective short-circuit current (kA rms)		100	100	100	70	100	100	80	50	100	100
Associated fuse rating (A)		40	63	80	100	125	160	200	250	315	400
Overload capacity											
Rated short-time withstand current 1s I_{cw} (kA rms)		2.5	2.5	2.5	2.5	7	7	9	9	13	13
Rated peak withstand current (kA peak)(6)		12	12	12	12	20	20	30	30	45	45
Connection											
Minimum Cu cable section (mm^2)		4	10	16	25	35	50	70	95	150	185
Minimum Cu busbar section (mm^2)		-	-	-	-	-	-	-	-	-	-
Maximum Cu cable section (mm^2)		16	16	35	35	50	95	95	150	240	240
Maximum Cu busbar width (mm)		-	-	15	15	25	25	32	32	40	40
Min. tightening torque (Nm)		4	4	5	5	9	9	20	20	20	20
Mechanical characteristics											
Endurance (number of operating cycles)		10 000	10 000	10 000	10 000	10 000	10 000	10 000	10 000	5 000	5 000
Operating effort (Nm)		2	2	2	2	6.5	6.5	10	10	14.5	14.5
Weight of 3 p switch (kg)		0.5	0.5	0.5	0.5	1	1.5	2	2	3.5	3.5
Weight of 4 p switch (kg)		0.5	0.5	0.5	0.5	1.5	1.5	2	2	4	4

(1) A/B: Category with index A = frequent operation - Category with index B = infrequent operation. (2) With terminal shrouds or phase barrier. (3) 4-pole device with 2 pole in series by polarity. (4) 3-pole device with 2 pole in series for the + and 1 pole for the -. (5) The power value is given for information only, the current values vary from one manufacturer to another. (6) For a rated operating voltage U_e = 400 VAC.

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500 A	630 A	800 A	1000 A	CD 1250 A	1250 A	1600 A	1800 A	2000 A	2500 A	3150 A	4000 A
1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
12	12	12	12	12	12	12	12	12	12	12	12
A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)	A/B (1)
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1600/1600	1800/1800	2000/2000	2500/2500	3150/3150	3150/3150
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1600/1600	1800/1800	2000/2000	2000/2500	2500/2500	2500/2500
500/500	500/630	800/800	1000/1000	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250
500/500	630/630	800/800	800/800	800/800	1250/1250	1600/1600	1600/1600	2000/2000	2500/2500	3150/3150	3150/3150
400/400	500/500	800/800	800/800	800/800	1250/1250	1250/1250	1250/1250	1600/2000	1600/2000	2000/2000	2000/2000
315/315	315/315	630/800	630/800	630/800	1000/1000	1000/1000	1000/1000	1000/1000	1000/1000	1000/1000	1000/1000
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1600/1600	1800/1800	2000/2000	2500/2500	3150/3150	4000/4000
400/400	500/500	800/800	800/800	800/800	1000/1000	1000/1000	1000/1000	2000/2000	2000/2500	2000/2500	2000/2500
250/315	315/315	800/800	800/800	800/800	1000/1000	1000/1000	1000/1000	1000/1000	1000/1000	1000/1000	1000/1000
160/200	160/200	200/250	200/250	200/250	500/500	500/500	500/500	800/800	800/800	800/800	800/800
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1600/1600	1800/1800	2000/2000	2500/2500	3150/3150	4000/4000
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1250/1250	1250/1250	2000/2000	2000/2500	2000/2500	2000/2500
400/500	500/500	800/800	1000/1000	1250/1250	1250/1250	1250/1250	1250/1250	1250/1600	1250/1600	1250/1600	1250/1600
400/400	500/500	800/800	1000/1000	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250	1250/1250
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1600/1600	1800/1800	2000/2000	2500/2500	3150/3150	4000/4000
400(4)/500(4)	500(4)/500(4)	800(3)/800(3)	1000(3)/1000(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	2000/2000	2000/2000	2000/2000	2000/2000
400(4)/400(4)	500(4)/500(4)	800(3)/800(3)	1000(3)/1000(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250/1250	1250/1250	1250/1250	1250/1250
400(3)/400(3)	500(3)/500(3)	800(3)/800(3)	1000(3)/1000(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1000(3)/1000(3)	1000(3)/1000(3)	1000(3)/1000(3)	1000(3)/1000(3)
500/500	630/630	800/800	1000/1000	1250/1250	1250/1250	1600/1600	1800/1800	2000/2000	2500/2500	3150/3150	4000/4000
400(4)/400(4)	500(4)/500(4)	800(3)/800(3)	1000(3)/1000(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250/1250	1250/1250	1250/1250	1250/1250
315(3)/400(3)	500(3)/500(3)	800(3)/800(3)	1000(3)/1000(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)
315(3)/400(3)	500(3)/500(3)	800(3)/800(3)	1000(3)/1000(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1250(3)/1250(3)	1000(3)/1000(3)	1000(3)/1000(3)	1000(3)/1000(3)	1000(3)/1000(3)
280/280	280/280	450/450	560/560	710/710	710/710	710/710	710/710	710/710	710/710	710/710	710/710
220/220	220/220	450/560	450/560	450/560	710/710	710/710	710/710	710/710	710/710	710/710	710/710
150/185	150/185	185/220	185/220	185/220	475/475	475/475	475/475	750/750	750/750	750/750	750/750
230	290	365	460	575	575	-	-	-	-	-	-
100	70	50	100	100	100	100	100	100	100	-	-
500	630	800	1000	1250	1250	2 x 800	2 x 800	2 x 1000	2 x 1250	-	-
13	13	26	35	35	50	50	50	50	50	55	70
45	45	55	80	80	110	110	110	110	110	120	150
240	2 x 150	2 x 185	2 x 240	-	-	-	-	-	-	-	-
-	2 x 30 x 5	2 x 40 x 5	2 x 50 x 5	2 x 60 x 5	2 x 60 x 5	2 x 80 x 5	3 x 100 x 5	3 x 100 x 5	4 x 100 x 5	4 x 100 x 5	4 x 100 x 10
240	2 x 300	2 x 300	4 x 185	4 x 185	4 x 185	6 x 185	6 x 185	-	-	-	-
40	50	63	63	63	100	100	100	125	125	125	125
20	20	-	-	-	40	40	40	40	40	40	40
5 000	5 000	3 000	3 000	3 000	4 000	4 000	4 000	3 000	2 500	2 500	2 500
14.5	14.5	37	37	37	56	56	56	60	60	60	110
3.5	3.5	8	8	8	12	12	12	31	32	42	90
4.5	4.5	10	10	10	15	15	15	40	40	49	102

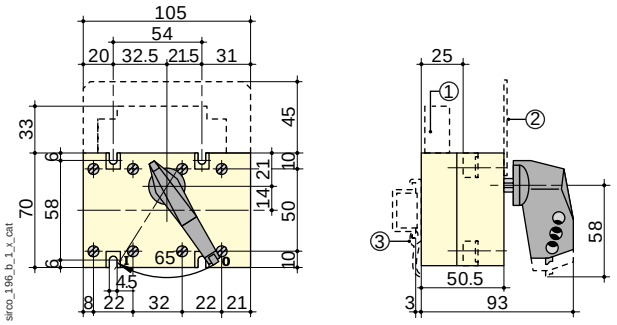
(1) A/B: Category with index A = frequent operation - Category with index B = infrequent operation. (2) With terminal shrouds or phase barrier. (3) 4-pole device with 2 pole in series by polarity. (4) 3-pole device with 2 pole in series for the + and 1 pole for the -. (5) The power value is given for information only, the current values vary from one manufacturer to another. (6) For a rated operating voltage U_e = 400 VAC.

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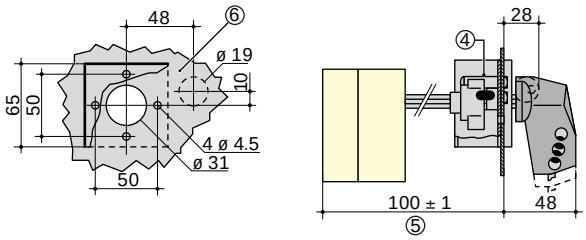
Dimensions

• SIRCO 40 to 63 A

Direct front operation



External front operation

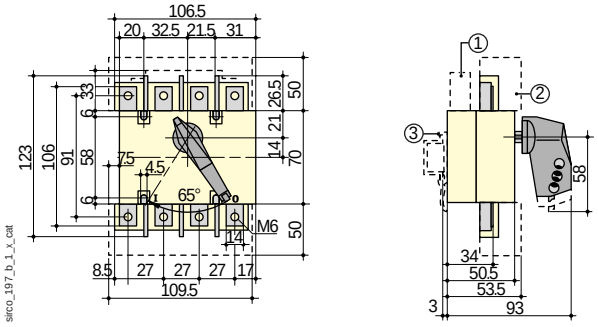


1. NO / NC pre-break AC.
2. Terminal screens.
3. Clips for mounting on symmetrical DIN rail.

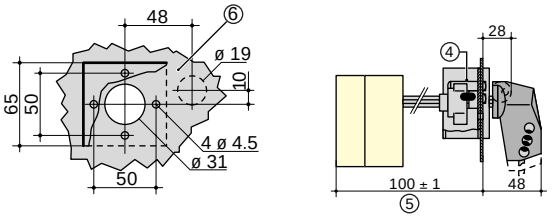
4. RONIS 1016 lock with sliding bolt width 30 mm.
5. Minimum length with shaft extension: 125 ±1.
6. Door drilling with RONIS 1016 lock.

• SIRCO 80 to 100 A

Direct front operation



External front operation



1. NO / NC pre-break AC.
2. Terminal screens.
3. Clips for mounting on symmetrical DIN rail.

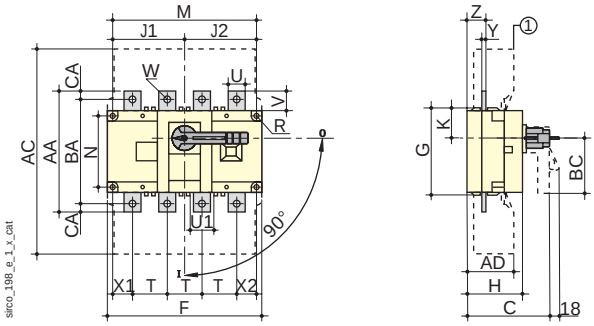
4. RONIS 1016 lock with sliding bolt width 30 mm.
5. Minimum length with shaft extension: 125 ±1.
6. Door drilling with RONIS 1016 lock.

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Dimensions

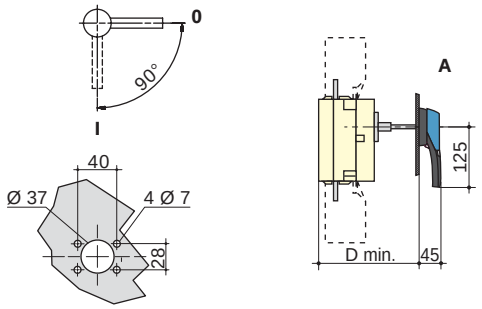
• SIRCO 125 to 630 A

Direct front operation



1. Terminal shrouds.

External front operation

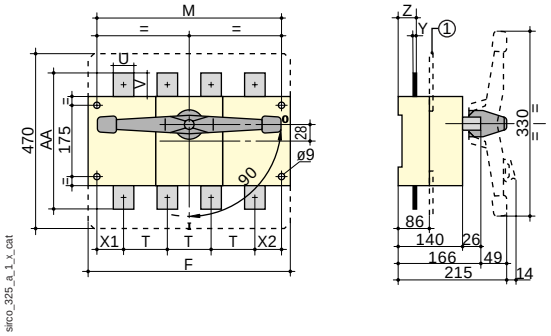


A. Handle S2 type.

Rating	Overall dimensions		Terminall shrouds		Switch body									Switch mounting				Connection terminals											
(A)	C	D min.	AC	AD	F 3p.	F 4p.	G	H	J1 3p.	J1 4p.	J2	K	BC	M 3p.	M 4p.	N	R	T	U	U1	V	W	X1 3p.	X1 4p.	X2	Y	Z	AA	BA	CA
125	115	125	235	50	140	170	93	65	45	75	75	31.5	80	120	150	65	5.5	36	20	20.5	25	9	28	22	20	3.5	20.5	135	115	10
160	115	125	235	50	140	170	93	65	45	75	75	31.5	80	120	150	65	5.5	36	20	20.5	25	9	28	22	20	3.5	20.5	135	115	10
200	125	135	280	60	180	230	108	75	55	105	105	34	115	160	210	80	5.5	50	25	25.5	30	11	33	33	27	3.5	22.5	160	130	15
250	125	135	280	60	180	230	108	75	55	105	105	34	115	160	210	80	5.5	50	25	25.5	30	11	33	33	27	3.5	22.5	160	130	15
315	160	165	401	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	32	45.5	37.5	11	42.5	37.5	37.5	5	36	235	205	15
400	160	165	401	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	32	45.5	37.5	11	42.5	37.5	37.5	5	36	235	205	15
500	160	165	401	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	32	45.5	37.5	13	42.5	37.5	37.5	5	36	235	205	15
630	160	165	400	89	230	290	170	110	75	135	135	55	115	210	270	140	7	65	45	45.5	50	13	42.5	37.5	37.5	5	36	260	220	20

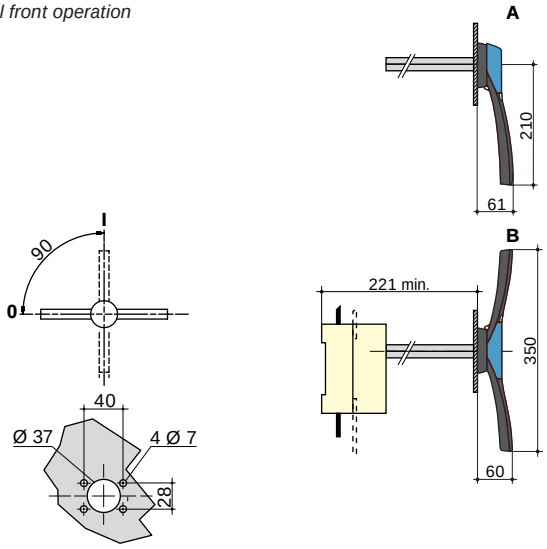
• SIRCO 800 to 1800 A

Direct front operation



1. Terminal screens.

External front operation



A. Handle single lever S3 type.
B. Handle double lever S4 type.

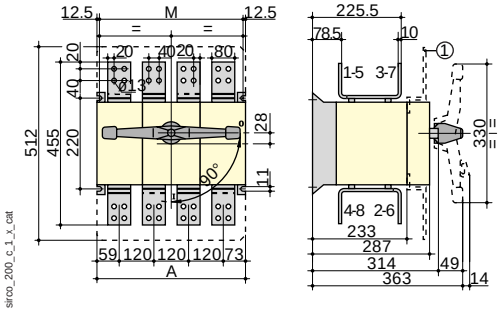
Rating	Switch body		Switch mounting		Connection terminals							
(A)	F 3p.	F 4p.	M 3p.	M 4p.	T	U	V	Y	X1	X2	Z	AA
800	280	360	255	335	80	50	60.5	7	47.5	47.5	46.5	321
1000	280	360	255	335	80	50	60.5	7	47.5	47.5	46.5	321
CD 1250	280	360	255	335	80	60	65	7	47.5	47.5	46.5	330
1250	372	492	347	467	120	90	44	8	53.5	53.5	47.5	288
1600	372	492	347	467	120	90	44	8	53.5	53.5	47.5	288
1800	372	492	347	467	120	90	44	8	53.5	53.5	47.5	288

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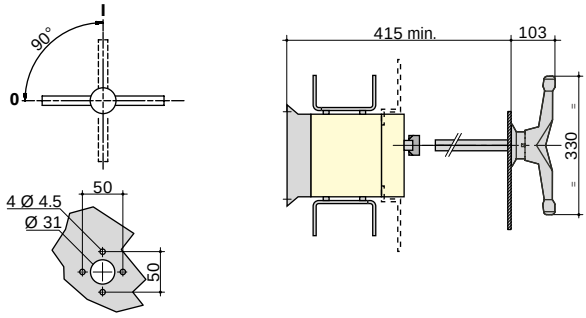
Dimensions

• SIRCO 2000 to 2500 A

Direct front operation



External front operation

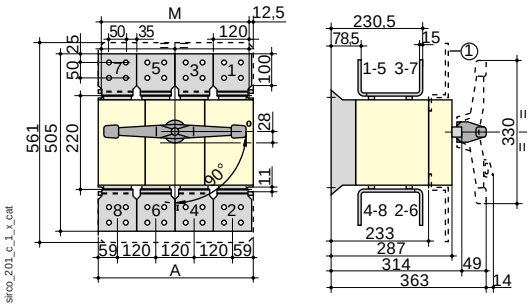


1. Terminal screens.

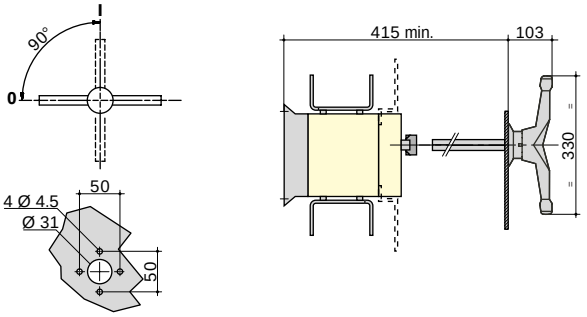
Rating	Overall dimensions		Switch mounting	
(A)	A 3p.	A 4p.	M 3p.	M 4p.
2000	372	492	347	467
2500	372	492	347	467

• SIRCO 3150 A

Direct front operation



External front operation

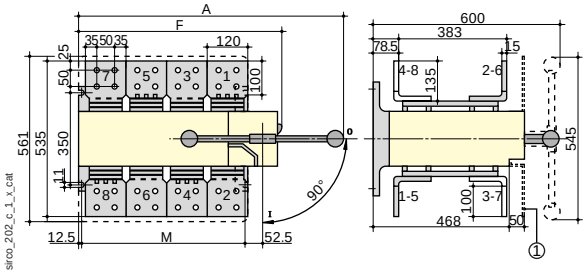


1. Terminal screens.

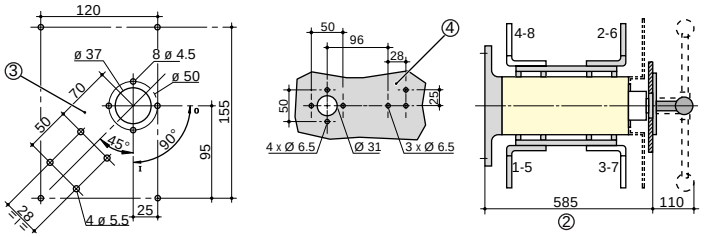
Rating	Overall dimensions		Switch mounting	
(A)	A 3p.	A 4p.	M 3p.	M 4p.
3150	372	492	347	467

• SIRCO 4000 A

Direct front operation



External front operation



1. Terminal screens.
2. Min. length with coupling part for shaft extension (shaft 40 mm): 635 mm.
3. Door drilling with RONIS EL11AP lock.
4. Door drilling with CASTELL K lock.

Rating	Overall dimensions		Switch body		Switch mounting	
(A)	A 3p.	A 4p.	F 3p.	F 4p.	M 3p.	M 4p.
4000	684	804	470	590	347	467

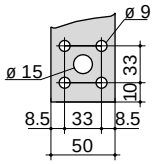
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Dimensions

Connection terminals

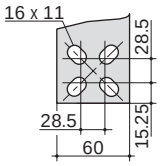
• **SIRCO 800 to 1000 A**

sirco_207_a_1_x_cat



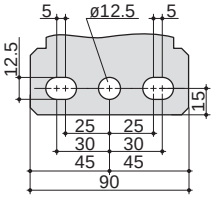
• **SIRCO CD 1250 A**

sirco_270_b_1_x_cat



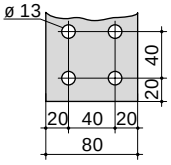
• **SIRCO 1250 to 1800 A**

sirco_271_a_1_x_cat



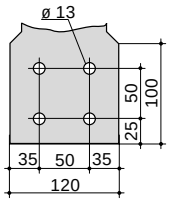
• **SIRCO 2000 to 2500 A**

sirco_210_a_1_x_cat



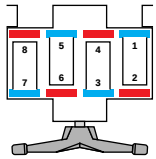
• **SIRCO 3150 to 4000 A**

sirco_212_a_1_x_cat



• **SIRCO 2000 to 4000 A**

sirco_213_a_1_x_cat

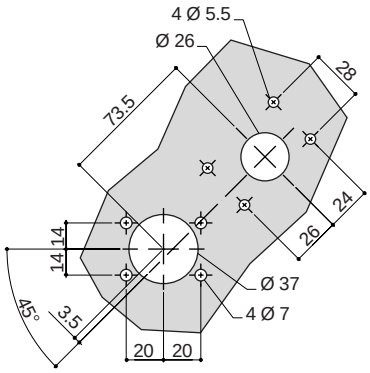


Top terminals
Bottom terminals

Note : Screws and bolts not suitable for SIRCO 800 to 4000 A ratings.

Door drilling with RONIS EL11AP lock

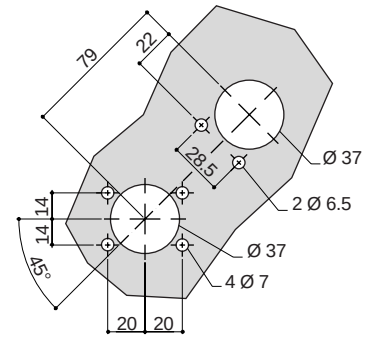
svr_102_a_1_x_cat



Door drilling with CASTELL K lock

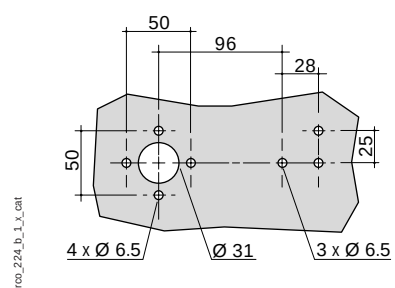
• **SIRCO 125 to 1800 A**

svr_101_a_1_x_cat



• **SIRCO 2000 to 3150 A**

sirco_224_b_1_x_cat

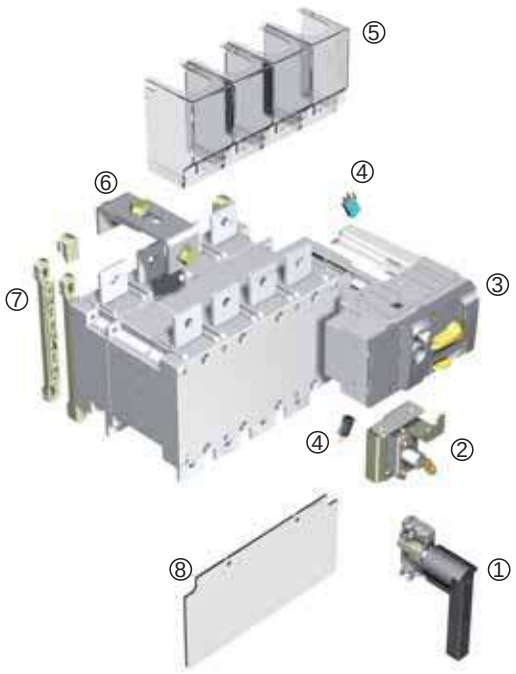


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ATyS 3
motorised switches
125 to 1800 A

Functions
References
Characteristics
Accessories: see page A.142
Dimensions: see page A.148





Functions

ATyS 3 products are 3 and 4-pole switches **remotely controlled by volt free contacts**. They are a combination of two load-break switches mounted back to back electrically and mechanically interlocked.

They provide switching, source inversion or changeover under load of two low voltage power circuits, as well as safety isolation.

Conformity to standards

- IEC 60947-3
- EN 60947-3
- NBN EN 60947-3
- BS EN 60947-3

General characteristics

- 3 stable positions (I, 0, II) or overlapping contacts on request (I, I+II, II).
- AC-22 and AC-23 switching under load.
- Isolation with positive break indication.
- Electrical control by volt free dry contacts.
- Manual emergency operation.
- Padlocking in 0 position (I and II optional).
- 1 power supply for the ATyS 3s.
- 2 power supplies for the ATyS 3e and possibility of adding optional modules such as an RS 485 communication port.
- Available enclosed, see page “Non-Automatic Transfer Switch ATyS 3 enclosed range”, C.24.

Available on request

- Specific control voltages.
- Overlapping contacts (I, I + II, II).

Overview (for further details, please see the installation instructions supplied with each device).

1. Backup handle and support (included with device).
2. Handle key interlocking accessories.
3. Standard device.
4. Additional auxiliary contacts.
5. Terminal shrouds.
6. Bridging bars.
7. Mounting spacers.
8. Terminal screens.

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References





Standard device - 230 VAC	125 A	160 A	250 A	400 A
ATyS 3s				
No. of poles	References	References	References	References
3 pole	1523 **3012**	1523 **3016**	1523 **3025**	1523 **3040**
4 pole	1523 **4012**	1523 **4016**	1523 **4025**	1523 **4040**
ATyS 3e				
3 pole	1533 **3012**	1533 **3016**	1533 **3025**	1533 **3040**
4 pole	1533 **4012**	1533 **4016**	1533 **4025**	1533 **4040**

Other voltages

12, 24 VDC	consult us	consult us	consult us	consult us

Accessories

Bridging bars						
1 pole			4109 **0019**	4109 **0019**	4109 **0025**	4109 **0039**
Plug-in optional modules (ATyS 3e only)						
COM RS485 (No. 1)			1599 **2000**	1599 **2000**	1599 **2000**	1599 **2000**
2 inputs/2 outputs (No. 2)			1599 **2001**	1599 **2001**	1599 **2001**	1599 **2001**
Terminal shrouds (1 set) (1)(2)						
3 pole		top / bottom / front (I) / rear (II)	2694 **3014**	2694 **3014**	2694 **3021**	2694 **3021**
4 pole		top / bottom / front (I) / rear (II)	2694 **4014**	2694 **4014**	2694 **4021**	2694 **4021**
Terminal screens (1 set top and bottom)						
3 pole			1509 **3012**	1509 **3012**	1509 **3025**	1509 **3025**
4 pole			1509 **4012**	1509 **4012**	1509 **4025**	1509 **4025**
Pre-breaking and signalling of position I and II auxiliary contacts						
2nd AC	NO/NC changeover	ATyS 3s	1599 **1002**	1599 **1002**	1599 **1012**	1599 **1012**
2nd AC	NO/NC changeover	ATyS 3e	1599 **0002**(3)	1599 **0002**(3)	1599 **0002**(3)	1599 **0002**(3)
Control voltage transformer						
400/230 VAC			1599 **4063**	1599 **4063**	1599 **4063**	1599 **4063**
Padlocking (factory fitted)						
"Padlocking in the 3 positions I, 0 and II" option			1599 **0003**	1599 **0003**	1599 **0003**	1599 **0003**
Key handle interlocking system (factory fitted)						
Locking using RONIS EL11AP lock in padlocked position			1509 **1006**	1509 **1006**	1509 **1006**	1509 **1006**
Mounting spacers						
1 set of 2 spacers			1509 **0001**	1509 **0001**	1509 **0001**	1509 **0001**
Door protective surround						
			1529 **0012**	1529 **0012**	1529 **0012**	1529 **0012**

(1) To shroud front switch top and bottom 2 references required.
(2) To fully shroud front and rear / top and bottom 4 references required.
(3) Factory assembly only.

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ATyS 3
motorised switches
125 to 1800 A

Functions
References
Characteristics
Accessories: see page A.142
Dimensions: see page A.148

References





Standard device - 230 VAC	630 A	800 A	1000 A	1250 A
ATyS 3s				
No. of poles	References	References	References	References
3 pole	1523 **3063**	1523 **3080**	1523 **3100**	1523 **3120**
4 pole	1523 **4063**	1523 **4080**	1523 **4100**	1523 **4120**
ATyS 3e				
3 pole	1533 **3063**	1533 **3080**	1533 **3100**	1533 **3120**
4 pole	1533 **4063**	1533 **4080**	1533 **4100**	1533 **4120**

Other voltages

12, 24 VDC	consult us	consult us	consult us	consult us

Accessories

Bridging bars						
1 pole			4109 **0063**	4109 **0080**	4109 **0080**	4109 **0120**
Plug-in optional modules (ATyS 3e only)						
COM RS485 (No. 1)			1599 **2000**	1599 **2000**	1599 **2000**	1599 **2000**
2 inputs/2 outputs (No. 2)			1599 **2001**	1599 **2001**	1599 **2001**	1599 **2001**
Terminal shrouds (1 set) (1)(2)						
3 pole	top / bottom / front (I) / rear (II)		2694 **3051**	-	-	-
4 pole	top / bottom / front (I) / rear (II)		2694 **4051**	-	-	-
Terminal screens (1 set top and bottom)						
3 pole			1509 **3063**	1509 **3080**	1509 **3080**	1509 **3080**
4 pole			1509 **4063**	1509 **4080**	1509 **4080**	1509 **4080**
Pre-breaking and signalling of position I and II auxiliary contacts						
2nd AC	NO/NC changeover	ATyS 3s	1599 **1022**	1599 **1032**	1599 **1032**	1599 **1032**
2nd AC	NO/NC changeover	ATyS 3e	1599 **0022**(3)	1599 **0032**(3)	1599 **0032**(3)	1599 **0032**(1)
Control voltage transformer						
400/230 VAC			1599 **4063**	1599 **4120**	1599 **4120**	1599 **4120**
Padlocking (factory fitted)						
"Padlocking in the 3 positions I, 0 and II" option			1599 **0003**	1599 **0004**	1599 **0004**	1599 **0004**
Key handle interlocking system (factory fitted)						
Locking using RONIS EL11AP lock in padlocked position			1509 **1006**	1509 **1004**	1509 **1004**	1509 **1004**
Mounting spacers						
1 set of 2 spacers			1509 **0001**	-	-	-
Door protective surround						
			1529 **0012**	1529 **0080**	1529 **0080**	1529 **0080**

(1) To fully shroud front and rear / top and bottom 4 references required.
(2) To shroud front switch top and bottom 2 references required.
(3) Factory assembly only.

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References



Standard device - 230 VAC	1600 A	1800 A
ATyS 3s		
No. of poles	References	References
3 pole	1523 **3160**	1523 **3180**
4 pole	1523 **4160**	1523 **4180**
ATyS 3e		
3 pole	1533 **3160**	-
4 pole	1533 **4160**	-

Other voltages		
12, 24 VDC	consult us	consult us

Accessories

Bridging bars					
1 pole				4109 **0160**	4109 **0160**
Plug-in optional modules (ATyS 3e only)					
COM RS485 (No. 1)				1599 **2000**	-
2 inputs/2 outputs (No. 2)				1599 **2001**	-
Terminal screens (1 set top and bottom)					
3 pole				1509 **3160**	1509 **3160**
4 pole				1509 **4160**	1509 **4160**
Pre-breaking and signalling of position I and II auxiliary contacts					
2nd AC	NO/NC changeover		ATyS 3s	1599 **1032**	1599 **1032**
2nd AC	NO/NC changeover		ATyS 3e	1599 **0032**(1)	-
Control voltage transformer					
400/230 VAC				1599 **4120**	1599 **4120**
Padlocking (factory fitted)					
“Padlocking in the 3 positions I, 0 and II” option				1599 **0004**	1599 **0004**
Key handle interlocking system (factory fitted)					
Locking using RONIS EL11AP lock in padlocked position				1509 **1004**	1509 **1004**
Door protective surround					
				1529 **0080**	1529 **0080**

(1) Factory assembly only.

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ATyS 3 motorised switches 125 to 1800 A

Functions
References
Characteristics
Accessories: see page A.142
Dimensions: see page A.148

Characteristics (according to IEC 60947-3)

Thermal current I_{th} (40°C)		125 A	160 A	250 A	400 A	630 A
Rated insulation voltage U_i (V)		800	800	800	800	1000
Rated impulse withstand voltage U_{imp} (kV)		8	8	8	8	12
Rated operational currents I_e (A)						
Rated voltage	Load duty category	A/B(1)	A/B(1)	A/B(1)	A/B(1)	A/B(1)
400 VAC	AC-21 A / AC-21 B	125/125	160/160	250/250	400/400	630/630
	AC-22 A / AC-22 B	125/125	160/160	250/250	400/400	630/630
	AC-23 A / AC-23 B	125/125	160/160	250/250	250/250	500/500
690 VAC(2)	AC-20 A / AC-20 B	125/125	160/160	250/250	400/400	630/630
	AC-21 A / AC-21 B	125/125	160/160	200/250	200/250	500/500
	AC-22 A / AC-22 B	125/125	125/125	125/160	125/160	315/315
	AC-23 A / AC-23 B	63/80	63/80	100/125	100/125	160/200
220 VDC	DC-20 A / DC-20 B	125/125	160/160	250/250	400/400	630/630
	DC-21 A / DC-21 B	125/125	160/160	250/250	250/250	630/630
	DC-22 A / DC-22 B	125/125	160/160	250/250	250/250	500/500
	DC-23 A / DC-23 B	125/125	125/125	200/200	200/200	500/500
440 VDC	DC-20 A / DC-20 B	125/125	160/160	250/250	400/400	630/630
	DC-21 A / DC-21 B	125(3)/125(3)	125(3)/125(3)	200(3)/200(3)	200(3)/200(3)	500(3)/500(3)
	DC-22 A / DC-22 B	125(3)/125(3)	125(3)/125(3)	200(3)/200(3)	200(3)/200(3)	500(3)/500(3)
	DC-23 A / DC-23 B	125(4)/125(4)	125(4)/125(4)	200(4)/200(4)	200(4)/200(4)	500(4)/500(4)
Fuse protected short-circuit withstand (kA rms prospective)(5)						
Prospective short-circuit current (kA rms)		100	100	50	18	70
Associated fuse rating (A)		125	160	250	400	630
Overload capacity						
Rated short-time withstand current 1 s. I_{cw} (kA rms)		7	7	9	9	13
Rated peak withstand current (kA peak) (5)		20	20	30	30	45
Connection						
Minimum Cu cable section (mm^2)		35	50	95	185	2 x 150
Minimum Cu busbar section (mm^2)		-	-	-	-	2 x 30 x 5
Maximum Cu cable section (mm^2)		50	95	150	240	2 x 300
Maximum Cu busbar width (mm)		25	25	32	32	50
Min. tightening torque (Nm)		9	9	20	20	20
Switching time						
I - II or II - I (s)(6)		0.75	0.75	1.3	1.3	1.3
I - 0 or II - 0 (s)(6)		0.45	0.45	0.85	0.85	0.85
Duration of “electrical blackout”(s)		0.3	0.3	0.6	0.6	0.6
Power-supply tolerance						
Supply 230 VAC min / max (V)		184 / 276	184 / 276	184 / 276	184 / 276	184 / 276
Control supply power demand (during transfer)						
Supply 230 VAC inrush / nominal (VA)		420 / 80	420 / 80	400 / 100	400 / 100	420 / 110
Mechanical characteristics						
Endurance (number of operating cycles)		10 000	10 000	8 000	8 000	5 000
Weight of 3 p switch (ATyS 3s) (kg)		3.2	3.3	3.7	4.7	5.2
Weight of 4 p switch (ATyS 3s) (kg)		3.3	3.4	3.8	5.2	5.7

(1) A/B: Category with index A = frequent operation / Category with index B = infrequent operation.
(2) With terminal shrouds or phase barrier.
(3) 3-pole device with 2 pole in series for the + and 1 pole for the -.
(4) 4-pole device with 2 pole in series by polarity.
(5) For a rated operating voltage U_e = 400 VAC.
(6) Between the order given and the arrival in position (under the nominal conditions).

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Characteristics (according to IEC 60947-3)

Thermal current I_{th} (40°C)		800 A	1000 A	1250 A	1600 A	1800 A
Rated insulation voltage U_i (V)		1000	1000	1000	1000	1000
Rated impulse withstand voltage U_{imp} (kV)		12	12	12	12	12
Rated operational currents I_e (A)						
Rated voltage	Load duty category	A/B(1)	A/B(1)	A/B(1)	A/B(1)	A/B(1)
400 VAC	AC-21 A / AC-21 B	800/800	1000/1000	1250/1250	1600/1600	1800/1800
	AC-22 A / AC-22 B	800/800	1000/1000	1250/1250	1600/1600	1800/1800
	AC-23 A / AC-23 B	800/800	1000/1000	1250/1250	1250/1250	1250/1250
690 VAC(2)	AC-20 A / AC-20 B	800/800	1000/1000	1250/1250	1600/1600	1800/1800
	AC-21 A / AC-21 B	800/800	800/800	800/800	1000/1000	1000/1000
	AC-22 A / AC-22 B	800/800	800/800	800/800	1000/1000	1000/1000
	AC-23 A / AC-23 B	200/250	200/250	200/250	500/500	500/500
220 VDC	DC-20 A / DC-20 B	800/800	1000/1000	1250/1250	1600/1600	1800/1800
	DC-21 A / DC-21 B	800/800	1000/1000	1250/1250	1250/1250	1250/1250
	DC-22 A / DC-22 B	800/800	1000/1000	1250/1250	1250/1250	1250/1250
	DC-23 A / DC-23 B	800/800	1000/1000	1250/1250	1250/1250	1250/1250
440 VDC	DC-20 A / DC-20 B	800/800	1000/1000	1250/1250	1600/1600	1800/1800
	DC-21 A / DC-21 B	800(4)/800(4)	1000(4)/1000(4)	1250(4)/1250(4)	1250(4)/1250(4)	1250(4)/1250(4)
	DC-22 A / DC-22 B	800(4)/800(4)	1000(4)/1000(4)	1250(4)/1250(4)	1250(4)/1250(4)	1250(4)/1250(4)
	DC-23 A / DC-23 B	800(4)/800(4)	1000(4)/1000(4)	1250(4)/1250(4)	1250(4)/1250(4)	1250(4)/1250(4)
Fuse protected short-circuit withstand (kA rms prospective)(5)						
Prospective short-circuit current (kA rms)		50	100	100	100	100
Associated fuse rating (A)		800	1000	1250	2 x 800	2 x 800
Overload capacity						
Rated short-time withstand current 1 s. I_{cw} (kA rms)		26	35	35	50	50
Rated peak withstand current (kA peak)(5)		55	80	80	110	110
Connection						
Minimum Cu cable section (mm^2)		2 x 185	2 x 240	-	-	-
Minimum Cu busbar section (mm^2)		2 x 40 x 5	2 x 50 x 5	2 x 60 x 5	2 x 80 x 5	3 x 100 x 5
Maximum Cu cable section (mm^2)		2 x 300	4 x 185	4 x 185	6 x 185	6 x 185
Maximum Cu busbar width (mm)		63	63	63	100	100
Min. tightening torque (Nm)		-	-	20	40	40
Switching time						
I - II or II - I (s)(6)		2.6	2.6	2.6	2.6	2.6
I - 0 or II - 0 (s)(6)		1.6	1.6	1.6	1.6	1.6
Duration of “electrical blackout” (s)		1.5	1.5	1.5	1.6	1.6
Power-supply tolerance						
Supply 230 VAC min / max (V)		184 / 276	184 / 276	184 / 276	184 / 276	184 / 276
Control supply power demand (during transfer)						
Supply 230 VAC inrush / nominal (VA)		450 / 120	450 / 120	450 / 120	450 / 120	450 / 120
Mechanical characteristics						
Endurance (number of operating cycles)		4 000	4 000	4 000	3 000	3 000
Weight of 3 p switch (ATyS 3s) (kg)		19.6	23.1	24.6	36.1	36.1
Weight of 4 p switch (ATyS 3s) (kg)		23.1	24.6	29.6	42.1	42.1

(1) A/B: Category with index A = frequent operation / Category with index B = infrequent operation.
(2) With terminal shrouds or phase barrier.
(3) 3-pole device with 2 pole in series for the + and 1 pole for the -.
(4) 4-pole device with 2 pole in series by polarity.
(5) For a rated operating voltage U_e = 400 VAC.
(6) Between the order given and the arrival in position (under the nominal conditions).

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PowerLogic® meters for entry-range applications

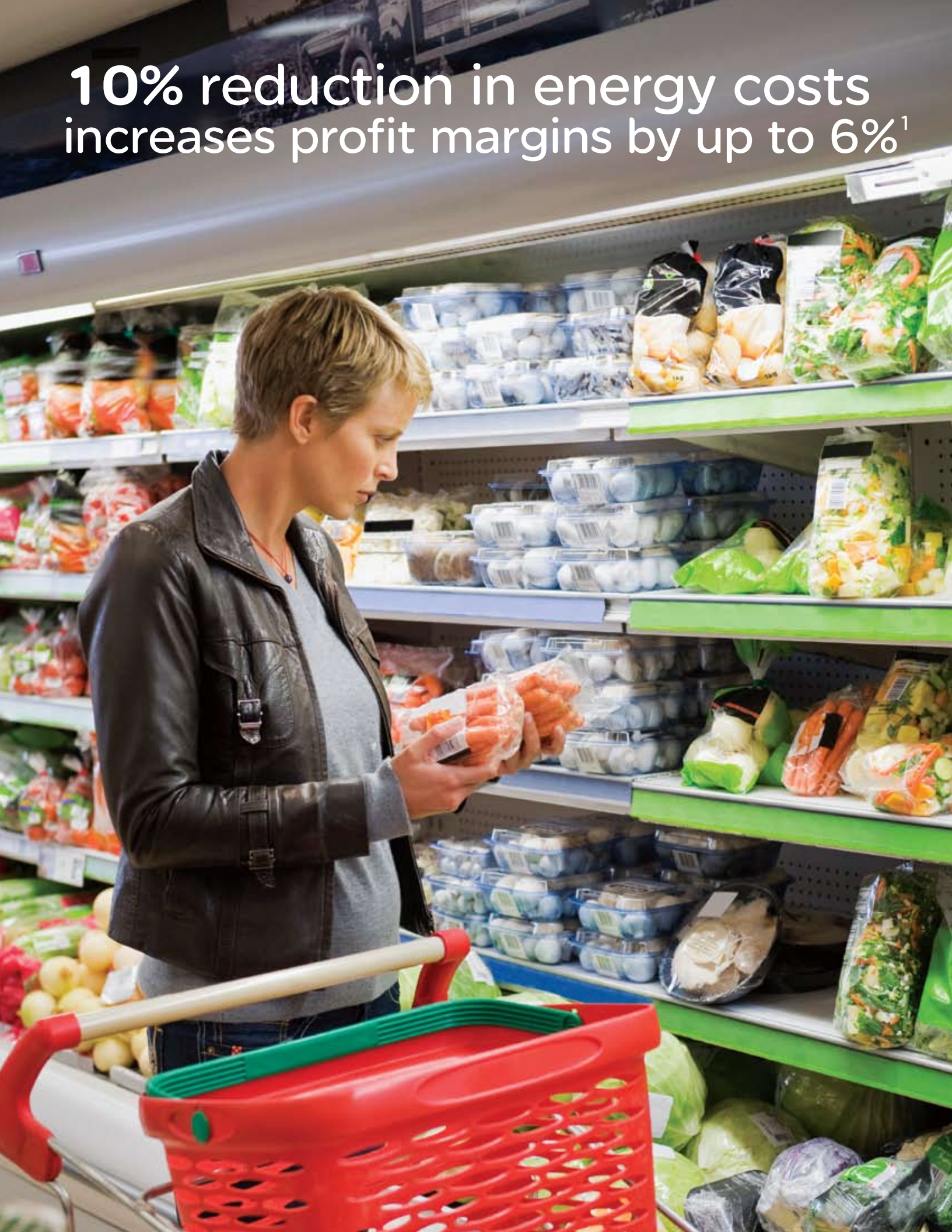
A complete range of meters for essential electrical system measurement



DM6000 series digital panel meters
PM1000 series multifunction power meters

Retail OEMs Buildings Industry

Schneider Electric



10% reduction in energy costs increases profit margins by up to 6%[1]

Gain control and save energy with PowerLogic technology from Schneider Electric.

Energy accounts for a significant portion of your operating costs – sometimes as much as 10 percent. It is a manageable expense that you cannot afford to ignore. The first step in taking control of your energy bills is measurement. You need reliable information about your system and your equipment to make good decisions. You need to be smart about your energy use. You need PowerLogic technology from Schneider Electric to make the most of your energy.



Save up to 10 percent on your energy costs by identifying energy consumption for individual loads and pinpointing the root cause for various problems.

The PowerLogic range has the answers you need

PowerLogic solutions from Schneider Electric constitute the world's largest and most advanced range of software and metering products for managing energy. PowerLogic solutions give thousands of energy suppliers and consumers a unique level of insight into every energy-related cost, risk and opportunity. Its range includes the most comprehensive scope of metering and monitoring equipment in the industry, providing quality, reliable products from the most basic measurements to the most advanced energy management systems.

A new range for entry-range applications

Schneider Electric offers Square D PowerLogic products with quality and reliability for entry-range applications where basic measurement capabilities are needed. Whether you simply need to know the load on your equipment or you need help allocating energy costs to departments or processes, you can depend on PowerLogic technology from Schneider Electric for every part of the equation.

A guaranteed return on investment

Although power meters on their own don't reduce electrical consumption, their payback has been well documented. A study by the Energy Cost Savings Council revealed that meters and monitors have an average payback period of less than six months and an average return on investment of 200 percent.[2]

" I need a basic energy measurement system that helps me identify areas for energy savings. The meters should monitor and clearly display the electrical load on my equipment so I can protect my investment. Should I choose to upgrade, I want it to be easy. "



Tap into essential energy measurements with a simple and cost-effective metering solution.

The PowerLogic DM6000 series digital panel meters and PowerLogic PM1000 series multifunction meters provide the features you need to monitor an electrical installation affordably. Rugged enough to withstand industrial and commercial environments, both meters help you save energy and installation costs, are easy to use, and adapt to various circuit requirements onsite.

PowerLogic DM6000 series meters:

> Basic measurements (volts, amps, frequency, and power factor)

Use these meters for:

> Equipment monitoring
> Preventive maintenance scheduling
> Monitoring electrical usage locally
> Replacing multiple analog meters

PowerLogic PM1000 series meters:

> Basic measurements (volts, amps, frequency, and power factor)
> Energy
> Power
> Demand
> Total Harmonic Distortion

Choose these meters for:

> Energy monitoring
> Power monitoring
> Demand monitoring
> Load studies and circuit optimization
> Energy balancing
> Energy optimization

Stock, order and program with ease

Our programmable CT ratios make ordering and stocking extremely easy and our meters very flexible. Program the meters to any PT ratio, CT ratio or circuit onsite, even after installation!

Replace multiple analog meters with one device

Depending on your application, either of these meters can replace multiple analog meters, saving panel space, reducing installation costs and simplifying wiring.

One PowerLogic DM6000 series meter directly replaces:

- One voltmeter with one selector switch, or three or six voltmeters
- One ammeter with one selector switch, or three ammeters
- Frequency meter
- PF meter
- RPM meter (wherever required)

One PowerLogic PM1000 series meter directly replaces:

- One voltmeter with one selector switch, or three or six voltmeters
- One ammeter with one selector switch, or three ammeters
- Frequency meter
- PF meter
- RPM meter (wherever required)
- KWh, KVARH and KVAH meters
- KW, KVA and KVAR meters

Prolong your equipment life

Prolong your equipment life by monitoring equipment status and providing information essential for a preventive maintenance schedule.



> Retail

Power monitoring equipment measures and records energy usage – information that helps retail owners and managers to better understand their energy bill. Retailers then can track total kilowatt hours used against outside or inside temperature, time of day, number of customers, level of sales, square footage, or any other quantifiable value.[1]



> OEMs

Enhance the value and life of your equipment by replacing multiple analog meters and selector switches with a single, accurate, high density meter at an affordable price.



> Buildings

Research shows that “installing submeters in master-metered buildings can reduce building-wide electricity consumption by 18-26 percent”.[3] Submetering and identifying energy usage patterns provide the means to encourage and drive behavior towards more efficient energy use, allocate costs according to cost center or tenant within a facility and deployment of effective load curtailment measures to conserve energy and turn off avoidable loads when not necessary.



> Industrial

By monitoring consumption on an ongoing basis, corporate energy managers can predict electricity costs for the month, avoid penalties and verify each bill.[2]



Simple to install, simple to configure, easy to use.



Simple installation

A color-keyed terminal board on the back simplifies installation and helps ensure accurate wiring. Direct connection is provided for metering voltage inputs of up to 480 V ac L-L.



User-friendly configurable load bar

A configurable load bar on the front display mimics an analog needle and monitors electrical usage locally so you can quickly gauge the percentage of load on your equipment at a glance. Customize the load bar to match your equipment.

Easy to use

A bright LED display, 15-mm alphanumeric characters, and large front panel buttons make these meters perfect for low-light environments. The display scrolls automatically from parameter to parameter, page to page, and scales displayed values from kilo to mega to giga.



The turbo key gives you quick access to the most commonly viewed parameters and easily takes you into setup mode.

Range comparisons at a glance

Metering and accuracy		PowerLogic PM1200	PowerLogic DM6200
Volts	Phase to phase average, per phase	1% of reading	1% of reading
	Phase to neutral average, per phase	1% of reading	1% of reading
Amps	Per phase and average	1% of reading	1% of reading
	Neutral amps	1% of reading	1% of reading
Power factor	Per phase and average	1% of reading	1% of reading
Power	Active	1% of reading	-
	Reactive	2% of reading	-
	Apparent (per phase and total)	1% of reading	-
Energy	Active	1.0 as per IEC 62053-21	-
	Reactive (inductive and capacitive)	2.0 as per IEC 62053-23	-
	Apparent	■	-
Energy	Total	■	-
	Import	■	-
	Export	■	-
Demand	Present demand and maximum demand (Amps, KW or KVA)	■	-
	Time remaining	■	-
Total harmonic distortion: % THD (volts and amps) per phase		■	-
Frequency		■	■
RPM		■	■
% Loading (amps)		■	■
ON hours		■	■
Number of interruptions		■	■
Run hours		■	-
Load bar: (% loading full scale)		■	■
Phase angles: amps per phase		■	■
Accuracy class 1.0 as per IEC62052-11 and IEC 62053-21		■	■
Power quality			
Total harmonic distortion: % THD (volts and amps) per phase		■	■
% Unbalance (volts and amps)		■	■
Communications			
RS-485 port with Modbus protocol		■	■

The PowerLogic advantage

PowerLogic solutions constitute the world's largest and most advanced range of software and metering products for managing energy, giving (energy) suppliers and (energy) consumers a unique level of insight into every energy-related cost, risk and opportunity.

Dependability

You can depend on the PowerLogic range of products for all your metering and monitoring needs from the most basic measurements to the most advanced energy management systems. Quality, reliability and flexibility – all from a name you can trust.

Utilities use PowerLogic products to:

> Meter key interchange points with the highest accuracy
> Improve the quality of power delivered to customers
> Increase reliability and efficiency of the network and equipment

Consumers use PowerLogic products to:

> Achieve energy-related savings through improved efficiency, lower emissions, reduced energy costs and maximized use of infrastructure
> Improve the overall quality of power and reliability of equipment and processes

Schneider Electric, a global leader in energy management, offers proven, integrated solutions to provide:

> Safer, more reliable energy
> Improved efficiency and productivity
> Reduced power quality issues
> Optimized energy infrastructures

For industry, data centers and networks, buildings and residential markets.
Learn more about PowerLogic products at www.schneider-electric.us

References:

1 Proven Strategies for Saving Energy and Reducing Costs in a Retail Environment. Schneider Electric

2 Industrial Energy Management: Doing More with Less. Schneider Electric

3 Lowering the Total Cost of Ownership of a Sub-metering System. Schneider Electric

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Doc #3000BR1006

March 2010

INSTALLATION/OPERATING INSTRUCTIONS FOR 24-HOUR MECHANICAL SOCKET BOX TIMER

Please read the instructions fully before attempting installation.

IMPORTANT

This unit should be installed to current IEE wiring regulations if in doubt please consult a qualified electrician

- Timer must not be mounted on a flammable surface.
- Ensure that the timer does not come into contact with any combustible materials such as towels or bedding.
- Ensure at least a 300mm air space is allowed around the timer.

INSTALLATION

- Prepare cable ends for connection to terminals.
- Remove 2 screws holding the timeswitch cover to the back box.
- Remove the front part of the timer switch from the back-box by pulling firmly to disconnect it from the internal 'push on' electrical connectors.
- Screw the back box onto the wall.
- To make the unit splash proof the rubber grommet must be used in the top of the unit and the clear plastic cover must be in place to the front.

MPORTANT: Ensure all the Terminal screws are ully tightened.

- Connect all earth wires to earthing point
- Push the timeswitch back into it's seating on the ackplate, taking care that all the wires are tucked ı. Fit the cover and tighten the two screws.

SETTING THE CLOCK

Turn the dial in the direction of the arrow (clockwise) until the correct time of day is shown on the big and little hands. The time set marker ▲ on the clockface should point at the correct time. (24-hour clock).

For the 'ON' period push the switching riders out towards the outside edge of the face. The timer will operate for the duration set (each segment is approx 15 minutes), i.e. If it is required to switch on between 16:00 and 18:00, all the segments between these times should be moved to the outer edge.

SETTING THE PROGRAMME

- By moving the switch located centre right of the clock face the following operations can be achieved

On = Permanently ON.
Auto = Switching programme as set on dial

- To switch the timer permanently off either push all of the 15-minute switch rider's inwards or alternatively the timer can be used with a separate override switch.

TECHNICAL DATA

Switching Capacity: 240VAC, 16A resistive (approx 3680W max); or up to 1250W CFL lights; or up to 2 X 400W HPS or Metal Halide lamp

GUARANTEE

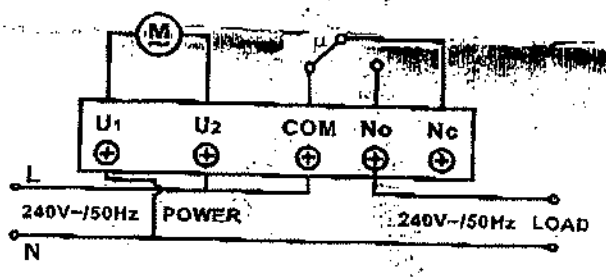
Your 24-Hour Mechanical Socket Box Timer is guaranteed for 12 months from the date of purchase.
This does not affect your statutory rights

CE INFORMATION

ACTION TYPE: 1B
POLLUTION SITUATION: NORMAL
CLASS 2 INSULATION: ⧈
μ : MICRO-DISCONNECTION LIVE POLE ONLY

PLEASE KEEP THESE INSTRUCTIONS SAFE FOR FUTURE REFERENCE

WIRING CONNECTION FOR EH711



MX200 / 180 / 160



MX200
Under & Over Voltage Relay



MX180
Over Voltage Relay



MX160
Under Voltage Relay

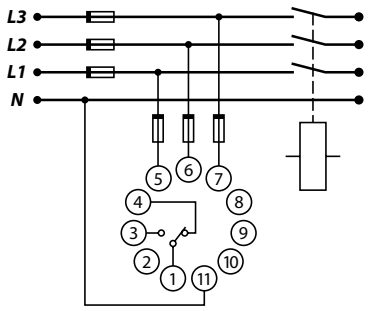
Features

- Electronic monitoring relay
- Voltage monitoring for 3-phase system
- Phase failure monitoring
- Adjustable voltage limit
- Adjustable delay time
- Indicators for voltage fault
- Indicators for power and output ON

Product Description

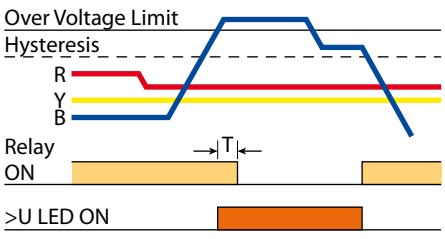
MX160, MX180 & MX200 are 3-phase monitoring relays. The relays are designed for application where it is required to maintain the voltage within set limits. A built-in adjustable time delay prevent nuisance tripping.

WIRING DIAGRAM

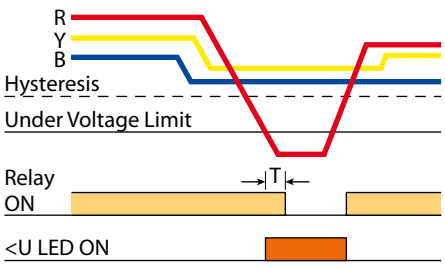


OPERATIONS DIAGRAM

i) Over Voltage Function**



ii) Under Voltage Function*



Technical Data

POWER SUPPLY INPUT

Phase-to-phase voltage	: 415 V AC ± 20% 400 V AC ± 20% 380 V AC ± 20%
Frequency range	: 45 to 65 Hz
Max. power consumption	: 3 VA
Input connections	: Phase L1, L2, L3 to pin 5, 6, & 7 Neutral to pin 11

SETTING RANGES

Lower voltage limit *	: 78% - 98%
Upper voltage limit **	: 102% - 122%
Delay time, T	: 0.1 - 10s

HYSTERESIS

≤1% of rms - value

CONTACT OUTPUT

Cotact arrangement	: SPDT change-over contacts.
Contact rating	: 5A, 250 V AC (cosφ=1)
Contact material	: Silver alloy
Expected electrical life	: 100,000 operations at rated current
Expected mechanical life	: 5 x 10^6 operations

INDICATORS

Power supply ON	: Green indicator
Output ON	: Red indicator
Under voltage limit (U<) *	: Red indicator
Over voltage limit (U>) **	: Red indicator

MECHANICAL

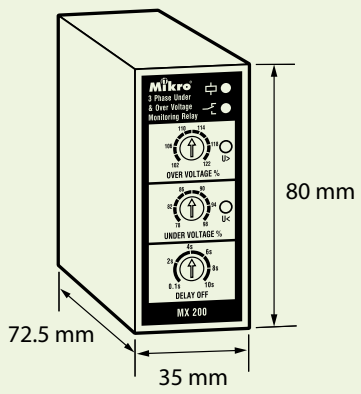
Mounting	: Circular 11-pin plug-in socket
Approximate weight	: 0.25kg

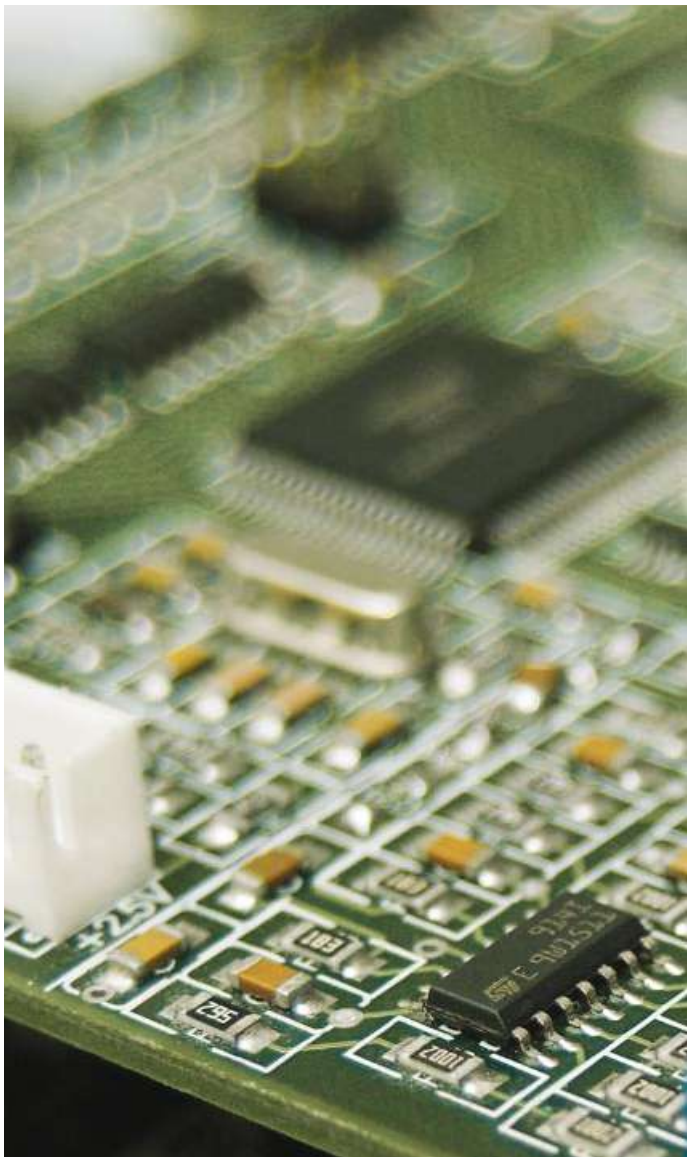
ENVIRONMENTAL CONDITIONS

Temperature	: -5˚C to +55˚C
Humidity	: 56 days at 93% RH and 40˚C non-condensing

* Applicable to MX160 and MX200 only
** Applicable to MX180 and MX200 only

CASE DIMENSIONS





Ordering Information

MODEL	FUNCTION Under Voltage Monitoring	Over Voltage Monitoring	Supply Voltage V AC
MX160 - 380	YES	NO	380
MX160 - 400	YES	NO	400
MX160 - 415	YES	NO	415
MX180 - 380	NO	YES	380
MX180 - 400	NO	YES	400
MX180 - 415	NO	YES	415
MX200 - 380	YES	YES	380
MX200 - 400	YES	YES	400
MX200 - 415	YES	YES	415

Electrical specification

	MMP C275/3	MMP C275/4	MMP C275/3+1T
Installation	TNC	TNS/TNCS	TT
Nominal voltage*	220 - 240V_{RMS}	220 - 240V_{RMS}	220 - 240V_{RMS}
Maximum continuous operating voltage (U_c)	275Vac / 350Vdc	275Vac / 350Vdc	275Vac / 350Vdc
Back up fuse (If mains supply >100A)	100AgL	100AgL	100AgL
Short circuit capability	25kA / 50Hz	25kA / 50Hz	25kA / 50Hz
Signal contact ratings Signal contact part no. Non-replaceable SPD part no. Non-replaceable SPD signal contact part no.	250V_{RMS} / 0.5A MMP C275/3/S MMP CN275/3 MMP CN275/3/S	250V_{RMS} / 0.5A MMP C275/4/S MMP CN275/4 MMP CN275/4/S	250V_{RMS} / 0.5A MMP C275/3+1T/S MMP CN275/3+1T MMP CN275/3+1T/S

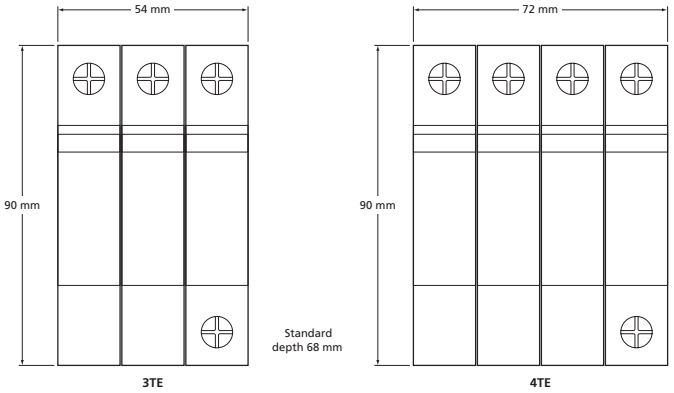
Transient specification

Arrestor classification[1] EN IEC E DIN VDE 0675	 2 II C	 2 II C	 2 II C
Let-through voltage (U_p)[2] at I_n (8/20µs) at I_{imp} (10/350µs), N-E at 1.2/50µs	 <0.9kV – –	 <0.9kV – –	 <0.9kV <1.3kV <1.2kV
Nominal discharge current I_n (8/20µs)	20kA	20kA	20kA
Maximum discharge current I_{max} (8/20µs) I_{imp} (10/350µs)	40kA –	40kA –	40kA 12.5kA (N-E)

[1] Tested to BS EN/IEC-61643
[2] Values stated are per pole

Mechanical specification

Temperature range	-40 to +80°C
Connection for power for signal	 35mm² solid conductor, 25mm² stranded conductor 1.5mm² conductor (/S Option)
Mounting	Indoor, 35mm top hat DIN rail
Degree of protection	IP20
Case material	Thermoplastic, UL 94 V-0
Dimensions to DIN 43880	90mm x 68mm x 54mm (3TE) 90mm x 68mm x 72mm (4TE) 90mm x 68mm x 72mm (4TE) Height with remote signal contact =100mm
Enclosure dimensions for up to 4TE wide	170mm x 98mm x 105mm (MMP ENC4)



*** Protectors are available for all system voltages - contact Furse.**



PFR140/120/80/60

Features

- Microprocessor based intelligent auto switching control
- Automatic C/K and rated step adjustment
- Automatic CT polarity correction
- Display of power factor, current & total harmonic distortion of current
- Programmable sensitivity
- Last step can be used as alarm/fan output
- Under/over voltage alarm, under/over compensate alarm & high harmonic distortion alarm
- User-friendly setting
- Complies with IEC 61000-6-2 standard

Technical Data

RATINGS AUXILIARY POWER SUPPLY

Current Supply voltage	: 240 V AC / 415 V AC
Operating Limits	: -15% + 10%
Consumption	: 10 VA max
Rated frequency	: 50 Hz or 60 Hz

CURRENT INPUT

Rated current (I_n)	: 5 A
Operating Limits	: 0.15 A to 6.5 A
Rated Frequency	: 50 Hz or 60 Hz

RELAY OUTPUT

Numbers of outputs	: 6 / 8 / 12 / 14 (PFR60 / PFR80 / PFR120 / PFR140)
Contact arrangement	: NO contacts type
Contact rating	: 5 A, 250 V AC (cosφ = 1)
Contact material	: Silver alloy
Expected electrical life	: 100,000 operations at rated current
Expected mechanical life	: 5 x 10^6 operations
Max current for the common terminals	: 12 A continuous

CONTROL RANGE

Power factor setting	: 0.8 inductive - 0.8 capacitive
C/K setting	: 0.03 - 1.20 / Automatic
Switching sensitivity	: 5 - 600 s/step
Reconnection time for same step	: 5 - 240 s
THD threshold	: 0.20 - 3.00 (20% - 300%) / OFF
Switching Program	: Automatic / Automatic Rotate / 4-quadrant / Manual
Rated step coefficient	: 0 / 1 / 2 / 3 / 4 / 5 / 6 / 8 / 12 / 16 (Automatic if C/K set to Auto)

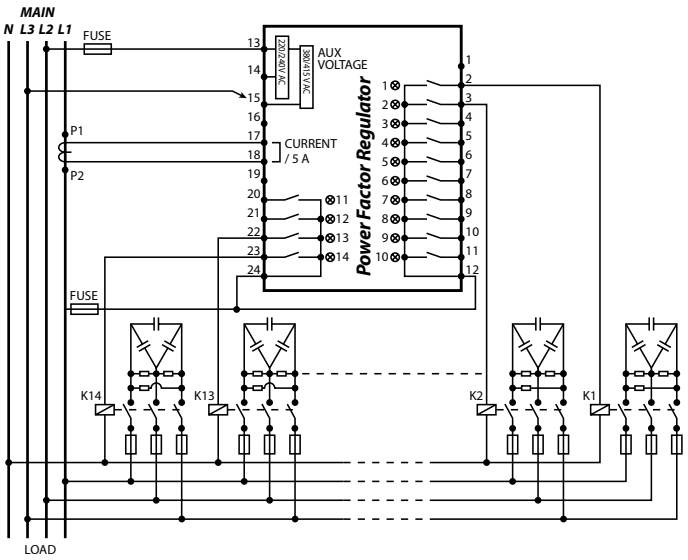
MECHANICAL

Mounting	: Panel mounting
Dimension (h x w x d)	: 144mm x 144mm x 90mm
Approximate weight	: 1 kg

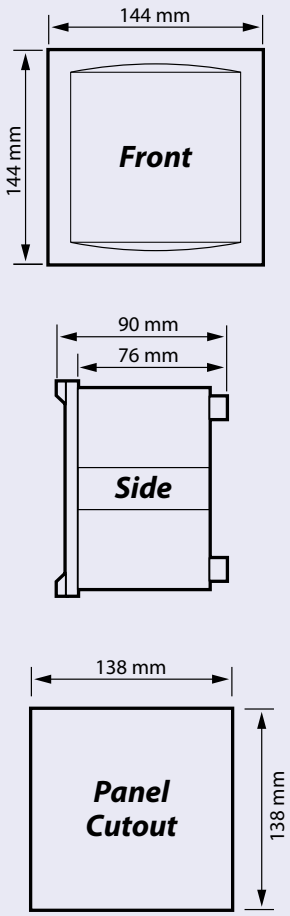
ENVIRONMENTAL CONDITIONS

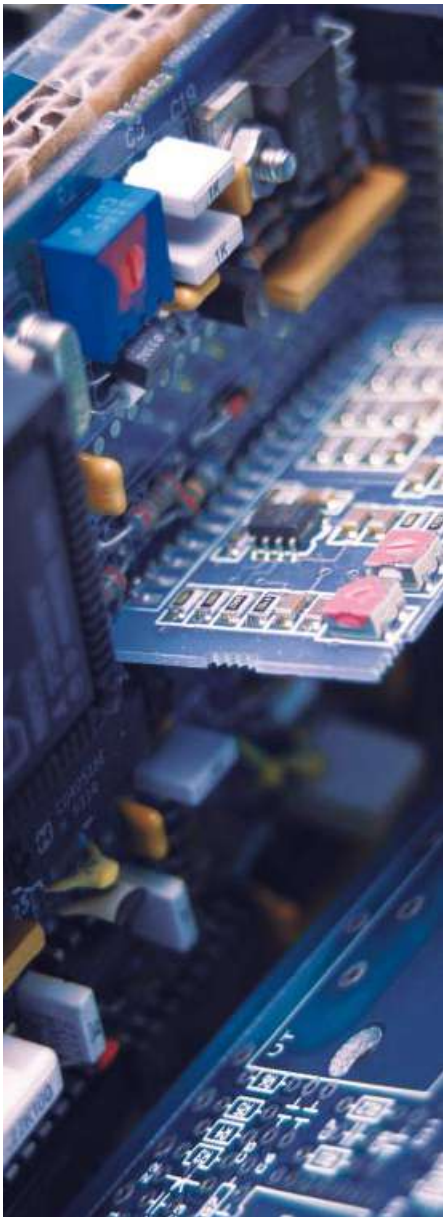
Temperature	: -5˚C to +55˚C
Humidity	: 56 days at 93% RH and 40˚C non-condensing

TYPICAL APPLICATION DIAGRAM



CASE DIMENSIONS





Ordering Information

MODEL	DESCRIPTION
PFR60 - 415 - 50	6 Steps, 50 Hz system, auxiliary voltage 415 V AC
PFR80 - 415 - 50	8 Steps, 50 Hz system, auxiliary voltage 415 V AC
PFR120 - 415 - 50	12 Steps, 50 Hz system, auxiliary voltage 415 V AC
PFR140 - 415 - 50	14 Steps, 50 Hz system, auxiliary voltage 415 V AC
PFR60 - 220 - 60	6 Steps, 60 Hz system, auxiliary voltage 220 V AC
PFR80 - 220 - 60	8 Steps, 60 Hz system, auxiliary voltage 220 V AC
PFR120 - 220 - 60	12 Steps, 60 Hz system, auxiliary voltage 220 V AC
PFR140 - 220 - 60	14 Steps, 60 Hz system, auxiliary voltage 220 V AC



MK301A



MK302A

MK301A / 302A

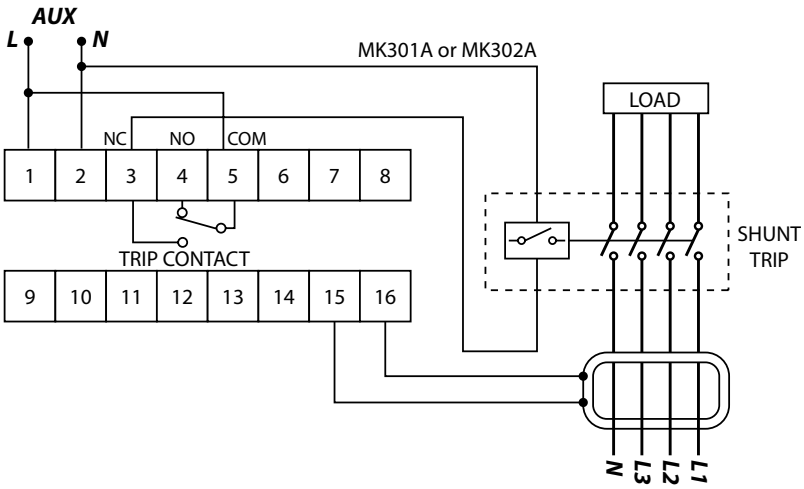
Features

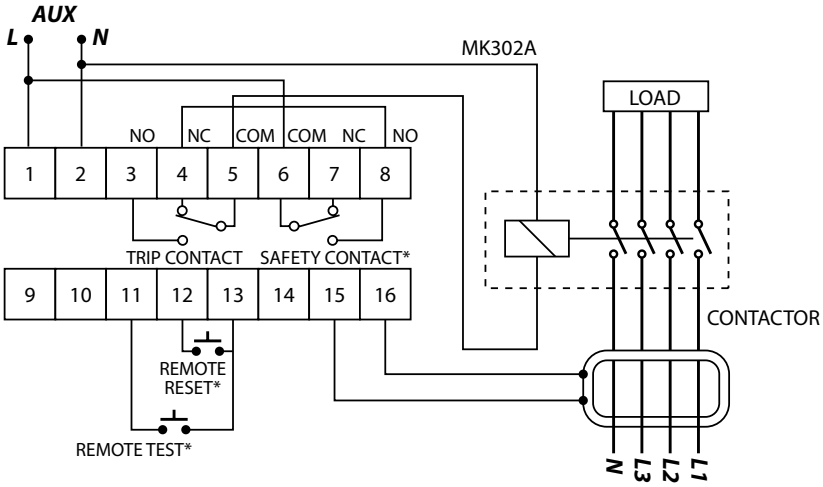
- Trip starting indicator
- Detection of no connection to current transformer for extra safety
- Relay tripped indicator
- High immunity to electrical interference

Features for MK302A only

- Safety output contact
- Earth leakage level indicators
- Remote reset and remote test functions

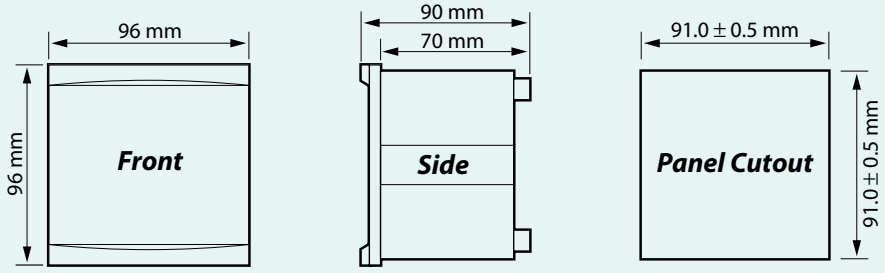
TYPICAL APPLICATION DIAGRAMS





* Applicable to MK302A series only

CASE DIMENSIONS



Technical Data

AUXILIARY SUPPLY

Model MK301A / 302A -240A	: 198 ~ 265 V AC
Model MK301A / 302A -110A	: 94 ~ 127 V AC
Rated frequency	: 50 / 60 Hz
VA rating	: 3 VA typical

SETTING RANGES

Sensitivity adjustment	: 0.03 A to 30 A
Delay time adjustment	: 0 sec to 3.0 sec

PERFORMANCE

Setting accuracy	: -15% to +0%
Timing accuracy	: ±5%

CONTACTS

Contact arrangement	: 1 x latching type with manual reset
	: 1 x safety contact*
	: NC and NO contacts available
Contact rating	: 5 A, 250 V AC (cosφ = 1) contact rating
Contact material	: Silver alloy
Expected electrical life	: 100,000 operations at rated current
Expected mechanical life	: 5 x 10^6 operations

INPUTS

Remote Test* / Reset Inputs*	: N.O. dry contact

INDICATORS

Auxiliary supply	: Green indicator
Time delay	: Red indicator
Trip	: Red indicator
Real-time leakage current	: Red indicator

ZERO - PHASE CURRENT TRANSFORMER

To operate with Mikro's ZCT series of current transformer

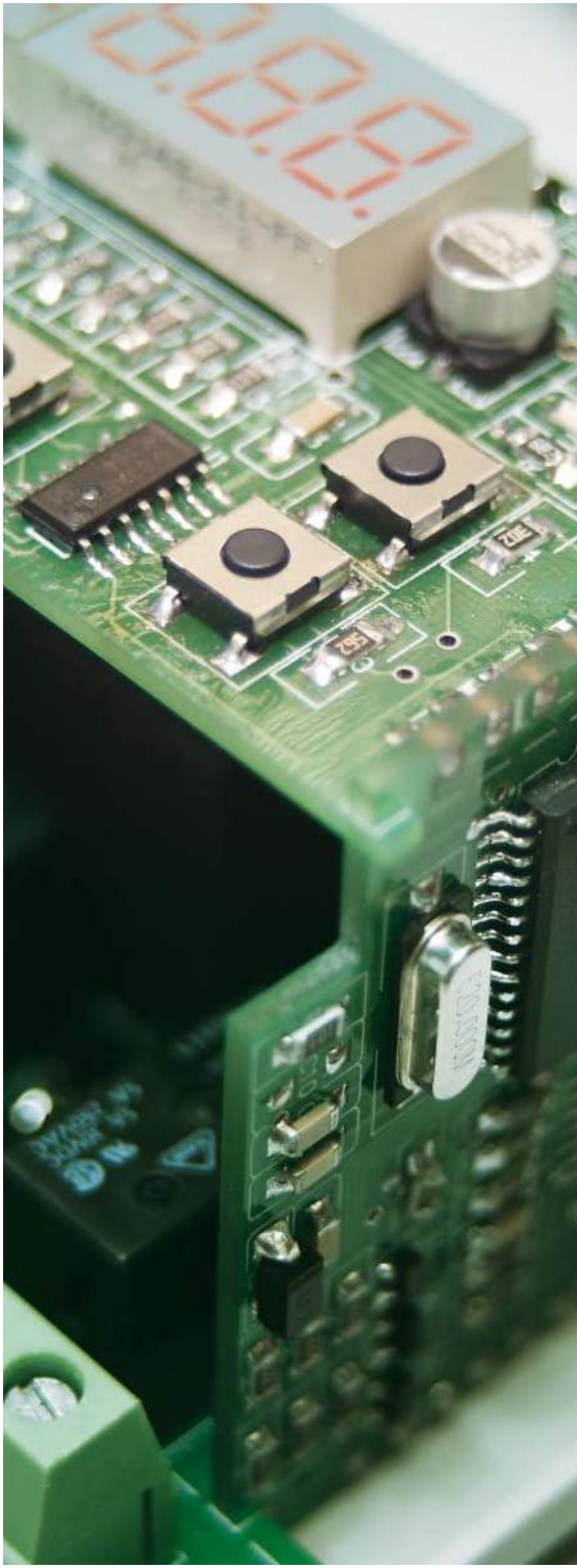
MECHANICAL

Mounting method	: Panel mounting
Front panel	: Standard DIN 96mm x 96mm
Approximate weight	: 0.6 kg (excluding ZCT)

ENVIRONMENTAL CONDITIONS

Temperature	: -5˚C to +55˚C
Humidity	: 56 days at 93% RH and 40˚C non-condensing

* Applicable to MK302A series only



Ordering Information

MODEL	DESCRIPTION
MK301A - 240A	For 50 / 60 Hz system, auxiliary voltage 198 ~ 265 V
MK301A - 110A	For 50 / 60 Hz system, auxiliary voltage 94 ~ 127 V AC
MK302A - 240A	For 50 / 60 Hz system, auxiliary voltage 198 ~ 265 V
MK302A -110A	For 50 / 60 Hz system, auxiliary voltage 94 ~ 127 V AC



MK201A

Features

- Microprocessor based numerical relay
- Current measurement based on fundamental frequency
- Low-set definite time relay
- High-set instantaneous relay
- Separate low-set and high-set indicators
- Option to disable the high-set relay
- Front panel access to the test function
- Complies with IEC 60255-26 standard

PERFORMANCE

Adjustable accuracy : Less than ±5%
Repeatability : Less than 0.5% of full scale

MECHANICAL

Mounting : Panel mounting
Front panel : Standard DIN 96 mm x 96 mm
Approximate weight : 0.6 kg

ENVIRONMENTAL CONDITIONS

Temperature : -5˚C to +55˚C
Humidity : 56 days at 93% RH and 40˚C non-condensing

Technical Data

RATINGS

Rated current (I_n) : 5 A
Rated frequency : 50 Hz
Burden : < 0.3 VA at I_n
Thermal withstand : 4 x I_n continuous

AUXILIARY SUPPLY

Model MK201A-240A : 198 ~ 265 V AC
Model MK201A-110A : 94 ~ 127 V AC
Supply frequency : 50 Hz
VA rating : 3 VA typical

SETTING RANGES

Low-set (I >) : 0.1 A to 2.0 A
: 2% to 40%
Low-set delay time(DELAY): 0.05 sec to 1.0 sec
High-set (I >>) : I > to 10 x I > or disable
High-set delay time (t >>): Instantaneous

CONTACTS

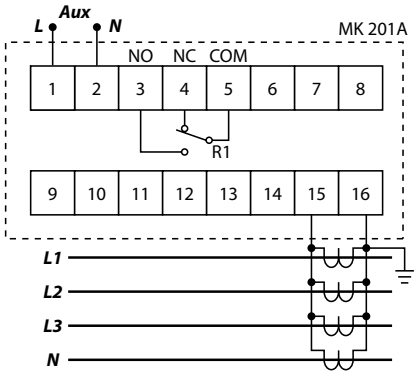
Trip contact (R1) : Manual reset type
Contact Arrangement : Change-over
Contact rating : 5 A, 250 V AC (cosφ = 1)
Contact material : Silver alloy
Expected electrical life: 100,000 operations at rated current
Expected mechanical life: 5 x 10^6 operations

INDICATORS

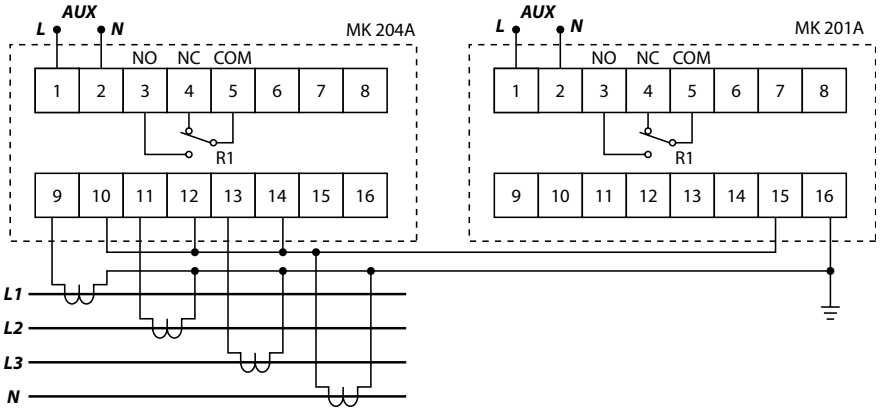
Auxiliary supply : Green indicator
Pick-up : Red indicator
Trip : Red indicator



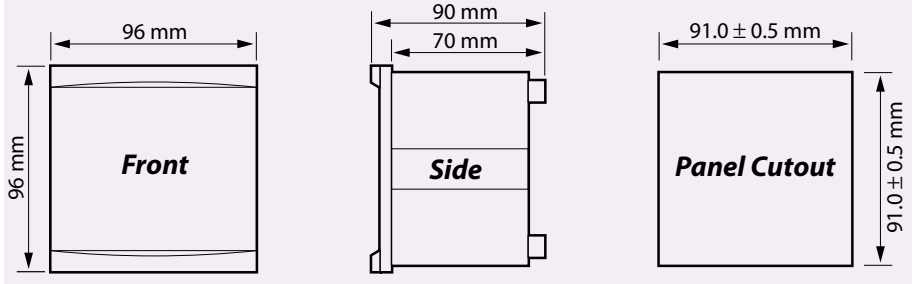
TYPICAL APPLICATION DIAGRAM



COMBINED OVERCURRENT & EARTH FAULT RELAYS



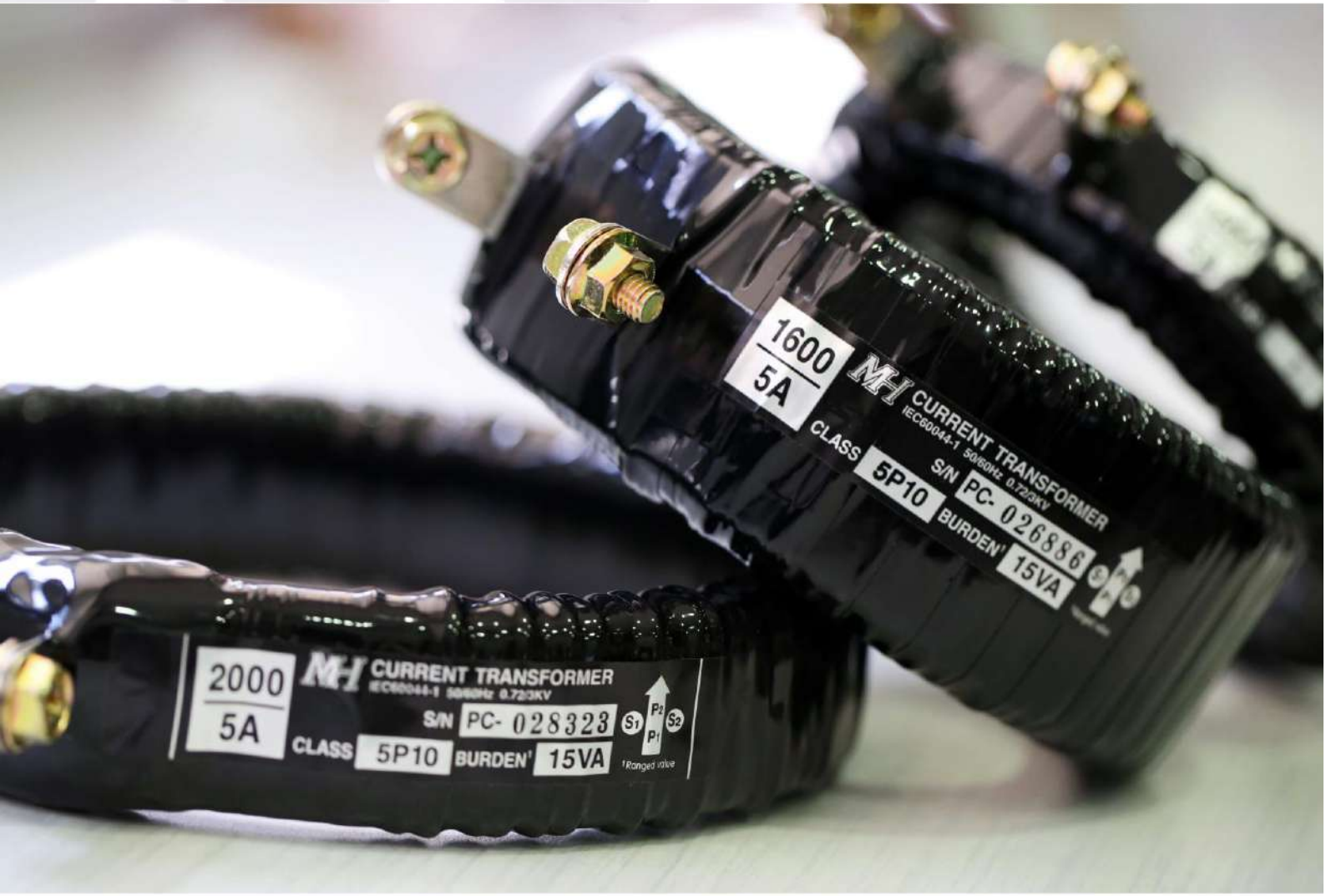
CASE DIMENSIONS



Ordering Information

MODEL	DESCRIPTION
MK201A - 240A	For 50 Hz system, auxiliary voltage 198 ~ 265 V AC
MK201A - 110A	For 50 Hz system, auxiliary voltage 94 ~ 127 V AC

MH Current Transformers



MH Since 1981
INSTRUMENTS

Current Transformer



MH Current Transformer
Tape wound construction for Low Voltage AC network measurement

Device features

METERING CT

- Monitoring of kWh/ W/ A
- Class 0.5/ 1/ 3
- Cast Resin or Insulated Tape Wound

PROTECTION CT

- For detection of circuit fault condition with high peak current handling
- Class 5P/ 10P/ PX
- Insulated Tape Wound construction

Standard Compliance

- IEC 60044-1 for manufacturing and testing method used
- IP 20 Degree of Protection for indoor application

Customized CT

- MH CT are available in custom built specification such as PX type requirement
- We have over 20 years' experience in making CT with precise tolerance & special performance

Product description

MH Current Transformer (MH CT) is used in energy metering and feeder protection application. Designed for use in low voltage 50/60Hz network, the CT is installed in electrical switch board, control panel and motor control centre. High grade annealed grain-oriented silicon steel is used in the CT core to provide improved accuracy and linearity of measurement.

The CT can be directly installed onto bare copper busbar up to 720VAC rating. Available in a wide variety of dimensions and current ratio rating. Connection to the Secondary winding is made via 2 bolt terminal. Customized model can be manufactured to customer specification.

MH CT is manufactured to comply with IEC 60044-1 standard. This ensures that each CT will provide measurement at its rated accuracy when operating at fluctuating temperature, humidity, surge impulses and radio interference. Additional requirement for protective CT is applied to ensure its reliable operation in the event of heavy fault condition.

Product selection guide

Metering CT

Class 0.5	For kWh revenue meter application where accurate recording of energy consumption is required. 0.5% Current (Ratio) Error at 100% Rated Current.
Class 1	For general metering of feeder 1% Current (Ratio) Error at 100% Rated Current.
Class 3	For industrial load status indication purpose. 3% Current (Ratio) Error at 100% Rated Current.

Protection CT

5P	For stringent time graded coordination protection scheme. 5% composite error at rated Accuracy Limit Factor.
10P	For general time coordination and instantaneous over current scheme. 10% composite error at rated Accuracy Limit Factor.
PX	Special application where protection scheme requires precise parameter defined for Knee Point Voltage, Turn Ratio, Maximum Excitation Current at Knee Point, CT Secondary Resistance. (Customized built item).

Examples of CT Specification

Metering CT	***e.g. 400/5, CL1 10VA*** 400A Primary Full Load, 5A Secondary Output, 10VA Burden, Class 1
Protection CT	***e.g. 1600/5, 5P10 15VA*** 1600A Primary Full Load, 5A Secondary Output, 15VA Burden, 5P10 Stringent Time Coordination with 10x Accuracy Limit Factor.

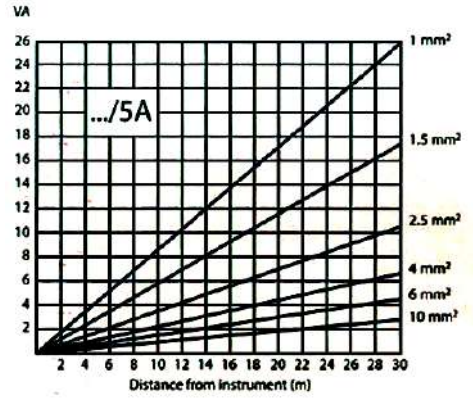
MH Since 1981 INSTRUMENTS

Current Transformer

Technical data

Rated insulation voltage	720VAC
Rated impulse voltage	3kV/ 1min

Instrument Wire Distance







Standard Model Range

Pri/Sec Current Rating	VA		CL5P10	Class 0.5	Class 1	Class 3
	5	15				
6000/5	●	●	●	●	●	●
5000/5	●	●	●	●	●	●
4000/5	●	●	●	●	●	●
3200/5	●	●	●	●	●	●
3000/5	●	●	●	●	●	●
2500/5	●	●	●	●	●	●
2000/5	●	●	●	●	●	●
1600/5	●	●	●	●	●	●
1500/5	●	●	●	●	●	●
1200/5	●	●	●	●	●	●
1000/5	●	●	●	●	●	●
800/5	●	●	●	●	●	●
600/5	●	●	●	●	●	●
500/5	●	●	●	●	●	●
400/5	●	●	●	●	●	●
300/5	●	●	●	●	●	●
200/5	●	●	●	●	●	●
150/5	●	●	●	●	●	●
120/5	●	-	-	-	●	-
100/5	●	●	●	●	●	○
80/5	●	-	-	-	●	○
60/5	●	●	-	●	●	○
50/5	●	-	-	-	●	●
40/5	●	-	-	-	●	●

Legend: ● standard item
○ upon request

Note: *Other rating and sizes are available on customized built order.*

About MH Current Transformer

MH Current Transformer (MH CT) is designed and manufactured by Challenge Industrial Co. (Malaysia) Sdn. Bhd. which was founded in the year 1993 by a joint venture between Mun Hean and Challenge Industrial Co. Ltd. The MH Current Transformer is solely made under MH Instruments, a wing under Mun Hean Group. The founding of MH Current Transformer is in line with Mun Hean's flagship products, MH Protection Relays and Meters. In 1994, the product range for Protection Current Transformer is extended to Class X Type and subsequently in year 1996, Class 0.5 Metering Current Transformer was included into the production range. The complete chain of value creation including product design & development, production, and testing is based in Selangor, Malaysia. The major expansion of production area at the mid of year 2014 shows that the product demand of MH Current Transformer is increasing. Today, MH Current Transformer has been sold to Singapore, Malaysia, Hong Kong, Myanmar, Philippines, Indonesia and Vietnam, and it is the market leader in Malaysia and Singapore.

MH Current Transformers

Authorized Distributor:

Since 1981
INSTRUMENTS

MACK

E166130

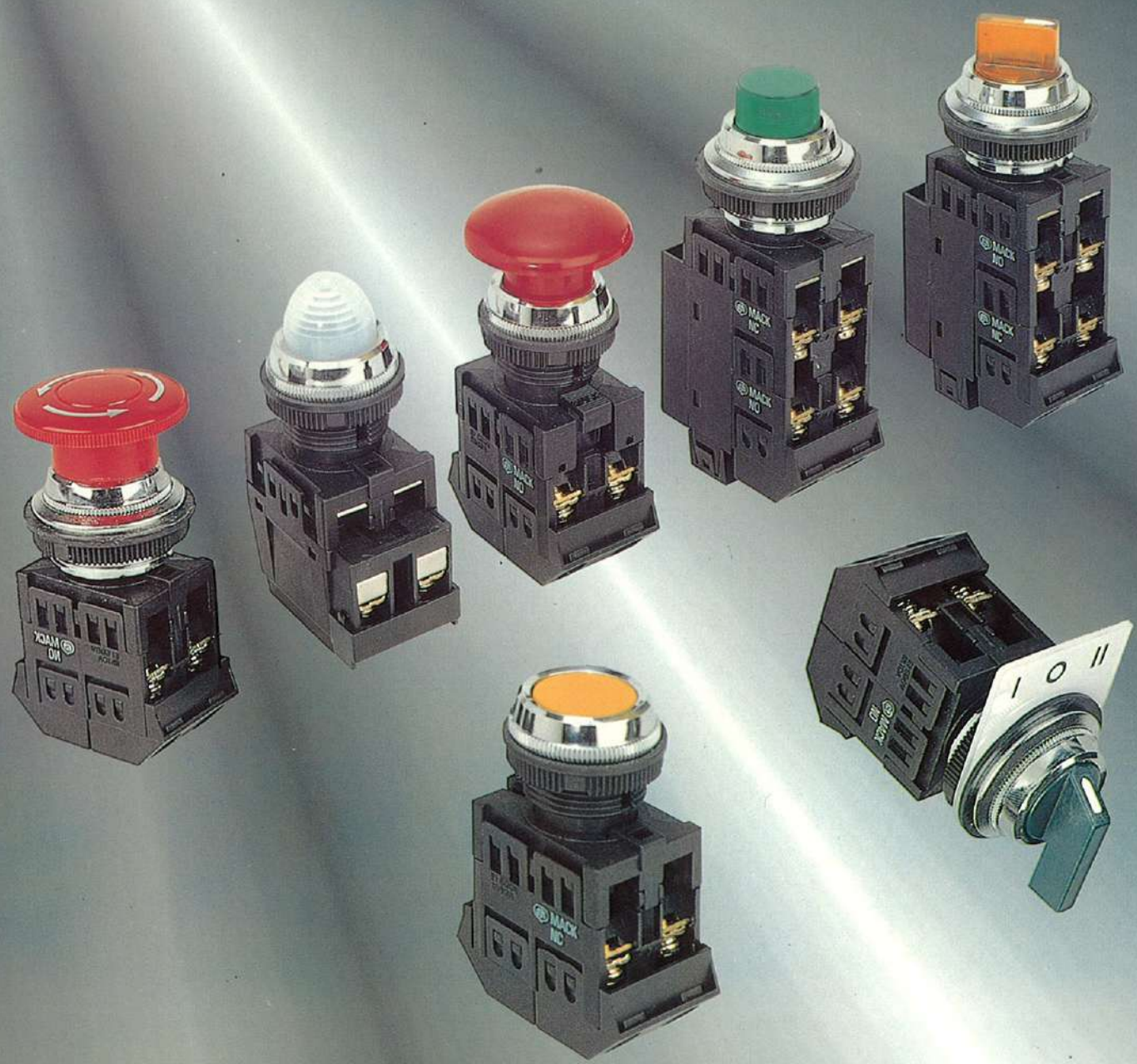
22mm/25mm/30mm

Push Button, Selector, Key Switch,& Pilot Enclosed Control Station

Cam Switch, Load Break & Isolating Switch

Rail–Type Terminal Blocks and C/W Cover

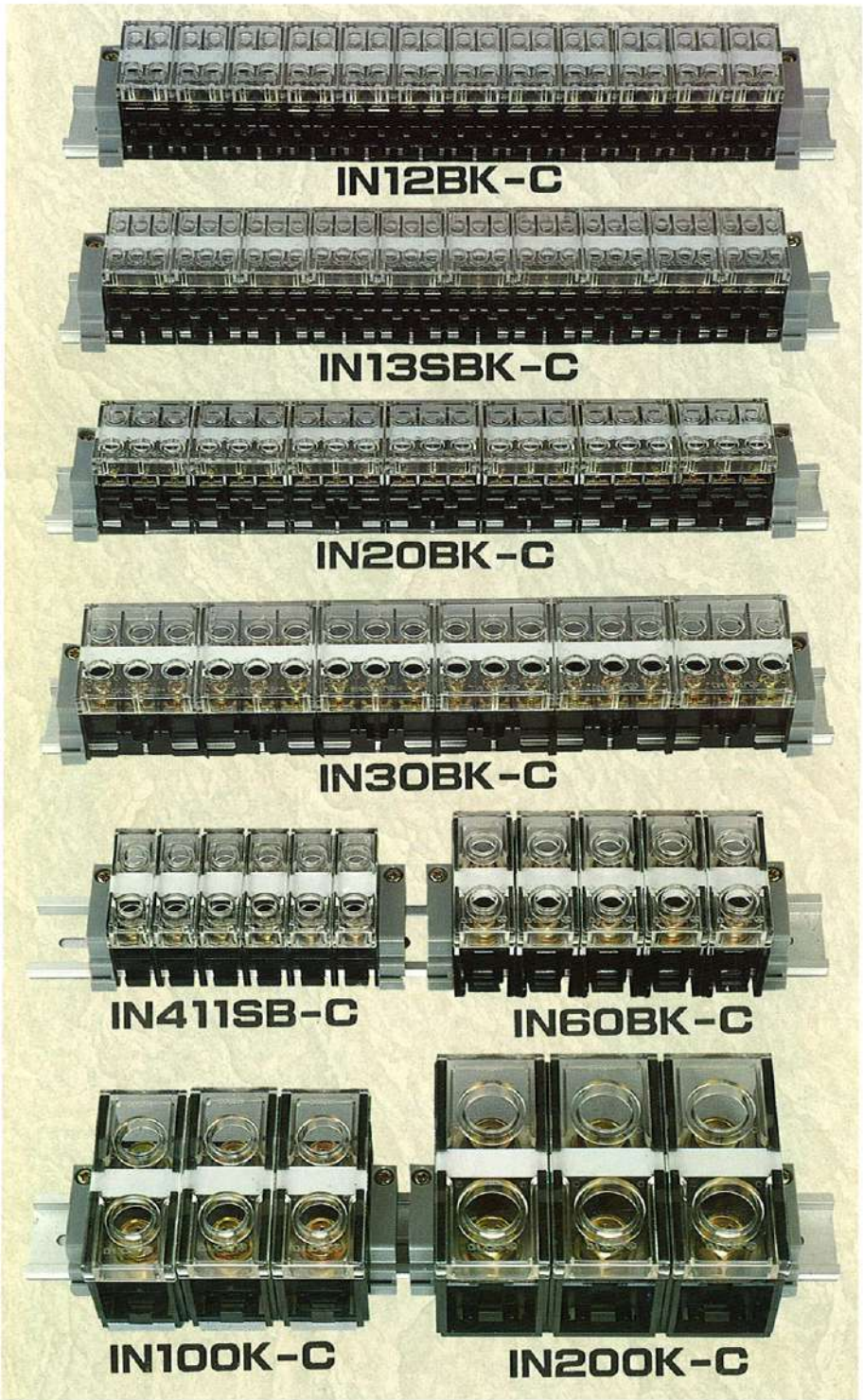
Power Push Button.

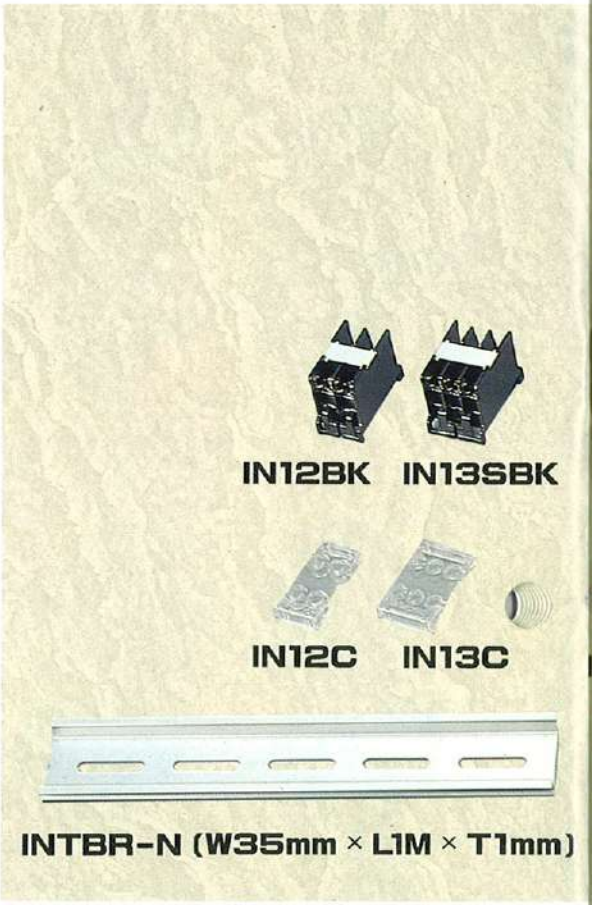


MACK DIN SERIES TERMINAL- BL

Mack Type "IN"--Quick mounting and removal Din series Terminal Blocks can be snap on and removed from 35mm-wide Din rails by single finger operation.

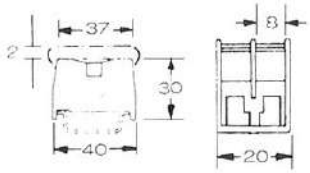
* Current capacity upto 400 Amps,with rated insulation voltage of 600volts.
* No,Stopper or separator is needed.
* Available in single,double or three circuits type.
* Rugged construction with fire resistant (self-extinguishing) properties.
* Making accessories are provided and protection covers(IP 20) are optional.
* UL and CSA Approval Pending.





TYPE:IN12BK-C

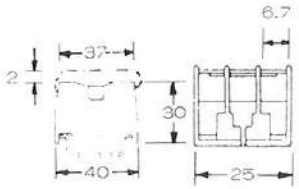
Dimensions(mm)



Ratings	
定格絕緣電壓 Rated Voltage	60
定格絕緣電流 Rated Current	20
耐電壓 Dielectric Strength	25
絕緣抵抗 Insulation Resistance	10
適合電線 Applicable Wire	2m
極數 Circuits Poles	2P

TYPE:IN13SBK-C

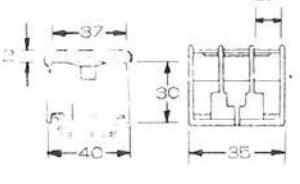
Dimensions(mm)



Ratings	
定格絕緣電壓 Rated Voltage	60
定格絕緣電流 Rated Current	20
耐電壓 Dielectric Strength	25
絕緣抵抗 Insulation Resistance	10
適合電線 Applicable Wire	2m
極數 Circuits Poles	3P

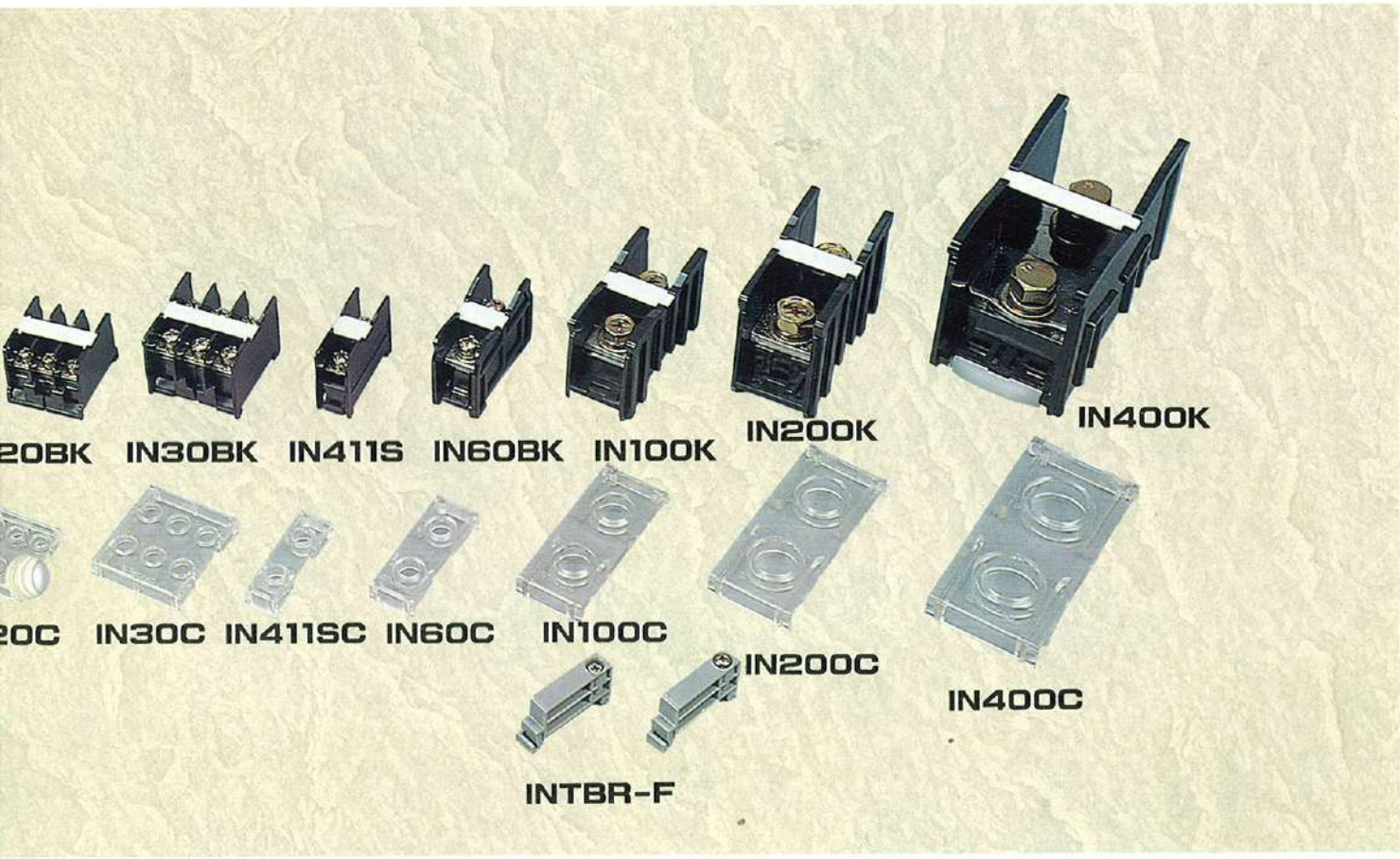
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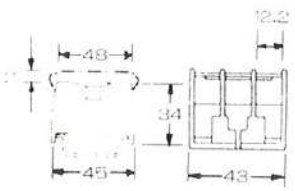
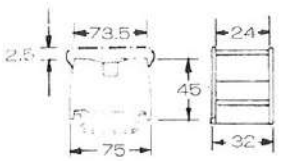
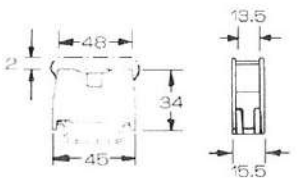
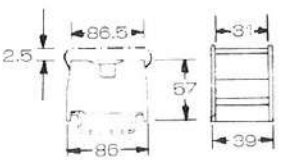
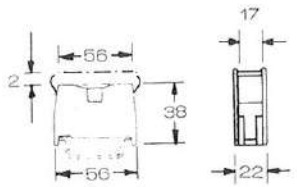
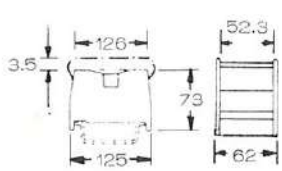
Dimensions(mm)



Ratings	
定格絕緣電壓 Rated Voltage	60
定格絕緣電流 Rated Current	30
耐電壓 Dielectric Strength	25
絕緣抵抗 Insulation Resistance	10
適合電線 Applicable Wire	3.5
極數 Circuits Poles	3P

CKS WITH FINGER PROTECTION COVER



	TYPE:IN30BK-C Dimensions(mm) 	Ratings 定格絕緣電壓 Rated Voltage 600V 定格絕緣電流 Rated Current 50A 耐電壓 Dielectric Strength 2500V, 1MIN 絕緣抵抗 Insulation Resistance 100MΩMIN 適合電線 Applicable Wire • • 8mm²Max 極數 Circuits Poles 3Poles	TYPE:IN100K-C Dimensions(mm) 	Ratings 定格絕緣電壓 Rated Voltage 600V 定格絕緣電流 Rated Current 130A 耐電壓 Dielectric Strength 2500V, 1MIN 絕緣抵抗 Insulation Resistance 100MΩMIN 適合電線 Applicable Wire • • 38mm²Max 極數 Circuits Poles 1Poles
	TYPE:IN411SB-C Dimensions(mm) 	Ratings 定格絕緣電壓 Rated Voltage 600V 定格絕緣電流 Rated Current 60A 耐電壓 Dielectric Strength 2500V, 1MIN 絕緣抵抗 Insulation Resistance 100MΩMIN 適合電線 Applicable Wire • • 14mm²Max 極數 Circuits Poles 1Poles	TYPE:IN200K-C Dimensions(mm) 	Ratings 定格絕緣電壓 Rated Voltage 600V 定格絕緣電流 Rated Current 240A 耐電壓 Dielectric Strength 2500V, 1MIN 絕緣抵抗 Insulation Resistance 100MΩMIN 適合電線 Applicable Wire • • 100mm²Max 極數 Circuits Poles 1Poles
	TYPE:IN60BK-C Dimensions(mm) 	Ratings 定格絕緣電壓 Rated Voltage 600V 定格絕緣電流 Rated Current 90A 耐電壓 Dielectric Strength 2500V, 1MIN 絕緣抵抗 Insulation Resistance 100MΩMIN 適合電線 Applicable Wire • • 22mm²Max 極數 Circuits Poles 1Poles	TYPE:IN400K-C Dimensions(mm) 	Ratings 定格絕緣電壓 Rated Voltage 600V 定格絕緣電流 Rated Current 370A 耐電壓 Dielectric Strength 2500V, 1MIN 絕緣抵抗 Insulation Resistance 100MΩMIN 適合電線 Applicable Wire • • 200mm²Max 極數 Circuits Poles 1Poles



馬可企業有限公司
MACK INDUSTRIAL CO., LTD.

桃園公司：
桃園市壽山路194號
電話：(03)-3342742
3344453
傳真：886-3-3343291

NO. 194 SOU SAN ROAD,
TAOYUAN TAIWAN R.O.C
TEL：886-3-3342742
3344453
FAX：886-3-3343291

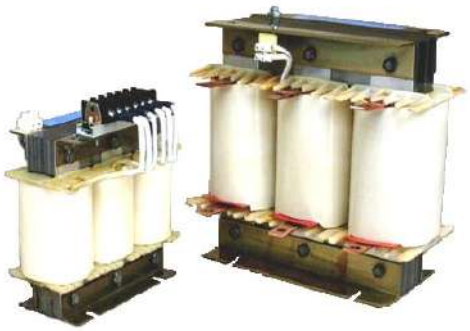
經銷商：
Agent

LETRIMATIK SDN. BHD. (182236 T)
LETRIMATIK (Penang) SDN. BHD. (422509 P)
No. 4, Jalan TPK 2/4, Taman Perindustrian Kinrara,
Batu 7½ OFF Jalan Puchong, 47100 Puchong, Selangor D.E.
Tel: +60 3 80762588 (Hunting Line) Fax: +60 3 80762582 Email: letrim@tm.net.my

LETRIM Harmonic Filter Circuit Reactor

Description

Capacitors used for power factor improvement may interact with existing systems with high harmonic content. The use of non-linear loads like current source inverters and converters is increasing, producing harmonics that results in additional losses, particularly in capacitors for power factor correction systems.

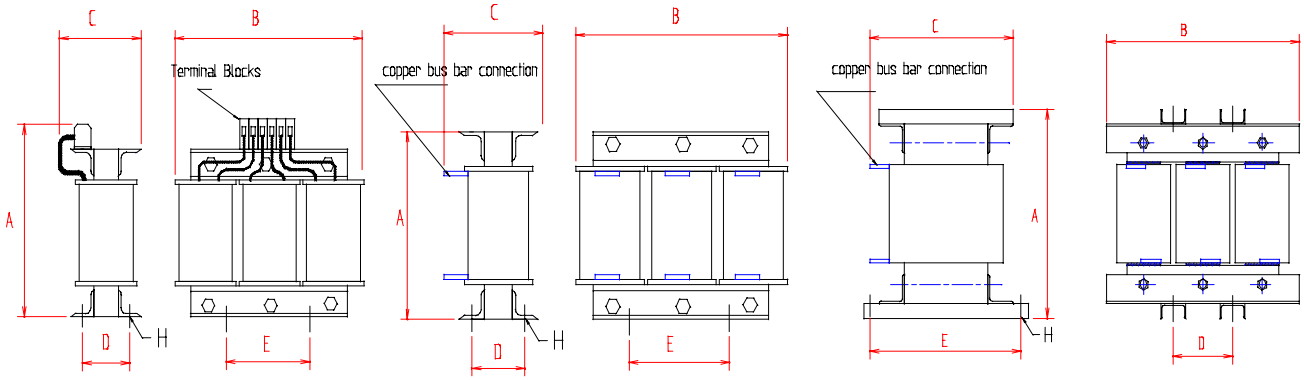


Filtering with LETRIM Harmonic Filter Circuit Reactor is required when distortion limits of local utility or IEEE 519 are exceeded. The following are advantages offered:

- Prolong capacitor lifespan by reducing overcurrent, distortion & overheating.
- Reduce losses; hence no capacitor overload.
- Prevent nuisance blowing of fuses or tripping of circuit breakers.
- Reduce overheating of transformers.
- Impedance behaviour of the mains is improved.
- Suitable to be used in mains with inverters, variable speed drives, AC-DC converter, DC drives, welders and etc.

The use of specific filtering factor requires careful system analysis. As a general rule, filtering factor p = 7.0 % is used where imported harmonics from the power source is the main concern.

- Rated mains voltage: 415 V 50 Hz
- Application: To be matched with 525 V capacitor only.
- Series resonance frequency: 189 Hz or p = 7.0 %
- Other frequencies available upon request.



Vert. mnt: Type A Vert. mnt: Type B Vert. mnt: Type C

Capacitor Power	I_n	$P_{V(MAX)}$	A	B	C	D	E	H_{holes}	Weight	Design
kVAr	Amps	Watt	mm	mm	mm	mm	mm	mm	kg	Type
10	12	80	225	210	130	67	116	10	10	Type A
15	17	108	225	210	133	69	116	10	12.5	Type A
20	22	117	225	210	138	74	116	10	13.5	Type A
25	27	120	225	210	140	80	116	10	15	Type A
30	33	155	200	240	140	87	136	10	18	Type B
40	44	160	255	240	145	100	136	10	24	Type B
50	55	170	255	306	180	103	170	10	32	Type B
60	67	175	255	306	210	113	170	10	36	Type B
70	76	180	255	306	235	123	170	10	40	Type B
80	89	185	255	306	245	137	170	10	53	Type B
100	110	205	255	306	260	153	170	10	61	Type B
120	133	220	255	306	290	182	170	10	67	Type B
150	165	240	310	306	330	254	153	12	75	Type C
200	220	280	335	380	330	294	168	12	90	Type C

Design: Acc. to IEC 76 & VDE 0550
Rated Voltage: 600 V
Insulation Class: Class H or 180ºC
Tolerance: < ± 3 %
Linearity Characteristics: 1.50x I_N at no change of inductivity
Insulation Strength: 2.5 kV
Noise Level: < 40 dB (no humming)
Ambient Temperature: 40ºC (90ºC max. temperature rise)

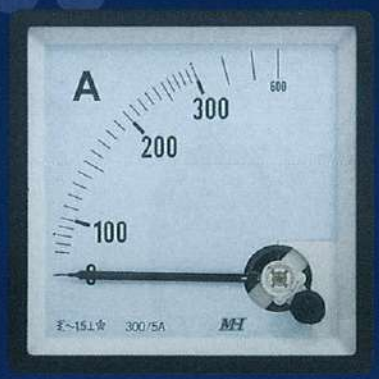
Thermal protection: Fitted with 135ºC thermostat at coil winding.

Load Carrying Capacity:
I_{50Hz} = 1.06 $I_{capacitor}$ (fundamental current)
I_{150Hz} = 1.04 x I_{50Hz} (3rd harmonic)
I_{250Hz} = 1.31 x I_{50Hz} (5th harmonic)
I_{350Hz} = 1.13 x I_{50Hz} (7th harmonic)
I_{max} = 1.50 x I_{50Hz}

MH series

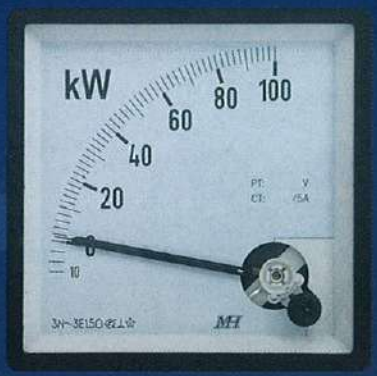
for Quality and Accuracy

Range of Analogue Measuring Instruments







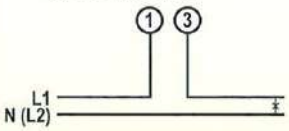
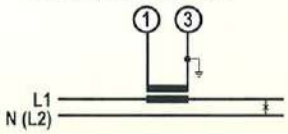
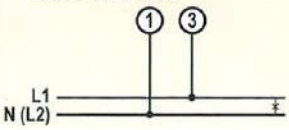
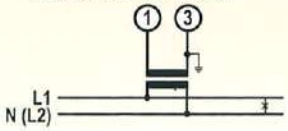
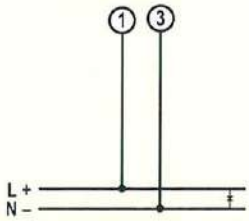
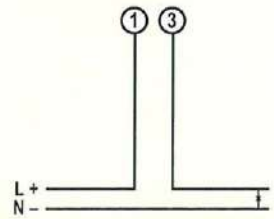
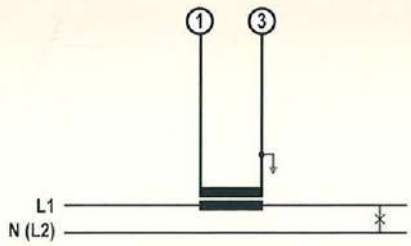
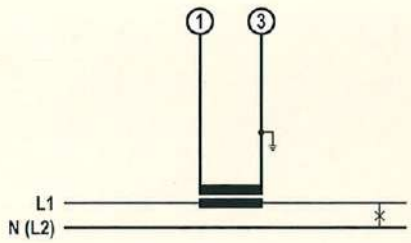
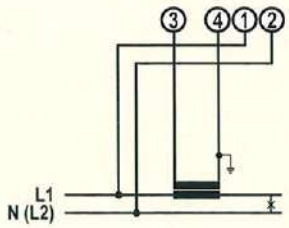
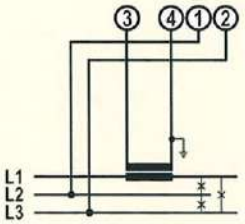




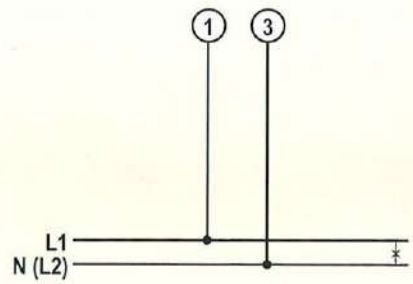
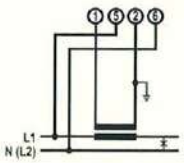
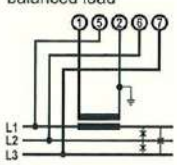
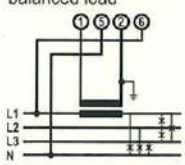
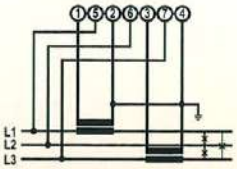
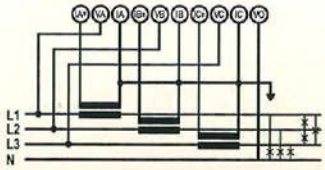
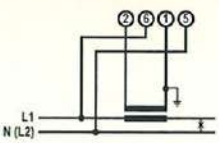
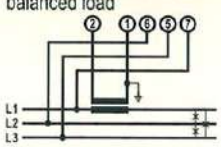
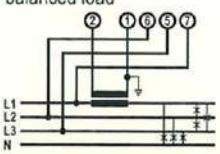
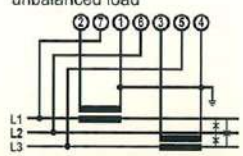
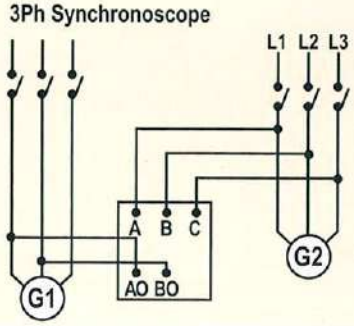
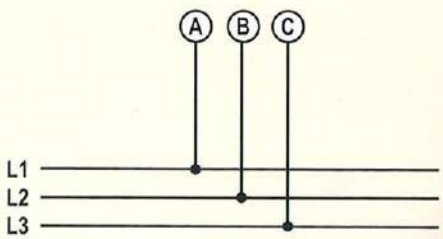


IEC 60051
BS 89
ISO 9001:2000 CE

MH SERIES

	TYPE	RANGE	CONNECTION DIAGRAM
MOVING IRON  Accuracy: class 1.5	**AC Ammeter** CP-96A CP-72A CP-48A CW Series (240°)	Direct: 0.1, 0.5, 1, 1.5, 3, 5, 10, 15, 20, 25, 30, 50, 60, 100A * CP-48 max. 50A .../5A .../1A	**AC current** direct connection  **AC current** transformer connection 
	AC Voltmeter CP-96V CP-72V CP-48V CW Series (240°)	30, 50, 75, 100, 120, 150, 200, 250, 300, 400, 500, 600V	**AC voltage** direct connection  **AC voltage** transformer connection 
MOVING COIL  Accuracy: class 1.5	**DC Ammeter** CP-96DA CP-72DA CP-48DA CW Series (240°)	Direct: 100, 150, 200, 300, 500µA 1, 3, 7.5, 10, 15, 20, 30, 50, 75, 100, 150, 200, 250, 300, 450, 500mA, 4-20mA, 1, 3, 5, 7.5, 10, 15, 20, 30, 50A	**DC Voltage**  **DC Current** 
	DC Voltmeter CP-96DV CP-72DV CP-48DV CW Series (240°)	3, 5, 7.5, 10, 15, 20, 30, 50, 75, 100, 150, 200, 250, 300, 450, 500, 600V 60mV, 100mV, 150mV	
MAXIMUM DEMAND INDICATOR  Accuracy: class 3	**Maximum Demand Meter** (2 pointer) CP-96MD2 CP-72MD2	15 min ../5A 8. 20 & 30 minutes are optional Thermal 20%	**Current transformer operated** 
MOVING IRON + MDI  Accuracy: class 3	**Combined Maximum Demand Meter** 3 pointer) CP-96MD3 CP-72MD3	15 min ../5A 8 & 30 minutes are optional Thermal 20% Inst 100%	**Current transformer operated** 
POWER FACTOR  Accuracy: class 3 (± 2 electrical degree)	**Power Factor Meter** Single & Three Phase CP-96PF CP-72PF CW Series (240°)	0.5cap-1-0.5 ind .../5A L-L AC220V, 380V L-L AC415V, 440V	**Power factor 1Ph AC**  **Power factor 3Ph AC** 

MH SERIES

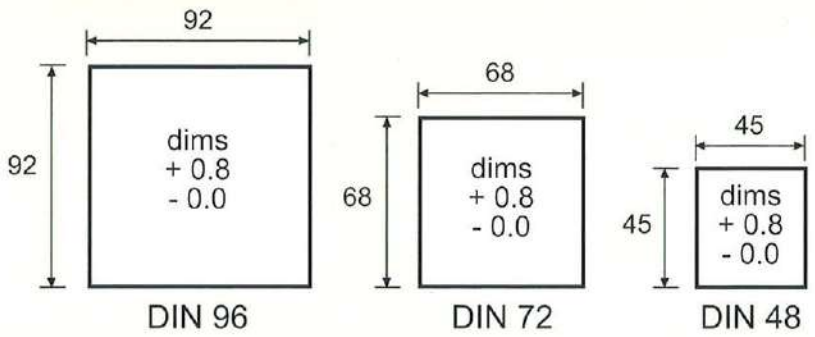
	TYPE	RANGE	CONNECTION DIAGRAM
FREQUENCY METER  Accuracy: class 0.5	**Frequency Meter** (Pointer Type) CP-96FQP CP-72FQP CP-48FQP	45~55Hz 55~65Hz 45~65Hz Input Voltage: 110V, 220V 380 - 440V	Frequency 1Ph / 3Ph AC 
	Frequency Meter (Reed Type) CP-96FQR CP-72FQR CW Series (240°)	7 Reed 47~53Hz 57~63Hz 11 Reed 45~55Hz 55~65Hz Input Voltage: 110V, 220V 380 - 440V	
WATTMETER  Dimension: CP 96# Accuracy: class 1.5	**Wattmeter (Balanced)** Single phase Three phase 3 wire Three phase 4 wire CP-96WB CP-72WB CW Series (240°) **Wattmeter (Unbalanced)** Single phase Three phase 3 wire Three phase 4 wire CP-96WU CP-72WU CW Series (240°)	Input voltage: 120V, 220V, 240V, 380V, 415V, 440V Input Amp: 5A	Active power 1Ph AC  Active power 3Ph 3W balanced load  Active power 3Ph 4W balanced load  Active power 3Ph 3W unbalanced load  Active power 3Ph 4W unbalanced load 
VARMETER  Dimension: CP 96# Accuracy: class 1.5	**Varmeter (Balanced)** Single phase Three phase 3 wire Three phase 4 wire CP-96VRB CP-72VRB CW Series (240°) **Varmeter (Unbalanced)** Single phase Three phase 3 wire CP-96VRU CP-72VRU CW Series (240°)	Input voltage: 120V, 220V, 240V, 380V, 415V, 440V Input Amp: 5A	Reactive power 1Ph AC  Reactive power 3Ph 3W balanced load  Reactive power 3Ph 4W balanced load  Reactive power 3Ph 3W unbalanced load 
SYNCHRONOSCOPE  Accuracy: ±2 electrical degrees	**Synchronoscope Meter** CP-96SC CP-72SC	Input voltage: 110V, 220V, 380V, 500V Input Amp: 5A	3Ph Synchronoscope 
PHASE SEQUENCE 	**Phase-Sequence Meter** CP-96PS CP-72PS	Input voltage: 150V - 500V AC	3Ph Sequence indicator 

MH SERIES

MH Series Switchboard analogue measuring instruments offer a comprehensive range to meet most requirements. These are manufactured to comply with International Standards to ensure high quality and reliability. These are also constructed to withstand severe vibration.

MH Series meters are suitable for horizontal and vertical in-line mounting. These meters are compact and easy to install. The interchangeable scales also offer much flexibility to applications of all types.

PANEL CUT-OUTS (All dimensions mm)



DIN 48 can be slot mounted using the standard fixing clip.
DIN 72 & DIN 96 can be supplied with special fixing clips for slot mounting.

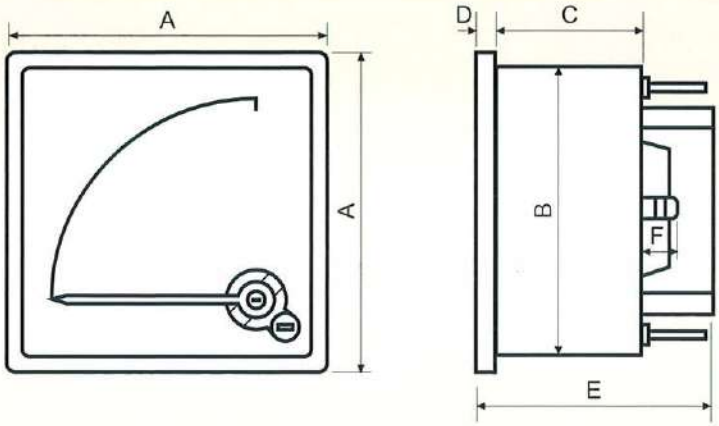
TECHNICAL SPECIFICATIONS

Standards:
IEC 60051, BS 89, DIN 43780

Enclosure:
DIN 43700
Material: Acrylonitrile Butadiene Styrene (ABS) & Polycarbonate (PC)
Flame Retardant
Base material UL94VO
Case & terminal cover material UL94VO

Insulation Test:
2kV / 1 min

Temperature:
-10˚C to +50˚C



MODEL	A	B	C	D	E	F
CP96	96	92	44	6	70	13
CP96#	96	92	44	6	102	13
CP72	72	68	44	6	70	13
CP48	48	44	44	6	69	13

**Other type and range are also available upon request.*

Authorized Dealer:

Product specifications and features are subject to change without prior

electrical energy metering on door


146 00 + 146 16


146 61


146 65


047 79


495 55

Ammeters, voltmeters, central measuring unit and cam switches can be mounted on XL³ 800 and XL³ 4000 curved doors

Pack	Cat.Nos	Analogue metering devices
		Ammeters
		Measure the intensity in amperes (A) of the current
		Connected via a 0 - 5 A output current transformer (CT)
		To be fitted with a measuring dial appropriate for the current to be measured
1	146 00	Round barrel Ø56 mm
1	146 01	Square barrel 68 x 68 mm
		Measuring dial for ammeters
		Supplied by set of 2 (1 for round barrel, 1 for square barrel)
1	146 10	0 - 50 A
1	146 13	0 - 100 A
1	146 15	0 - 200 A
1	146 16	0 - 250 A
1	146 17	0 - 300 A
1	146 18	0 - 400 A
1	146 20	0 - 600 A
1	146 21	0 - 800 A
1	146 22	0 - 1000 A
1	146 66	0 - 1250 A
1	146 24	0 - 1500 A
1	146 25	0 - 2000 A
1	146 26	0 - 2500 A
1	146 28	0 - 4000 A
		Voltmeters
		Measure the voltage in volts (V) AC ou DC
		Scale: 0 - 500 V
1	146 60	Round barrel Ø56 mm
1	146 61	Square barrel 68 x 68 mm

Pack	Cat.Nos	Digital central measuring units
		Enables via a 0 - 5 A output current transformer (CT), measuring electrical values for low voltage applications
		Multi-function centrals
		For measuring: current and voltage per phase, frequency, power factor, active and reactive energy…
		Adapts to 3-phase balanced or unbalanced supplies with or without neutral
		Max. measurement: 8000 A
		220 V
1	146 65	Standard
1	146 67	Communicating Modbus/JBUS
		Data speed transmission: 1200 to 9600 Bauds

Cam switches (p. 334)

Pack	Cat.Nos	Current transformers (CT)		
		Used with ammeters, electricity meters and central measuring units		
		Supply a current of 0 to 5 A to the secondary which is proportional to the primary current		
		Can be fixed on plate, on rail ⎍		
		EN 60715, on bars		
		Secondary joining with terminals for lugs, cage terminals		
		Precision class: 1 %		
		Single phase CT for bar 16 x 12.5 mm and cable Ø21 mm	Transformation rotio	Power (VA)
1	046 31		50/5	1.25
1	046 34		100/5	2.5
1	046 36		200/5	5.5
		Single phase CT for bar 20.5 x 12.5 and 30 x 10.5 mm and cable Ø23 mm		
1	047 75		300/5	11
		Single phase CT for bar 40.5 x 10.5 mm and cable Ø35 mm		
1	046 38		400/5	12
		Single phase CT for bar 65 x 32 mm		
1	047 76		600/5	12
1	047 77		800/5	15
1	047 78		1000/5	20
		Single phase CT for bar 84 x 34 mm		
1	047 79		1250/5	15
		Single phase CT for bar 127 x 38 mm		
1	046 45		1500/5	15
1	046 46		2000/5	20
		Single phase CT for bar 127 x 54 mm		
1	047 80		2500/5	50
1	046 48		4000/5	50
		3-phase CT for 3 bars 20.5 x 5.5 mm or 3 cables Ø8 mm		
1	046 98		250/5	3
		3-phase CT for 3 bars 35 x 5.5 mm		
1	046 99		400/5	4

Pack	Cat.Nos	Totalising hour counters (48 x 48)
		One-piece device - IP 40
		Front mounting on enclosure or cabinet doors
		Synchronous motor operation (operation indicator)
		For counting the operating hours of an electrical machine or device, with no reset
		Supplied with cover frame (55 x 55 mm) (for round cut-out) and fixing accessories
		Connection: 2 x 1.5 mm²
1	495 52	24 V∿ - 50 Hz
1	495 53	110 to 120 V∿ - 50 Hz
1	495 54	110 to 120 V∿ - 60 Hz
1	495 55	200 to 240 V∿ - 50 Hz
1	495 58	48 V∿ - 50 Hz
1	495 59	400 V∿ - 50 Hz
1	495 60	12 to 36 V⎓
100	495 97	Frame 55 x 55 mm

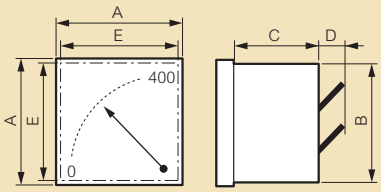
Legrand System
These products are part of protection and distribution systems > See p. 44-45

electrical energy metering on door

■ Analogue metering devices

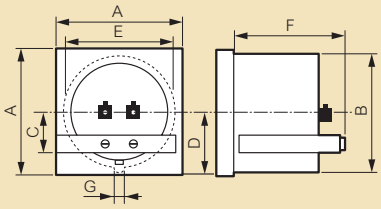
Frequency: 50/60 Hz
Precision class: 1.5 %
Operating temperature: - 10 °C to + 40 °C
Storage temperature: - 20 °C to + 80 °C
Consumption:
ammeter: 1.1 VA
voltmeter: 3 VA
Connection capacity: 2 x 2.5 mm² with screws or
Conform to IEC 60051, VDE 0410, BS 89,
EN 60051-1, cenelec HD 223

Cat.No. 146 01/61



Dimensions (mm)				
A	B	C	D	E
72	66.5	44	12	68±0,7

Cat.No. 146 00/60



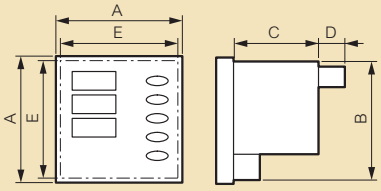
Dimensions (mm)						
A	B	C	D	E	F	G
72	Ø55	21.4	28.5	56	46	3.2

■ Digital central measuring units

- Precision class:
voltage: ± 0.5 %
current: ± 0.5 %
power: ± 1.5 %
power factor: ± 2 %
frequency: ± 0.15 Hz
Active energy: class 2
Reactive energy: class 3

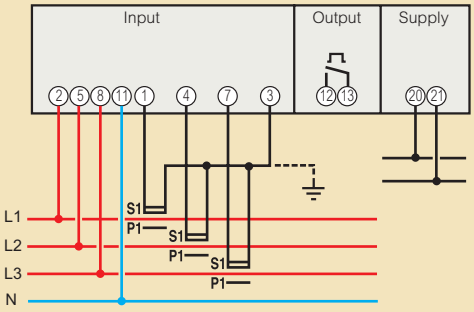
- Consumption:
voltage: 0.5 VA / phase
current: 0.75 VA / phase

- Auxiliary power supply:
single-phase voltage 230 V (196 to 253 V)
frequency 50 Hz (47 to 63 Hz)
self consumption 6 VA - 3.5 W



Dimensions (mm)				
A	B	C	D	E
96x96	90x90	64.5	20	92x92

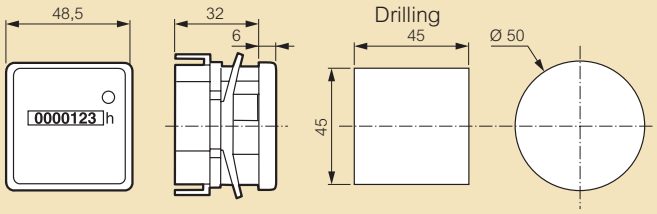
Output:
Energy pulse duration = 100 ms via volt free contact:
- for 5 A, 1 pulse/Wh
- from 20 to 150 A, 1 pulse/10 Wh
- from 200 to 1600 A, 1 pulse/100 Wh
- from 2000 to 8000 A, 1 pulse/kWh
Breaking capacity 110 V ∿/⎓ - 50 mA
4-wire connection - 3 CT:



■ Cam switches (p. 334)

■ Totalising hour counters (48 x 48)

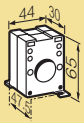
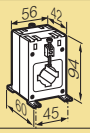
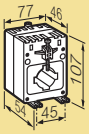
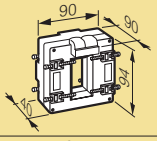
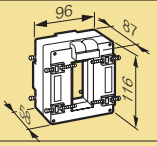
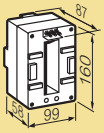
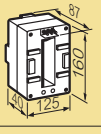
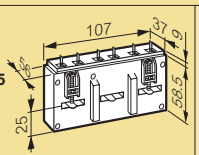
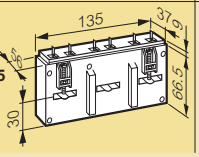
Technical characteristics
Counter capacity: AC: 0…99 999.99 h/DC: 0…999 999.9 h
Reading accuracy: AC: 1/100th h / DC 1/10th h
Consumption: alternating - 2 VA / continous - 0.65 W
Operating temperature: - 25 °C to + 80 °C



■ Current transformer

Degree of protection: IP 20
Frequency: 50/60 Hz

Dimensions

		Opening for cable Ø max. (mm)	Opening for bar width x th. (mm)	Fixing center for fixing on plate (mm)
Single phase CT				
CT 50/5 100/5 200/5		Ø21	16 x 12.5	on rail EN 50022
CT 300/5		Ø23	20.5 x 12.5 25.5 x 11.5 30.5 x 10.5	50 x 45
CT 400/5		Ø35	40.5 x 10.5	54 x 45
CT 600/5 800/5 1000/5		-	65 x 32	fix on bar
CT 1250/5		-	84 x 34	fix on bar
CT 1500/5 CT 2000/5		-	127 x 38	fix on bar
CT 2500/5 4000/5		-	127 x 54	fix on bar
3-phase CT				
CT 250/5		Ø8	20.5 x 5.5	fix on bar
CT 400/5		-	30.5 x 5.5	fix on bar

electrical energy metering on rail


046 02


046 00


046 63

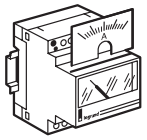

046 65


046 64

Dimensions (p. 183)

Analogue metering devices

Pack	Cat.Nos		Number of modules
		Ammeters	
		Measure the intensity in Amperes (A) of the current circulating in an electrical circuit	
1	046 02	Direct connection AC or DC Scale: 0 - 30 A - supplied with dial	4
1	046 00	Connected via a 0 - 5 A output current transformer (CT)	4
		Measuring dials for ammeter Cat.No 046 00	
2	046 10	0-50 A	
2	046 13	0-100 A	
2	046 15	0-200 A	
2	046 16	0-250 A	
2	046 17	0-300 A	
2	046 18	0-400 A	
2	046 20	0-600 A	
2	046 21	0-800 A	
2	046 22	0-1000 A	
2	046 66	0-1250 A	
2	046 24	0-1500 A	
2	046 25	0-2000 A	
		Voltmeter	
		Measure the AC or DC voltage in a circuit in volts (V)	Number of modules
1	046 60	Scale: 0-500 V	4



Digital ammeter / voltmeter

Pack	Cat.Nos		Number of modules
		Connection: - Ammeter mode: connected via a 0 - 5 A current transformer (CT) Reading range adjusted according to CT used - Voltmeter mode: measures the AC or DC voltage of an electrical circuit; scale 0 - 600 V	
1	046 63	Voltage: 230 V∿ - 50/60 Hz Reading: I - 0 to 8000 A U - 0 to 500 V	4

Central measuring units

Pack	Cat.Nos	
		Multi-function centrals Measure via a 0 - 5 A output current transformer (CT), electrical values for low voltage applications: For measuring current per phase, phase-to-phase voltage, frequency, power factor, instantaneous power (active, reactive, apparent), active and reactive energy Adapt to 3-phase balanced or unbalanced supplies with or without neutral 220 V - max. measurement: 8000 A
1	046 65	Standard
1	046 67	Communicating Modbus/JBUS Data speed transmission: 1200 to 9600 Bauds

Selective measurement switches

Pack	Cat.Nos		Number of modules
		For manual selection of the circuits to be measured	
		Ammeter cam switch	
		For measuring the current in a circuit with one ammeter, connected via a current transformer (CT)	
1	046 50	3-phase, 4-position cam switch	3
		Voltmeter cam switches	
		For measuring the voltages in a circuit with one voltmeter	
1	046 52	3-phase, 4-position cam switch	3
1	046 53	3-phase with neutral, 7-position cam switch	3

Digital frequency meter

Pack	Cat.Nos		Number of modules
		For measuring the frequency of a 230 V∿ electrical circuit in hertz (Hz) Supply voltage 230 V∿ (connected to circuit to be measured)	
1	046 64	Green LED 3 digit display - 40-80 Hz display	4

Totalising hour counters

Pack	Cat.Nos		Number of modules
		Count the operating hours of a machine or an electrical device to determine its exact operating time Counter with numerical display Capacity: 5 digits + 2 decimal places (1 unit = 1 hour) Precision: 1/100th hour Consumption: 0.2 VA	
1	046 94	230 V∿ - 50 Hz	2
1	046 91	24 V∿ - 50 Hz	2

Legrand System

These products are part of protection and distribution systems > See p. 44-45

electrical energy metering on rail (continued)

electrical energy metering on rail


046 81


046 72


046 74

Dimensions (p. 183)

Measure the electrical energy consumed by a single phase or 3-phase circuit downstream of the metering of energy distributor
Provide a clear display of the consumption in kWh
Class I precision for energy active for Cat.Nos 046 73 and 046 74 in accordance with IEC 62053-21/23
Class II precision for energy active for Cat.Nos 046 81 and 046 72 in accordance with IEC 62053-21/23 (with a sealable box)

Pack	Cat.Nos	Single phase meters	Number of modules
		Direct connection Power supply: 230 V~ - 50/60 Hz	
		Without pulse transmitter	
1	046 81	Up to 32 A Display: LCD screens 6 digits including 1 decimal place 1 unit = 0.1 kWh Partial counting with reset	2
		With pulse transmitter	
1	046 72	Up to 63 A Display: LCD screen 6 digits including 1 decimal place 1 unit: 0.1 kWh Partial counting with reset With pulse transmitter to feed back remote electronical energy consumption pulse output: 1 imp/10 Wh	2

		3-phase meters	Number of modules
		Display: LCD screen 8 digits, 1 unit: 0.01 kWh With pulse transmitter to feed back remote electrical energy consumption measurements via volt-free contact Partial counting with reset	
		Direct connection	
1	046 73	Up to 63 A per phase Power supply: - 230 V~ - 50/60 Hz (3 phase) - 400 V~ - 50/60 Hz (3 phase + N) Programmable pulse output: 1 x 200 ms pulse every 1 kWh (default value)	4
		Connection via a 0 - 5 A current transformer (CT)	
1	046 74	Power supply: - 230 V~ - 50/60 Hz (3 phase + N) - 400 V~ - 50/60 Hz (3 phase + N) Programmable pulse output: 1 x 200 ms pulse every 1 kWh (default value) Current transformation ratio: 50/5 to 8000/5	4

Current transformers (CT) (p. 104)

■ Ammeters

Technical characteristics

Type of measurement	Analogue Ferromagnetic	
Frequency	50 to 60 Hz	
Precision	1.5 %	
Operating temperature	- 10 °C to + 40 °C	
Storage temperature	- 20 °C to + 80 °C	
Consumption: • voltage circuit • measurement circuit	- 1.1 VA	
Connection capacity	Direct 6 mm²	Par TI 4 mm²
Conformity to standards	NF EN 61010-1	

■ Voltmeters

Technical characteristics

Type of measurement	Analogue Ferromagnetic integration
Frequency Precision	50 to 60 Hz 1.5 %
Operating temperature	- 10°C to + 40°C
Storage temperature	- 20°C to + 80°C
Consumption	3 VA
Connection capacity	2 x 2.5 mm²
Conformity to standards	NF EN 61010-1

■ Frequency

Technical characteristics

Type of measurement	Quartz electronic
Precision	± 0.2 % for ± 1 digit
Operating temperature	- 10°C to + 40°C
Storage temperature	- 20°C to + 70°C
Consumption	4.5 VA
Connection capacity	2 x 2.5 mm²
Conformity to standards	NF EN 61010-1

■ Multi-function central unit

Technical characteristics

• **Display:**
3 green LED displays with manual selection:
- Current per phase
- Phase-to-phase voltage
- Phase voltage
- Instantaneous power: active, reactive and apparent
- Frequency and power factor (inductive/capacitive indication)
- Active energy
Unit of measurement: display according to the CT ratios
Automatic change of rating
Energy metering: totalising 9 digits in kWh, resolution 10 Wh

• **Input:**
Voltage measurement consumption < 1 VA per phase
Current measurement consumption < 0.5 VA per phase

• **Auxiliary power supply:**
Voltage 230 V single phase (+/- 10%)
Frequency 50 Hz (47 to 63 Hz)
Consumption < 6 VA - 3.5 W

• **Output:**
Energy pulse: duration > 100 ms
Via volt free contact

Connection

• **3 or 4-wire connection - 3 CT**

L&T SWITCHGEAR
SAFE & SURE



Switch-Disconnector-Fuse
Switch-Disconnector
Type FN

LARSEN & TOUBRO LIMITED
It's all about Imagineering

SALIENT FEATURES

Features of FN series :

- Compact design saves space
- Electrodynamic Compensation
- Quad break Contact System
- Full AC - 23 A rating for the Complete range
- Highest fused Short Circuit Capacity
- Quick make / Quickbreak / Positive break
- Clear ON / OFF indicator
- Separate arcing / Current carrying zone
- High clearance & Creepages
- Separate bridge for each pole
- Maximum ground Clearance
- Phase barrier & Terminal Shroud as a Standard accessory
- Fuse stationary & Isolated from both sides
- Direct access to mounting & terminal screws
- Generous terminal capacity
- Replaceable contacts for enhanced life
- Suitable for vertical & horizontal orientation
- Wide range of Spares & Accessories
- Handle coupling as per IS 8623



The handle coupling has the following user-friendly features.

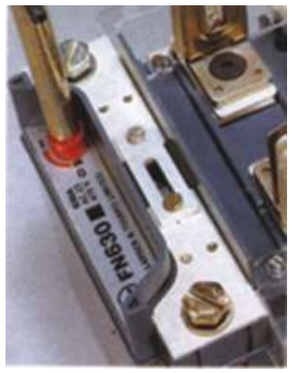
Easy fixing of handle on panel door by two screws.

Door interlock for safety of operating personnel when switch is 'ON'. The interlock can be defeated if required.

Built-in padlocking arrangement to lock the unit in either 'ON' or 'OFF' position.

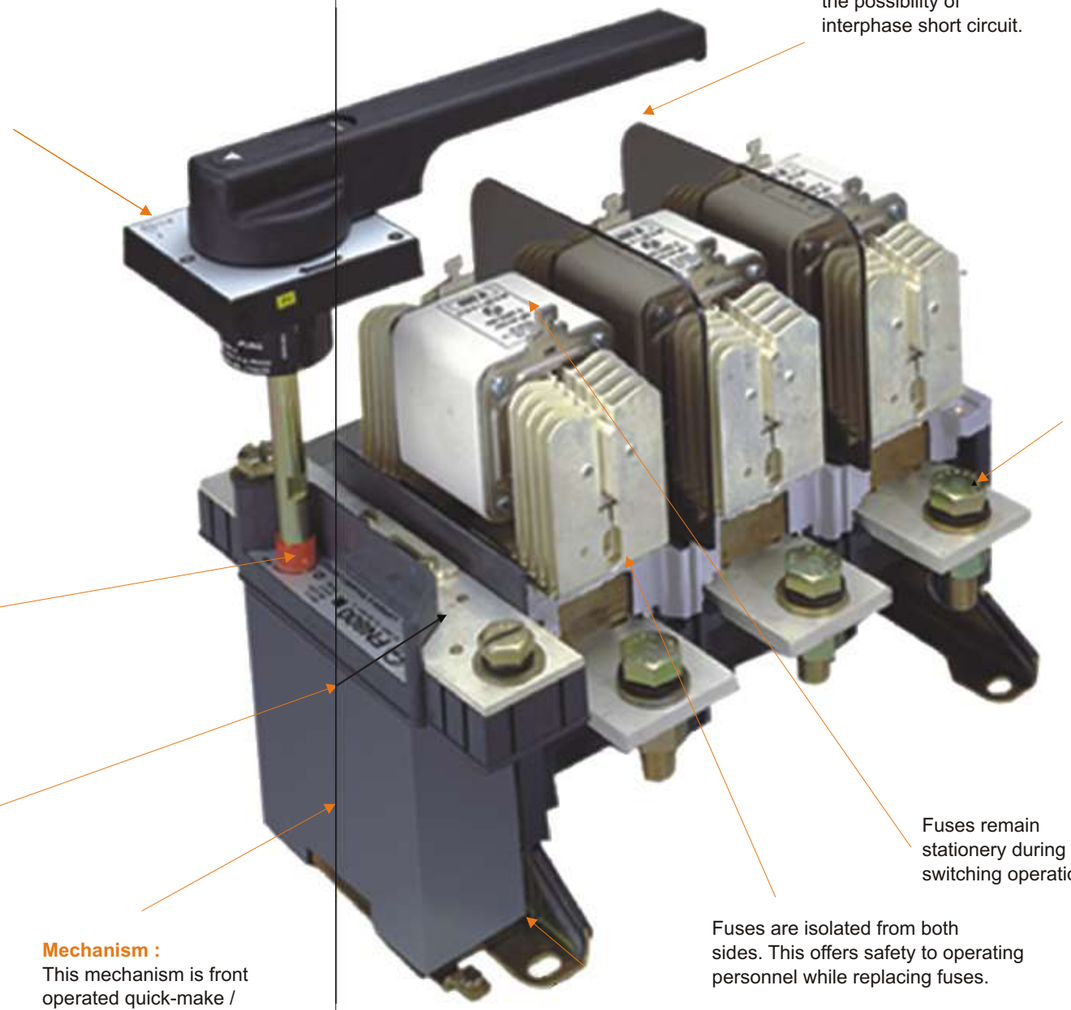
The handle coupling can take a mismatch or ±3mm in all directions.

Clear ON / OFF indication is provided on the switch (by a red pointer)



Built-in neutral :
Switch-Disconnector-Fuse consist of an integral neutral, making the units suitable for 3 phase, 4 - wire application. FN 32 / 63 has switched neutral while higher ratings have isolable neutral.

High making & breaking capacity Due to Quad break construction. High Electrical & Mechanical life.



Mechanism :
This mechanism is front operated quick-make / quick-break and independent of speed of operation.

Compact construction :
To ensure light weight low operating torque switch which saves panel space.

Easy to maintain contacts.

Phase barriers :
Interphase barriers are provided to eliminate the possibility of interphase short circuit.

Fuses remain stationery during switching operation.

Fuses are isolated from both sides. This offers safety to operating personnel while replacing fuses.

The Switch-Disconnector-Fuse units can be mounted at any angle in a vertical plane.

Large Ground Clearance to eliminate possibility of phase-ground flash over.



Large terminals to accommodate Aluminium bus bars.

Terminal shrouds, to protect against phase-phase short circuit
The terminals can be shrouded for protection against phase-phase short circuit through an external conducting path and also for protection against accidental human contact to live terminals.

Contact System :
Contact system is **QUAD BREAK**. There are no. of parallel moving contacts per pole per break. Hence, better Arc Quenching & more electrical life of contacts. Each pole has separate bridge, carrying the moving contacts, achieving a high order of interphase separation & avoiding phase-phase flash over.



SDF Interior in Sheet Steel Enclosure :
Complete range of S-D-F is also available in attractive powder coated sheet steel enclosures. **FN 32 / 63 in sheet steel enclosure comes fitted with gland plate.**

TECHNICAL DATA

SWITCH-DISCONNECTOR-FUSE UNITS, TYPE FN
CONFORMS TO IS 13947 (PART-3) / IEC 60947-3

TYPE DESIGNATION		FN 32	FN 63	FN 100	FN 125	FN 160	FN 200	FN 250	FN 315	FN 400	FN 630	FN 800
No. of Poles		3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral
Neutral #		Switched	Switched	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable
Service temperature	°C	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50
Rated operational voltage (U_e)	V	415	415	415	415	415	415	415	415	415	415	415
Rated insulation voltage (U_i)	V	690	690	690	690	690	690	690	690	690	690	690
Rated impulse withstand voltage (U_{imp})	kV	8	8	8	8	8	8	8	8	8	8	8
Rated Frequency	Hz	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60
Conventional enclosed thermal current at 40°C (I_{the})	A	32	63	100	125	160	200	250	315	400	630	800
Rated operational current (I_e) AC - 23 A utilization category	A	32	63	100	125	160	200	250	315	400	630	800
Rated making capacity (436 V, cosØ=0.35)	A	320*	630*	1000	1250	1600	2000	2500	3150	4000	6300	8000
Rated breaking capacity (436 V, cosØ=0.35)	A	256*	504*	800	1000	1280	1600	2000	2520	3200	5040	6400
Rated fused short circuit current with L&T fuses, rating	kA A / Type / Size	80 32/HF/14x51	80 63/HF/14x51	100 100/HN/00	100 125/HN/00	100 160/HN/00	100 200/HN/0	100 250/HN/1	100 315/HN/1	100 400/HN/2	100 630/HN/3	100 800/HN/3
Capacitor duty -△Connected- 415 V, 50 - 60 Hz	kVAr	14	29	45	57	57	92	115	145	175	270	270
Mechanical life (Operating cycles)		15000	15000	15000	15000	15000	10000	10000	10000	10000	10000	3000
Terminal capacity (main)	mm^2	35	35	95	95	185	240	240	400	2 x 400	2 x 625	2 x 625
Terminal capacity (neutral)	mm^2	35	35	50	50	50	120	120	240	240	400	400
Terminal screw	mm	M 6 x 12	M 6 x 12	M 8 x 20	M 8 x 20	M 8 x 20	M 10 x 30	M 10 x 30	M 10 x 30	M 12 x 40	M 16 x 50	M 16 x 50
DC RATING AT 220 V DC												
No. of poles in series, utilization category at rated current		3, DC-23 A	3, DC-23 A	2, DC-23 A	2, DC-23 A	2, DC-23 A	2, DC-23 A	2, DC-23 A	2, DC-22 A	2, DC-22 A	2, DC-22 A	2, DC-22 B

* -------- Power factor = 0.45 as required in IS 13947 - (part 3).

\# ------- For FN 125 to FN 800 Switched - Neutral is available as accessory.

TECHNICAL DATA

SWITCH DISCONNECTOR - TYPE FN
Conformance to IS 13947 (Part 3) and IEC: 60947-3

Type Designation		FN 32	FN 63	FN 100	FN 125	FN 200	FN 250	FN 315	FN 400	FN 630	FN 800	FN 1000
No. of poles		3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral	3+Neutral
Neutral		Switched	Switched	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable	Isolable
Service temperature	°C	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50	-20 to 50
Rated operational voltage (U_e)	V	415	415	415	415	415	415	415	415	415	415	415
Rated insulation voltage (U_i)	V	690	690	690	690	690	690	690	690	690	690	690
Rated impulse withstand voltage (U_{imp})	kV	8	8	8	8	8	8	8	8	8	8	8
Rated frequency	Hz	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60	50 - 60
Conventional Enclosed thermal current at 40°C	A	32	63	100	125	200	250	315	400	630	800	1000
Rated operational current Ie												
AC 20 A utilization category		32	63	100	125	200	250	315	400	630	800	1000
AC 21 A utilization category		32	63	100	125	200	250	315	400	630	800	1000
AC 22 A utilization category		32	63	100	125	200	250	315	400	630	800	1000
AC 23 A utilization category		32	63	100	125	200	250	315	400	630	800	1000
DC rating at 220 V DC												
No. of poles in series, utilization category at rated current		3, DC 23 A	3, DC 23 A	2, DC 23 A	2, DC 23 A	2, DC 23 A	2, DC 23 A	2, DC 22 A	2, DC 22 A	2, DC 22 A	2, DC 22 A	2, DC 22 B
Rated making capacity (436 V, cosØ-0.35)	A	320	630	1000	1250	2000	2500	3150	4000	6300	8000	10000
Rated breaking capacity (436 V, cosØ-0.35)	A	256	504	800	1000	1600	2000	2520	3200	5040	6400	8000
Capacitor duty - 415 V 50 - 60 Hz	kVAR	14	29	45	57	92	115	145	175	270	270	270
Mechanical life (operating cycles)		15000	15000	15000	15000	10000	10000	10000	10000	10000	3000	-
Terminal capacity (main)	mm^2	35	35	95	95	240	400	400	2 x 400	2 x 625	2 x 625	-
Terminal capacity (neutral)	mm^2	35	35	50	50	120	120	120	240	400	400	-
Terminal screw	mm	M 6 x 12	M 6 x 12	M 8 x 20	M 8 x 30	M 10 x 30	M 10 x 30	M 10 x 30	M 12 x 40	M 16 x 50	M 16 x 50	-
Short circuit withstand current (duration 1 secs)	kA	1.5	1.5	4	4	6	10	14	14	20	20	-
Rated fused short circuit current	kA	80	80	100	100	100	100	100	100	100	50	-
with L&T fuses rating, A / Type Size		32 / HF	63 / HF	100 / HN 00	125 / HN 00	200 / HN 0	250 / HN 1	315 / HN 1	400 / HN 2	630 / HN 3	800 / HN 3	-

SPARES & ACCESSORIES

Wide range of spares & accessories are available for Switch-Disconnector-Fuse units type FN.

ACCESSORIES :



SWITCHED NEUTRAL :

In FN 32 / 63 Switched-Neutral pole is an integral part of the Switch-Disconnector-Fuse. For higher ratings, a double break, site-fitted switched neutral pole can be provided. This is operated by the main mechanism.



TERMINAL SHROUD :

The terminals can be shrouded for protection against phase-short circuit through an external conducting path and against accidental human contact with live terminals.



MECHANICAL INTERLOCK KIT :

Two Switch-Disconnector-Fuse units can be interlocked by mechanical interlock kit. After interlocking, the following three positions are possible.

1) SDFU 1 in ON position SDFU 2 in OFF position.
2) SDFU 2 in ON position SDFU 1 in OFF position
3) Both SDFUs in OFF position Hence two mechanically interlocked SDFUs can be used as a change over switch.



CASTELL INTERLOCK :

Switch-Disconnector-Fuse units can be locked on OFF position with help of castell interlock. Castell interlock can also be used to interlock two S-D-F units. (Different variety of locks are available)



SHAFT EXTENSION KIT :

Shaft length can be increased with shaft extension kit.



FUSE PULLER :

A fuse puller is provided which facilitate easy & safe removal of fuses.



HANDLE COUPLING (Type A & B) :

Irrespective of the switch orientation (vertical or horizontal), operation in any of the four quadrants is possible by selecting right handle coupling (Refer table on next page)



AUXILIARY CONTACTS :

1 NO + 1 NC auxiliary contact is available as an accessory. This can be suitably wired in the control circuit.
Rated operational current I_e (AC - 15) - 4 A
Rated operational voltage U_e - 415

SPARES :



Moving Contact :

Moving contacts are available for ranges FN 100 to FN 800. One set of moving contact spare contains, spring, guide & moving contact.



Front Housing essambly :

Complete front housing assembly is available from FN 100 to FN 800.

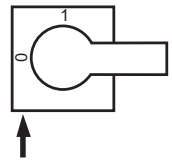
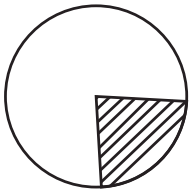
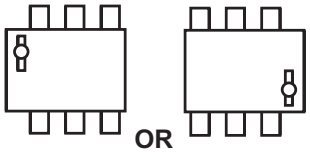
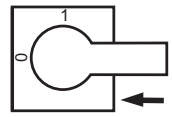
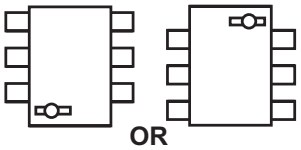
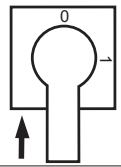
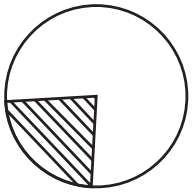
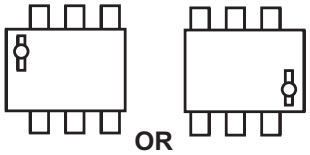
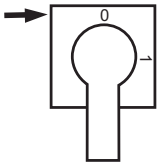
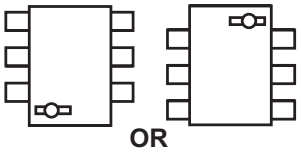
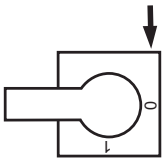
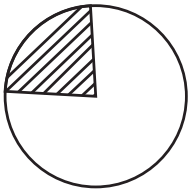
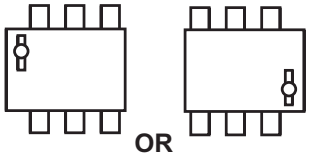
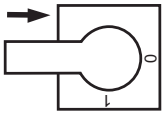
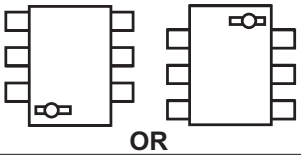
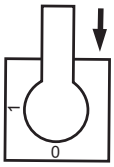
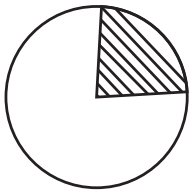
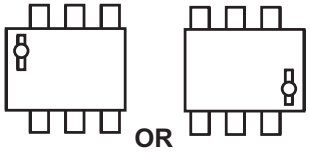
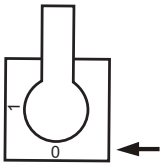
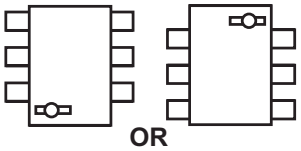
Spares & Accessories for FN Range - Ordering Information

	Versions	FN 32	FN 63	FN 100	FN 125/160	FN 200	FN 250	FN 315	FN 400	FN 630	FN 800
Spares	Moving Contact	Not Available		SK91373		SK91374	SK91375	SK91376	SK91377	SK91378	SK91379
	Front Housing Assembly	Not Available		ST31677	ST31678	ST31679	ST31729	ST31681	ST31682	ST31683	ST31730
Accessories	Terminal Shroud Kit	SK91190		SK91137		SK91335		SK91346			SK91347
	Switched Neutral Kit	Built-in		SK95233		SK95516		SK95517			SK95546
	Aux. Contact (1 NO + 1 NC)	SK91302		SK91328		SK91329		SK91330			
	Handle Coupling (Type - A)	SK91257		SK91258				SK91259			
	Handle Coupling (Type - B)	SK91277		SK91278				SK91279			
	Handle Coupling (Type - CE)	SK91337		Not Available							
	Fuse Puller	SK91185		SF90126							
	Shaft Extension Kit	Not Available		SK95600				SK91331			
	Mechanical interlock Kit	Not Available		SK95232				SK95545			
	Castell Lock (Type A-Type M)	Not Available		SK00333-SK00344				SK00345-SK00356			

Ordering Suffix - 0000 for all.

SELECTION OF HANDLE

SEEN FROM FRONT OF THE DOOR

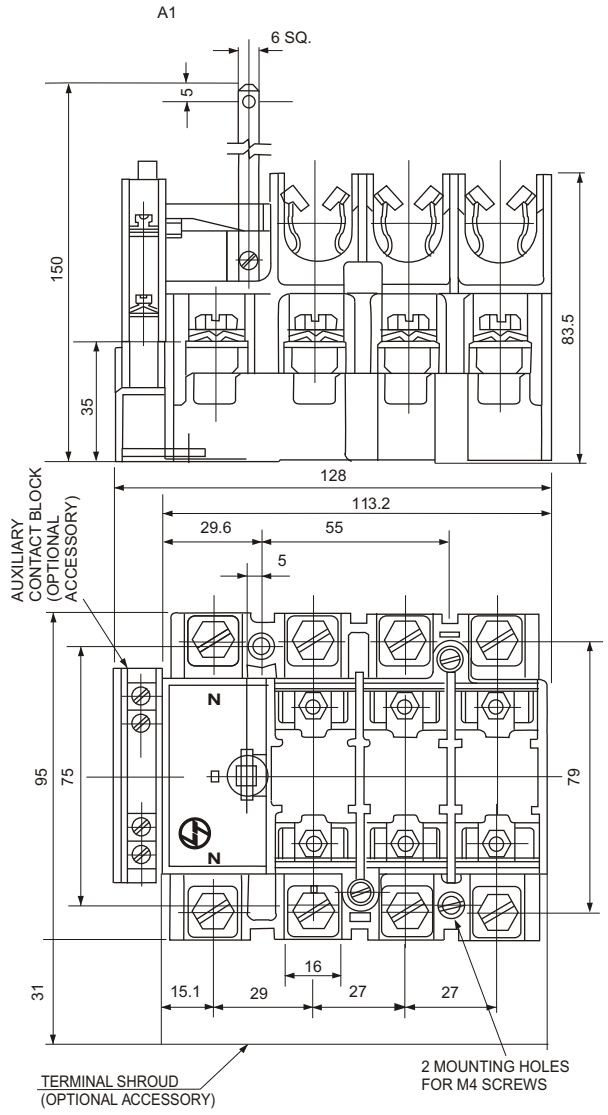
SR. NO.	HANDLE (OFF) POSITION	OPERATING QUADRANT (HAND)	SWITCH ORIENTATION	DOOR CUT-OUT	HANDLE COUPLING TYPE
1					A
2					B
3					B
4					A
5					A
6					B
7					B
8					A

Note : Arrow (←) indicates position of Interlock Defeat Key
Type A : supplied as standard with all S-D-Fs
Type B : supplied on request

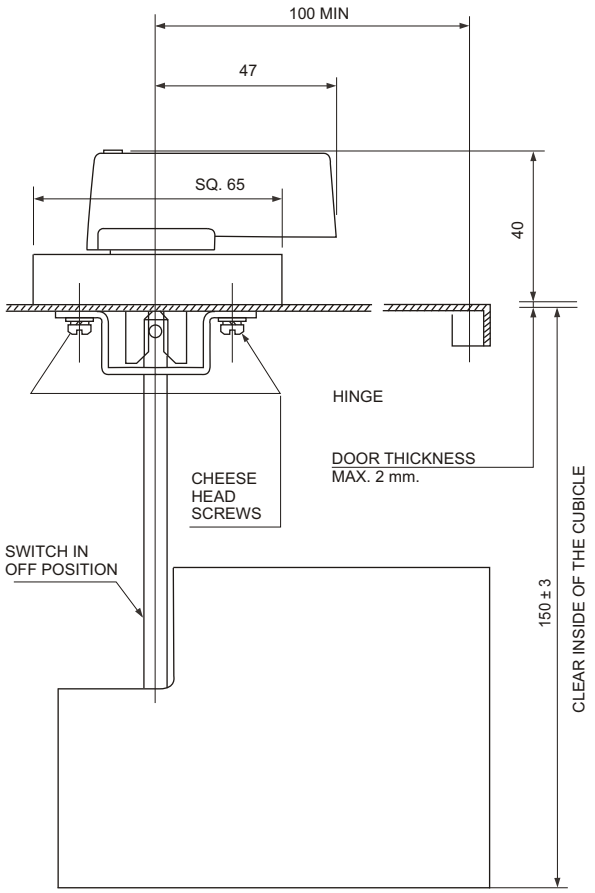
OVERALL DIMENSIONS

SWITCH-DISCONNECTOR-FUSE TYPE DIN FN 32 / 63

OVERALL DIMENSIONS - FN 32 / 63

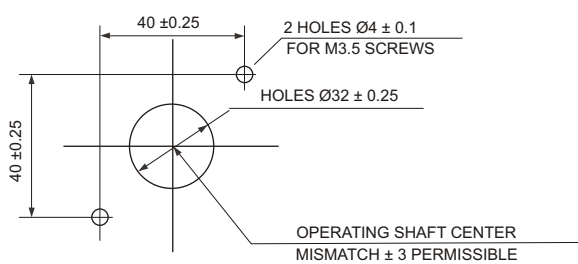


ASSEMBLY OFHANDLE COUPLING ON DOOR - FN 32 / 63

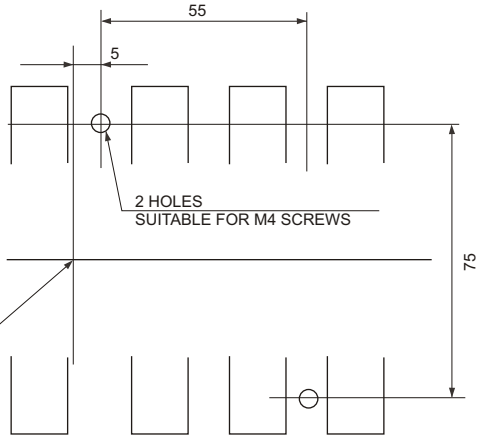


DRILLING DETAILS FN 32 / 63

DRILLING DETAILS ON DOOR FOR MOUNTING HANDLE COUPLING SEEN FROM FRONT OF THE DOOR

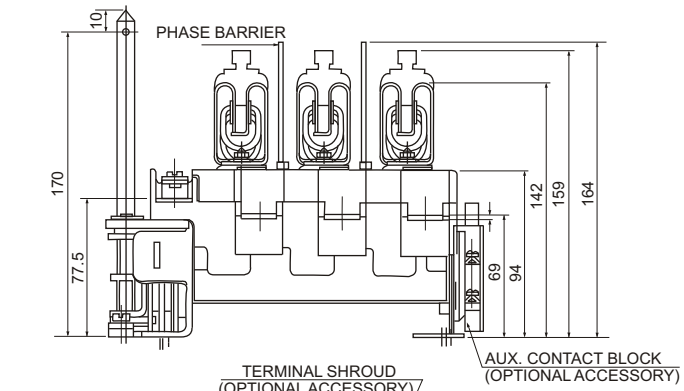


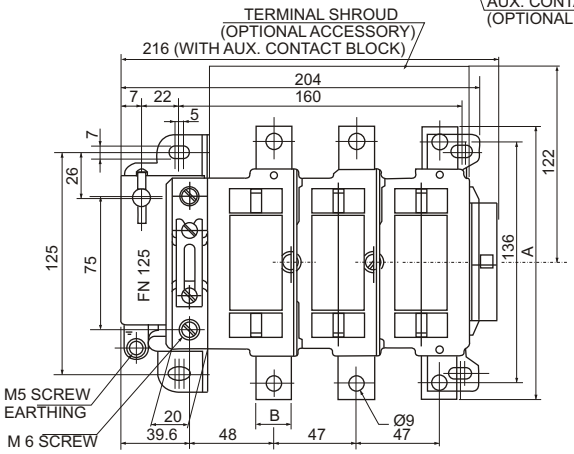
DRILLING DETAILS ON BASE PLATE FOR MOUNTING SWITCH SEEN FROM FRONT OF THE DOOR



Note: All dimensions are in mm.

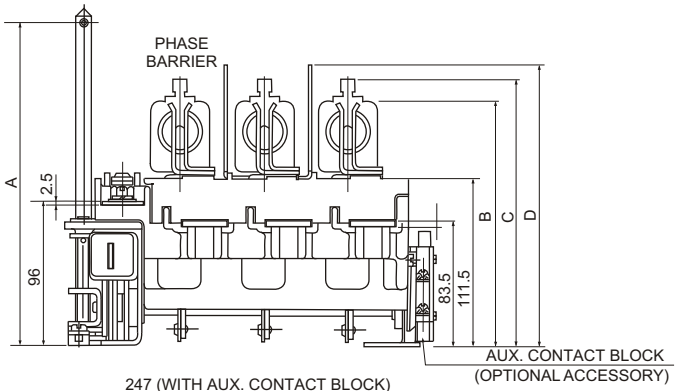
SWITCH-DISCONNECTOR-FUSE TYPE DIN FN 100 / 125 / 160

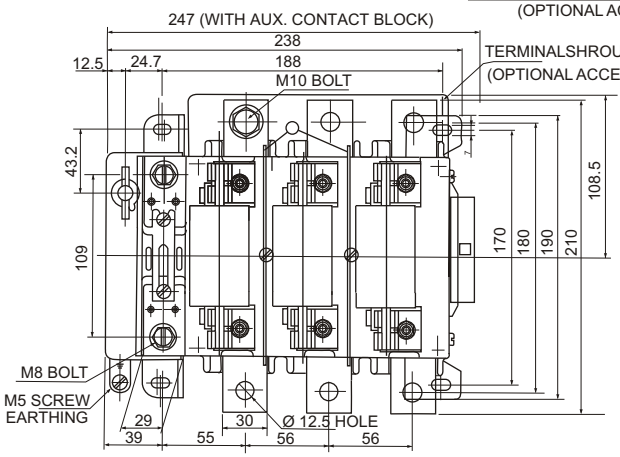




TYPE	A	B
FN 100 / 125	154	20
FN 160	164	25

SWITCH-DISCONNECTOR-FUSE TYPE DIN FN 200 / 250



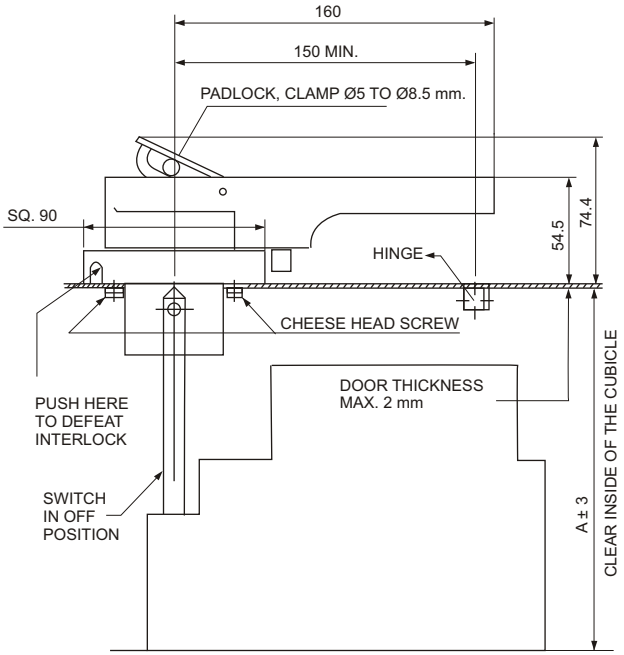


TYPE	A	B	C	D
FN 200	190	162.5	178	187.5
FN 250	206	108.5	194.5	204

Note: All dimensions are in mm.

OVERALL DIMENSIONS

ASSEMBLY OF HANDLE COUPLING ON DOOR FN 100 / 125 / 160 / 200 / 250

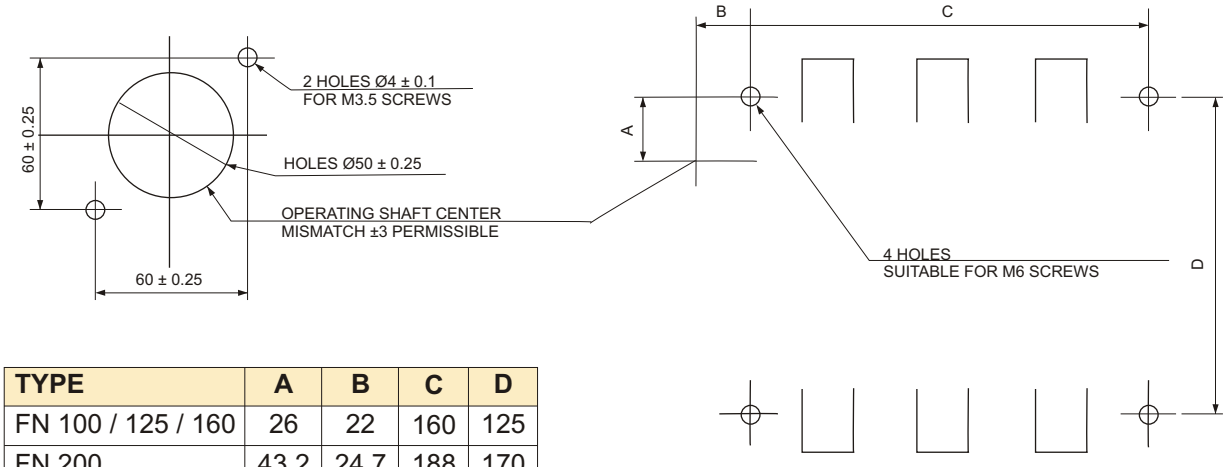


DIMENSION	FN 100 / 125 / 160	FN 200	FN 250
A	180	200	216

DRILLING DETAILS FN 100 / 125 / 160 / 200 / 250

DRILLING DETAILS ON DOOR
FOR MOUNTING HANDLE
COUPLING
SEEN FROM FRONT OF THE DOOR

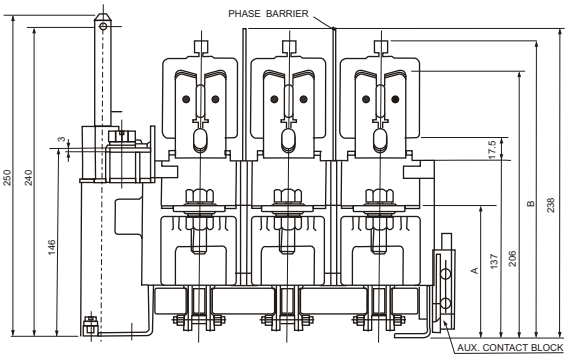
DRILLING DETAILS ON BASE
PLATE
FOR MOUNTING SWITCH
SEEN FROM FRONT OF THE DOOR

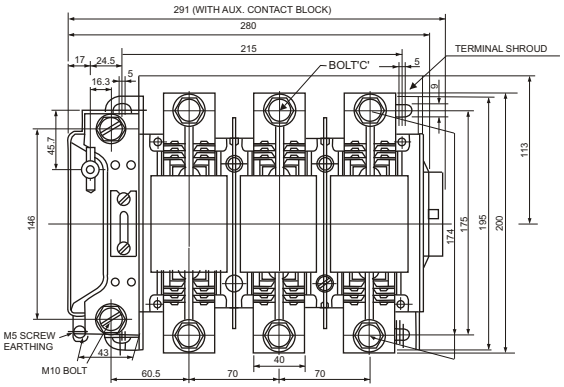


TYPE	A	B	C	D
FN 100 / 125 / 160	26	22	160	125
FN 200	43.2	24.7	188	170
FN 250	43.2	24.7	188	170

Note: All dimensions are in mm.

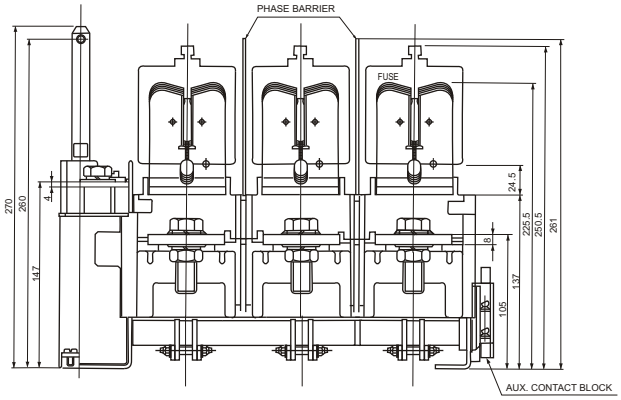
SWITCH-DISCONNECTOR-FUSE TYPE DIN FN 315 / 400

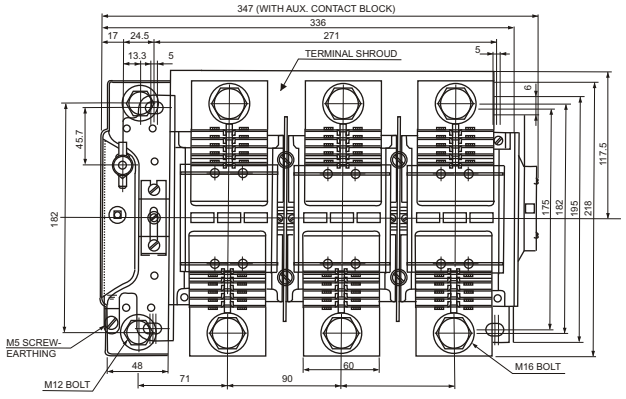




TYPE	A	B	C
FN 315	103	220	M10
FN 400	102	228	M12

SWITCH-DISCONNECTOR-FUSE TYPE DIN FN 630 / 800

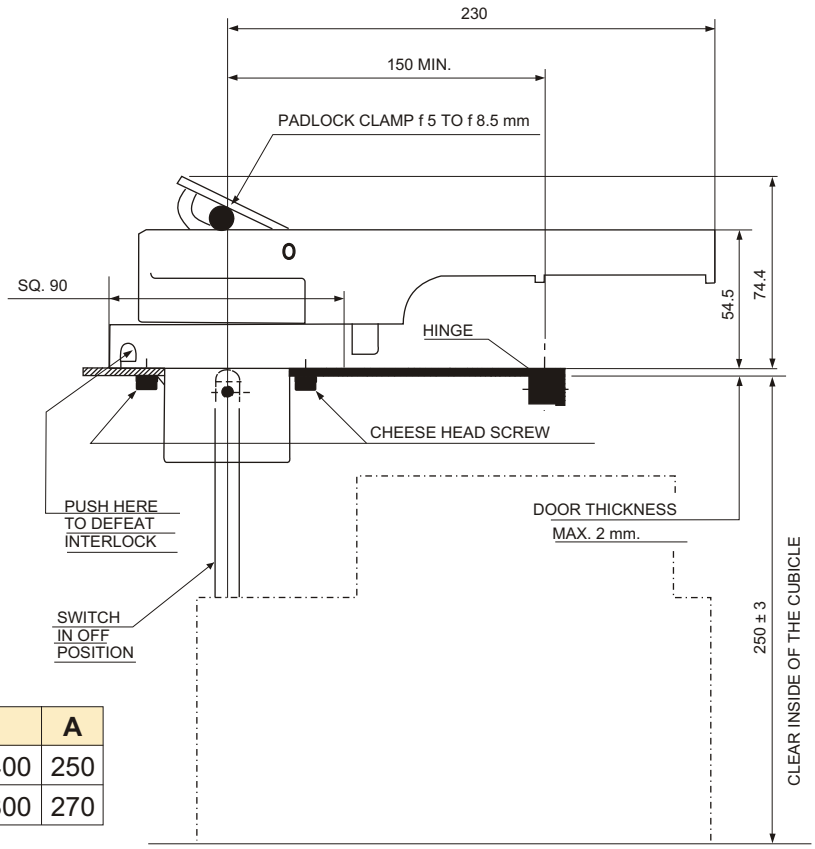




Note: All dimensions are in mm.

OVERALL DIMENSIONS

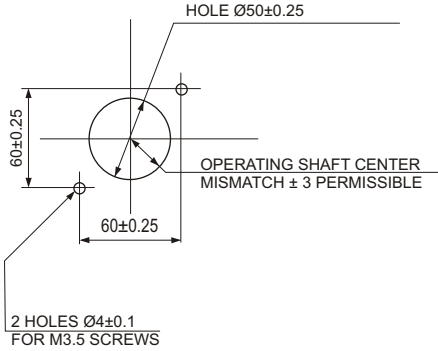
ASSEMBLY OF HANDLE COUPLING ON DOOR FN 315 / 400 / 630 / 800



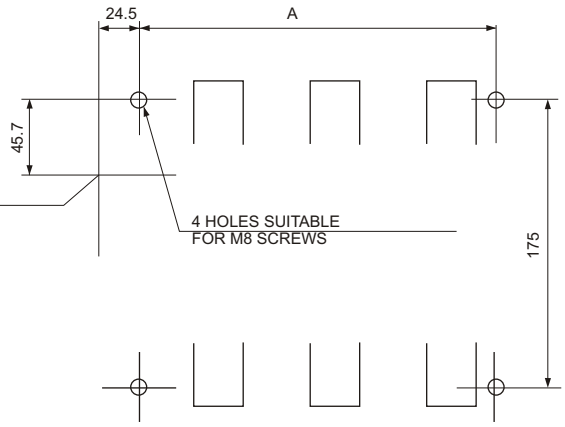
TYPE	A
FN 315 / FN 400	250
FN 630 / FN 800	270

DRILLING DETAILS FN 315 / 400 / 630 / 800

DRILLING DETAILS ON DOOR
FOR MOUNTING HANDLE COUPLING
SEEN FROM FRONT OF THE DOOR



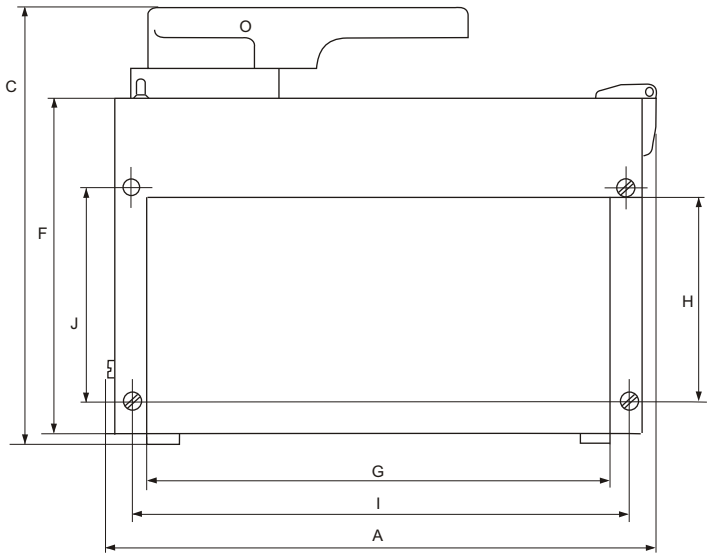
DRILLING DETAILS ON BASE PLATE
FOR MOUNTING SWITCH
SEEN FROM FRONT OF THE DOOR

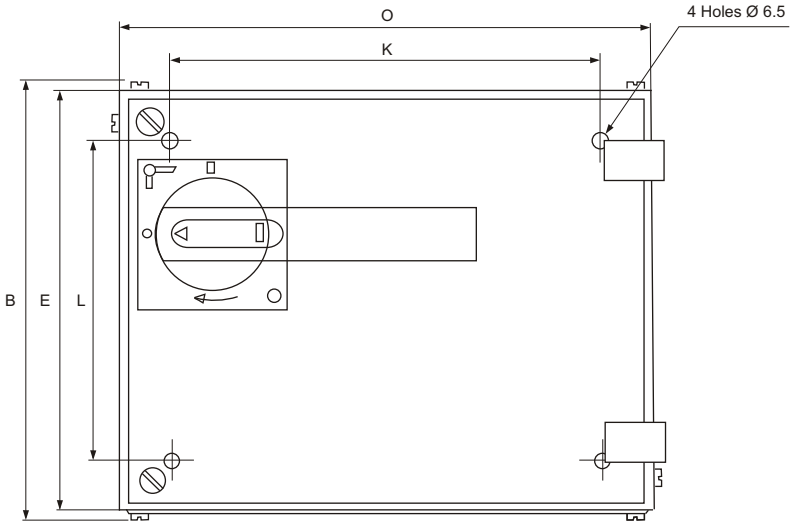


TYPE	A
FN 315 / FN 400	215
FN 630 / FN 800	271

Note: All dimensions are in mm.

FN IN SHEET STEEL ENCLOSURE





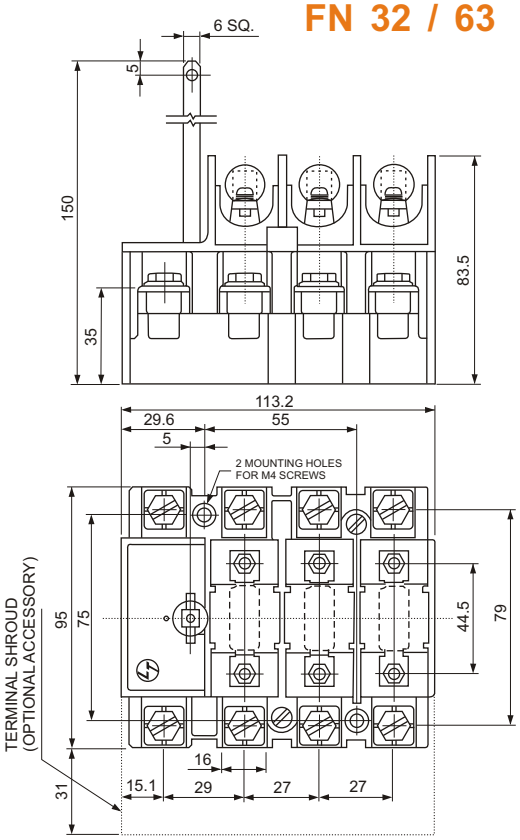
	Extreme Overall dimension			Basic Enclosure dimension			Cutout for Cables		GI and Plate mounting dimension		Enclosure mounting dimension	
TYPE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
FN 32 / 63	245	238	196	230	226	153	190	73	210	80	170	165
FN 100 / 125 / 160	288	265	245	273	253	183	233	104	253	110	213	193
FN 200	335	265	265	320	253	203	280	124	300	130	260	193
FN 250 / 315 / 400	365	265	315	350	253	253	310	185	330	191	300	203
FN 630 / 800	421	285	337	406	273	273	366	185	386	191	346	223

Note: All dimensions are in mm.

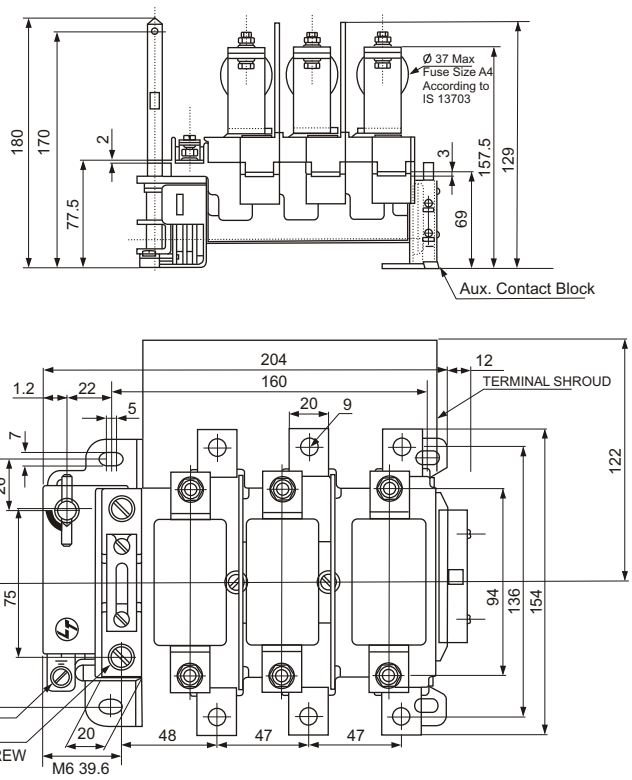
OVERALL DIMENSIONS

SWITCH-DISCONNECTOR-FUSE TYPE BOLTED

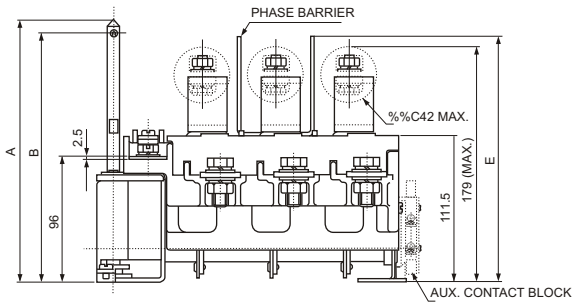
FN 32 / 63

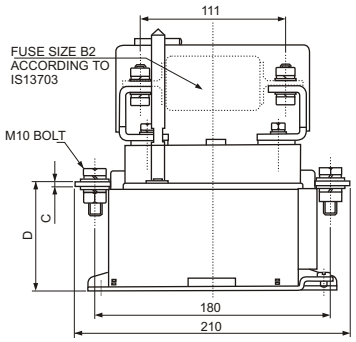


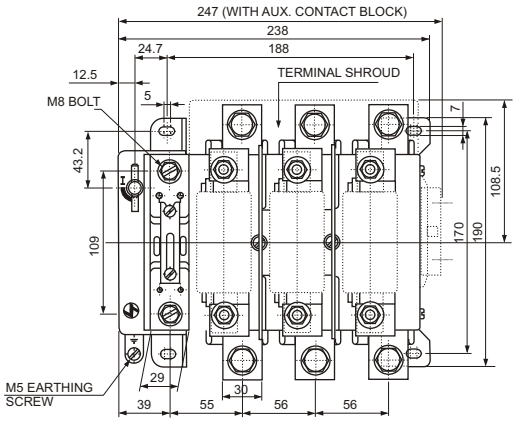
FN 100 / 125



FN 200 / 250



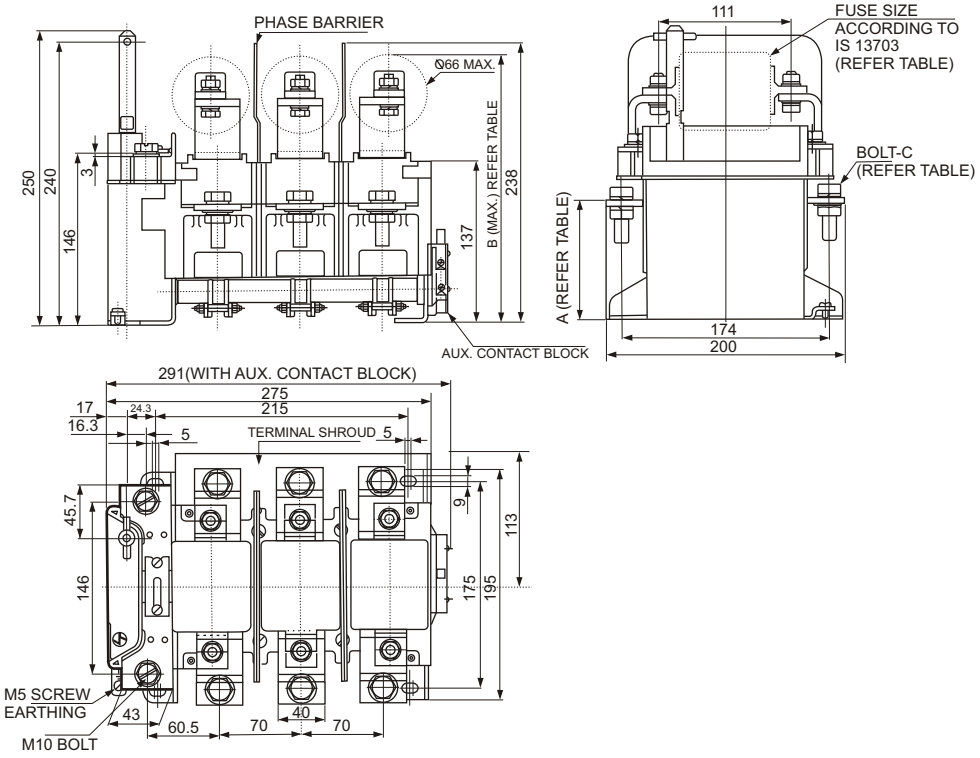




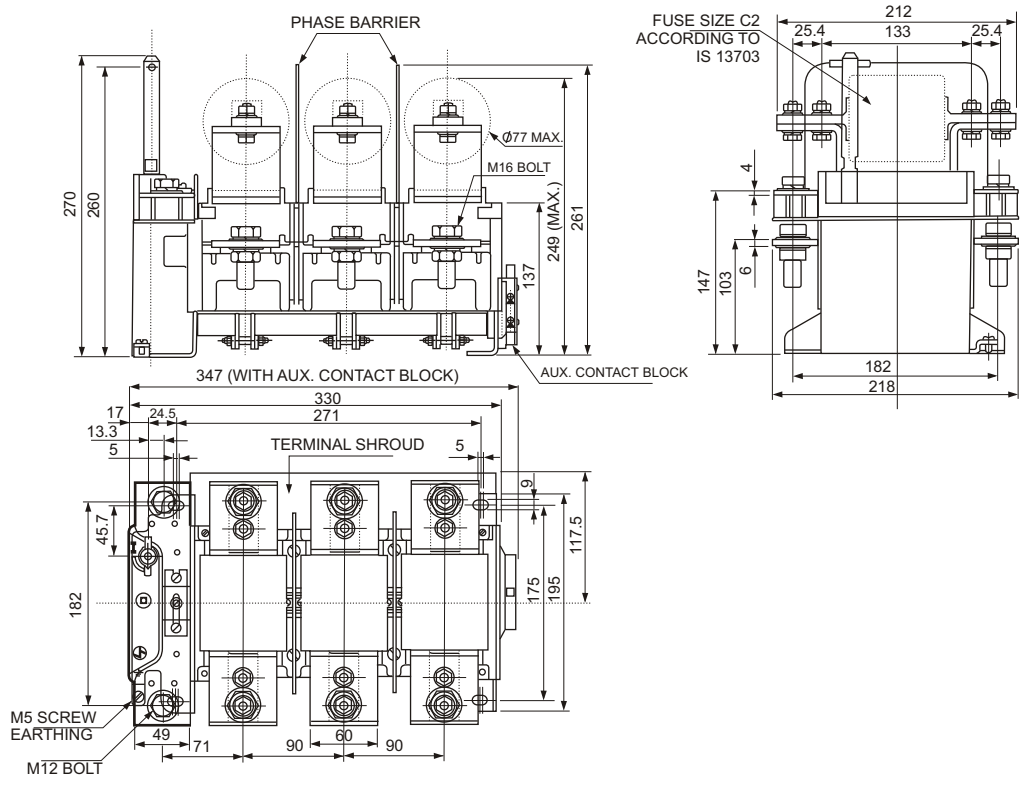
DIM	A	B	C	D	E	FUSE
FN 200	200	190	4	83.5	187.5	200 A
FN 250	216	206	5	84.5	204	250 A

Note: All dimensions are in mm.

SWITCH-DISCONNECTOR-FUSE TYPE BOLTED FN 315 / 400



SWITCH-DISCONNECTOR-FUSE TYPE BOLTED FN 630



Note: All dimensions are in mm.

CYLINDRICAL HRC FUSES

FUSE LINKS TYPE HF

(Fuse links with cylindrical contact caps)

- Conform to IEC 60269 / IS 13703
- Low watt loss - Saving in power
- Low let through energy
- High breaking capacity - 80 kA
- Rated voltage - 415 V
- Immediate fault indication through Red Pop up indicator.
- Lower Power loss in our fuses result in cooler running of asociated products.



ORDERING DETAILS

Fuse Rating (A)	Cat. Nos.	Size	Suitable for S-D-F type FN
2	SF90144	14 *51 MM	32, 63
4	SF90145		32, 63
6	SF90146		32, 63
8	SF90147		32, 63
10	SF90148		32, 63
16	SF90150		32, 63
20	SF90151		32, 63
25	SF90152		32, 63
32	SF90142		32, 63
40	SF90143		63
50	SF90158		63
63	SF90159		63

FUSE LINKS TYPE HN

(Fuse links with blade contacts)

- Conforms to IEC 60269 / IS 13703
- Low watt loss - Saving in power
- Cooler running of associated products
- Low let through energy
- High breaking capacity - 100 kA
- Immediate fault indication
- Rated voltage - 415 V



Size of the fuse link	Rating (A)	Cat. Nos.	Rated watt loss	Watt loss limits as per IS 13703	Suitable for S-D-Funits type FN or equivalent
Size 000	63	SF94940	5.3	100 Amp, Fuse-7.5 W	100, 125, 160
	80	SF94941	6.2		100, 125, 160
	100	SF94942	7		100, 125, 160
Size 00	63	SF94027	5.7	100 Amp, Fuse-7.5 W	100, 125, 160
	80	SF94028	6.9		100, 125, 160
	100	SF94029	7.5		100, 125, 160
	125	SF9430	9.8		125, 160
	160	SF94939			160
Size 0	80	SF94128	8.3	160 Amp, Fuse-16 W	200
	100	SF94129	9.1		200
	125	SF94130	11.3		200
	160	SF94131	12.7		200
	200	SF94132	14.5		200
Size 1	125	SF94230	10.3	250 Amp, Fuse-23 W	250, 315
	160	SF94231	12.3		250, 315
	200	SF94232	14.3		250, 315
	250	SF94233	17.3		250, 315
	315	SF94234	25.5		250, 315
Size 2	200	SF94332	14.1	400 Amp, Fuse-34 W	400
	250	SF94333	16.9		400
	315	SF94334	20.2		400
	400	SF94335	24.9		400
Size 3	315	SF94434	20.5	630 Amp, Fuse-48 W	630, 800
	400	SF94435	26.7		630, 800
	500	SF94436	36.1		630, 800
	630	SF94437	42.2		630, 800
	800	SF94938	48		800

Fuse-pulling handle should be used for safe and easy removal of fuse links (for HF : SK91185 & for HN : SF90126)

FUSE LINKS TYPE HG AND HQ

(Fuse-links for bolted connections)

- Conforms to IEC 60269 / IS 13703
- Low watt loss
- Low let through energy
- High breaking capacity - 80 kA
- Rated voltage - 415 V



TYPE HQ

Size of the fuse	Rating (A)	Cat. Nos.	Suitable for S-D-F units type FN or equivalent	Power Loss
A1	2	ST30736	32, 63	0.3
	4	ST30737	32, 63	0.5
	6	ST30738	32, 63	1.2
	10	ST30739	32, 63	1.4
	16	ST30740	32, 63	1.8
	20	ST30741	32, 63	2.2
	25	ST30742	32, 63	2.9
	32	ST30743	32, 63	3.0
A1L	20	ST34527	-	2.4
	25	ST34528	-	3.1
	32	ST34529	-	3.4
	50	ST35827	-	4.0
	63	ST35828	-	4.7
A2	4	ST30747	-	0.8
	6	ST30748	-	1.4
	10	ST30749	-	1.5
	16	ST30750	-	0.2
	20	ST30752	-	2.8
	25	ST30753	-	3.8
	32	ST30753	-	4.4
A3	35	ST30759	100, 125, 160	4.5
	50	ST30760	100, 125, 160	6.2
	63	ST30761	100, 125, 160	6.8
A4	80	ST30767	100, 125, 160	9.1
	100	ST30768	100, 125, 160	6.2
	125	ST30769	100, 125, 160	6.8
B1	80	ST30774	-	9.2
	100	ST30775	-	10.5
	125	ST30776	-	16.0
B2	125	ST30777	200	15.0
	160	ST30778	200	19.5
B3	200	ST30779	200	20.5
	250	ST30781	250, 315	28
	315	ST30782	315	32
B4	315	ST30782	400	32
	355	ST30783	400	34
C2	400	ST30784	400	38
	400	ST30785	630	38
	500	ST30786	630	50
	630	ST30787	630	55
C3	630	ST30788	-	58

TYPE HG

Rating (A)	Size	Cat. Nos.	Power Loss
2	F1	ST30725	0.3
4	F1	ST30726	0.5
6	F1	ST30727	1.2
10	F1	ST30728	1.4
16	F1	ST30729	1.8
20	F1	ST30730	2.2
25	F1	ST30731	2.9
32	F1	ST30732	3.0

ORDERING INFORMATION

SWITCH-DISCONNECTOR-FUSE AND SWITCH-DISCONNECTOR TYPE FN

ORDERING INFORMATION:
Orderig Suffix OOOO for all * Example: FN 32 Interior with handle * Ordering Information - **SK95518OOOO**

	Type Designation					
Description	**FN 32 (4 Pole)**	**FN 63 (4 Pole)**	**FN 100**	**FN 125**	**FN 160**	**FN 200**
S-D-F Suitable for DIN Fuses						
Interior with handle TPN	SK95518	SK95421	SK95568	SK95001	SK95713	SK95418
Interior without handle TPN	SK95544	SK95420		SK95000	SK95712	SK95417
Interior in sheet steel enclosure	SK95612	SK95613	SK95569	SK95005	SK95715	SK95511
Interior with handle TP			ST30287	ST27894		SK27895
S-D-F Suitable for BS Fuses						
Interior with handle TPN	SK95653	SK95651	SK95570	SK95009	SK95714	SK95588
Switch-Disconnector						
Interior with handle TPN	SK95541	SK955540	SK95571	SK95405		SK95607
	Type Designation					
Description	**FN 250**	**FN 315**	**FN 400**	**FN 630**	**FN 800**	**FN 1000**
S-D-F Suitable for DIN Fuses						
Interior with handle TPN	SK95642	SK95461	SK95481	SK95521	SK95679	
Interior without handle TPN	SK95641	SK95460	SK95480	SK95520	SK95678	
Interior in sheet steel enclosure	SK95681	SK95514	SK95515	SK95547	SK95705	
Interior with handle TP	ST31731	ST27897	ST27898	ST27899	ST31732	
S-D-F Suitable for BS Fuses						
Interior with handle TPN	SK95682	SK95590	SK95591	SK95592		
Switch-Disconnector						
Interior with handle TPN	SK95608	SK95609	SK95610	SK95611	SK95551	SK95710

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e-Front runners

FUJI ELECTRIC

NEW SC Series

CONTACTORS & MOTOR STARTERS

NEW SC Series



AEH231b

Global Standards

The Fuji NEW SC Series conforms to various overseas standards and has been approved by international standardization bodies.

NEW SC Series

Fuji Contactor is

Fuji NEW SC Series conforms to new JIS Standards (Including, IEC Standards).

IEC

IEC 60947-4-1





NEW SC Series Contactors and Starters　　Approved Standards

Specifications				Contactors		Starters (Open)	
				Standard	Reversing	Standard	Reversing
No. of heater elements				—	—	3	3
Type				SC-□	SC-□RM	SW-□/3H	SW-□RM/3H
Conformed	New **JIS**	Japan		○	○	○	○
	IEC	International		○	○	○	○
	VDE	Germany		○	○	○	○
	BS	UK		○	○	○	○
	EN	Europe		○	○	○	○
Approved	**UL**	USA	c UL us	○	○	○	○
	CSA	Canada		○	○	○	○
EC Directives	CE Marking	Europe	CE	○	○	○	○
Inspection Institute	**TÜV**	Germany	TÜV Rheinland	○	○	○	○

(Notes)……○ : Conforming to Standards

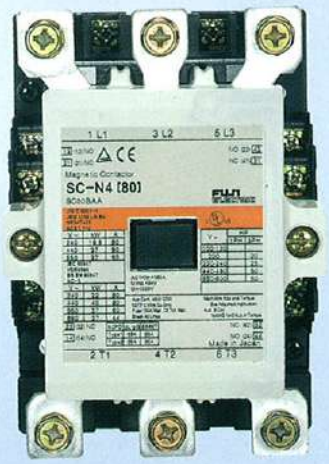
c UL us : A new certification mark that indicates compliance with both Canadian and U.S. requirements.

Standards Indication

A standards mark is included on the nameplate of each product.



SC-N1



SC-N4

Terminal Cover for Finger Protection

These optional terminal covers comply with VBG4 (German Rules of Accident Prevention), IEC60529, DIN57106, VDE0106 Teil100, which are recommendations for preventing exposure to live parts.
The terminal cover satisfies the requirements of Mechanical Direction EN60204-1 "Direct Contact Prevention" concerning mechanical safety.





NEW SC Series

Insulation Barrier

These optional insulation barriers, prevent accidental short-circuits caused by metallic objects falling onto the terminals.



Live-Section Cover

An optional live-section cover that completely encloses the front of a contactor or starter for increased worker safety during maintenance and inspection.



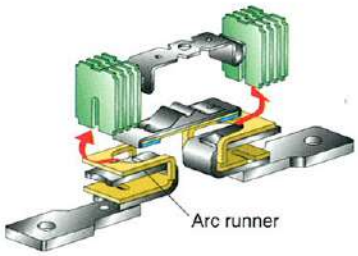
Free Arc Space

A new arc-extinguishing method, which makes full use of magnetic field analysis technology, and a new material (UL94V-0) that has been incorporated into the design of this new type of arc-extinguishing chamber to provide a free arc space. This new method and design reduces the depth size, not only of the main body, but also that of the board (Types SC-N1 to N12).

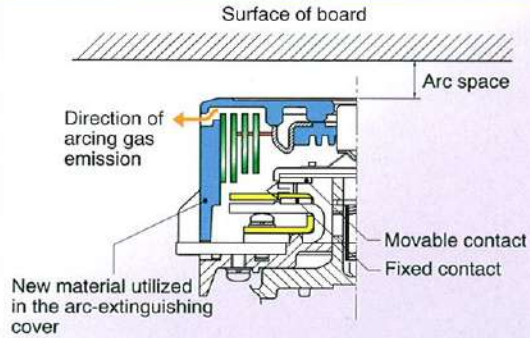
Free Arc Space means arc space is not needed on making and breaking condition according to IEC 60947-4-1. (Refer to chart Arcing gas cooling block.)



Molded arc-extinguishing chamber



Arc deriving block



Arcing gas cooling block

Insulation

●Improved tracking resistance

Tracking resistance of the molded parts comprising of the conductive block has been improved.

Comparative Tracking Index (CTI) : 175V or higher

Tracking : It means the route of the leak electric current caused on the surface of the isolation body.

●Standard heat-proof material

The molded parts used are made of heat-proof materials specified in UL94 (UL94 : STANDARD FOR SAFETY FOR TESTS FOR FLAMMABILITY OF PLASTIC MATERIALS FOR PARTS IN DEVICES AND APPLIANCES).

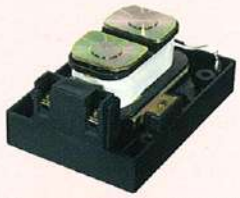
Mirror Contacts (Positively Safety Contacts)

The contactor with mirror contacts has been certified by TÜV.

Mirror contact conforms to the requirement for auxiliary contact that is intended to be included in the future amendment to IEC 60947-4-1.

Mirror contact : normally closed auxiliary contact,which cannot be in closed position simultaneously with the normally open main contact.

■ New Super Magnet with Higher Service Reliability



Mounting a new electronically controlled super magnet (AC input DC excitation method) with an IC on its operating circuit, allows the Fuji NEW SC Series Contactor to achieve higher service reliability.

- There is no unstable zone as seen in the diagram.The New Super Magnet holds without chattering which may cause damage such as contact welding or coil burning.
- Since normal rated voltage is applied when powering on, the contactor may be used without failure,even if the voltage drops down to 65% of the rated value when the main contact is connected.
- The motor is prevented from starting if there is insufficient voltage.
- The power consumption and operating VA for the control coil have been largely reduced.
- The rating range of the coil has been widened, and it may even be used as an AC/DC coil.
- A surge absorbing function has been incorporated.
- Comforming to EMC.

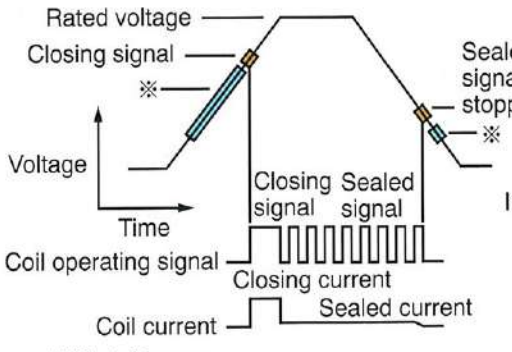
NEW SC Series

NEW SC Series

Motor capacity (kW)		Type		Super Magnet
220V AC	440V AC	Contactors	Starters	
5.5	11	SC-N1	SW-N1/3H	
7.5	15	SC-N2	SW-N2/3H	
11	22	SC-N2S	SW-N2S/3H	○
15	30	SC-N3	SW-N3/3H	
18.5	37	SC-N4	SW-N4/3H	
22	45	SC-N5	SW-N5/3H	
30	55	SC-N6	SW-N6/3H	
37	75	SC-N7	SW-N7/3H	
45	90	SC-N8	SW-N8/3H	
55	110	SC-N10	SW-N10/3H	
75	150	SC-N11	SW-N11/3H	◎
110	200	SC-N12	SW-N12/3H	
150	300	SC-N14	SW-N14/3H	
200	400	SC-N16	—	

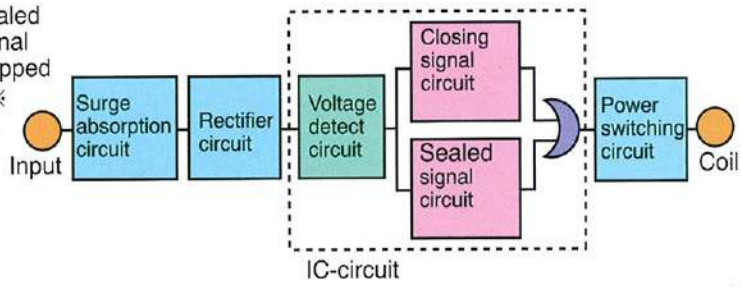
(Notes)····· ◎ : Standard (SC-N□)
○ : Option (SC-N□/SE)

●Operation Principle



※Unstable zone
In this zone, contact and coil burning frequently occur due to voltage drops.

●Circuit Configuration



Ambient Operating Temperature Improved to 55°C

By using a much more compact control board and higher mounting density of contactors, the ambient operating temperature was raised to 55°C.

Rail Mounting

Types SC N1 to N3, TR-N2H and -N3H incorporate one-touch mounting on 35mm-wide support rails (compatible with IEC and DIN Standards).



Bifurcated Auxiliary Contact System

By introducing a bifurcated contact system, higher contact reliability is achieved for service at 5V DC, 3mA (Types SC-N1 to N12).

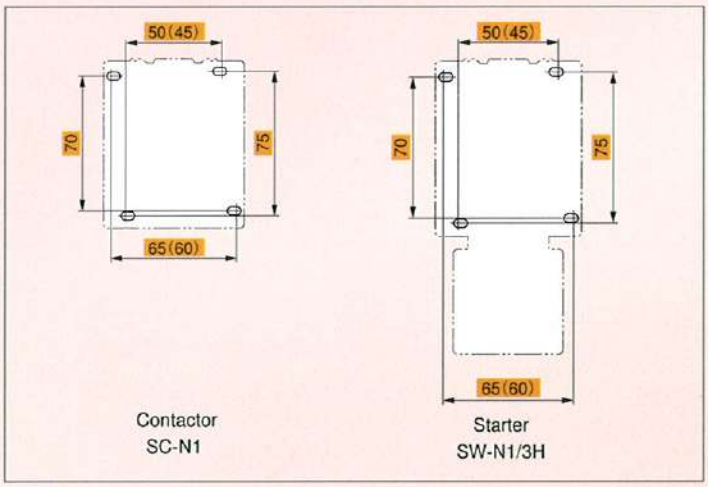
Special type "/G" for DC Operation Added to SC-N1 to N3 Series

A new type of "/G" has been added to SC-N1 to N3 Series for DC operation.
Power input and consumption have been considerably reduced by introducing a full voltage-applying coil.



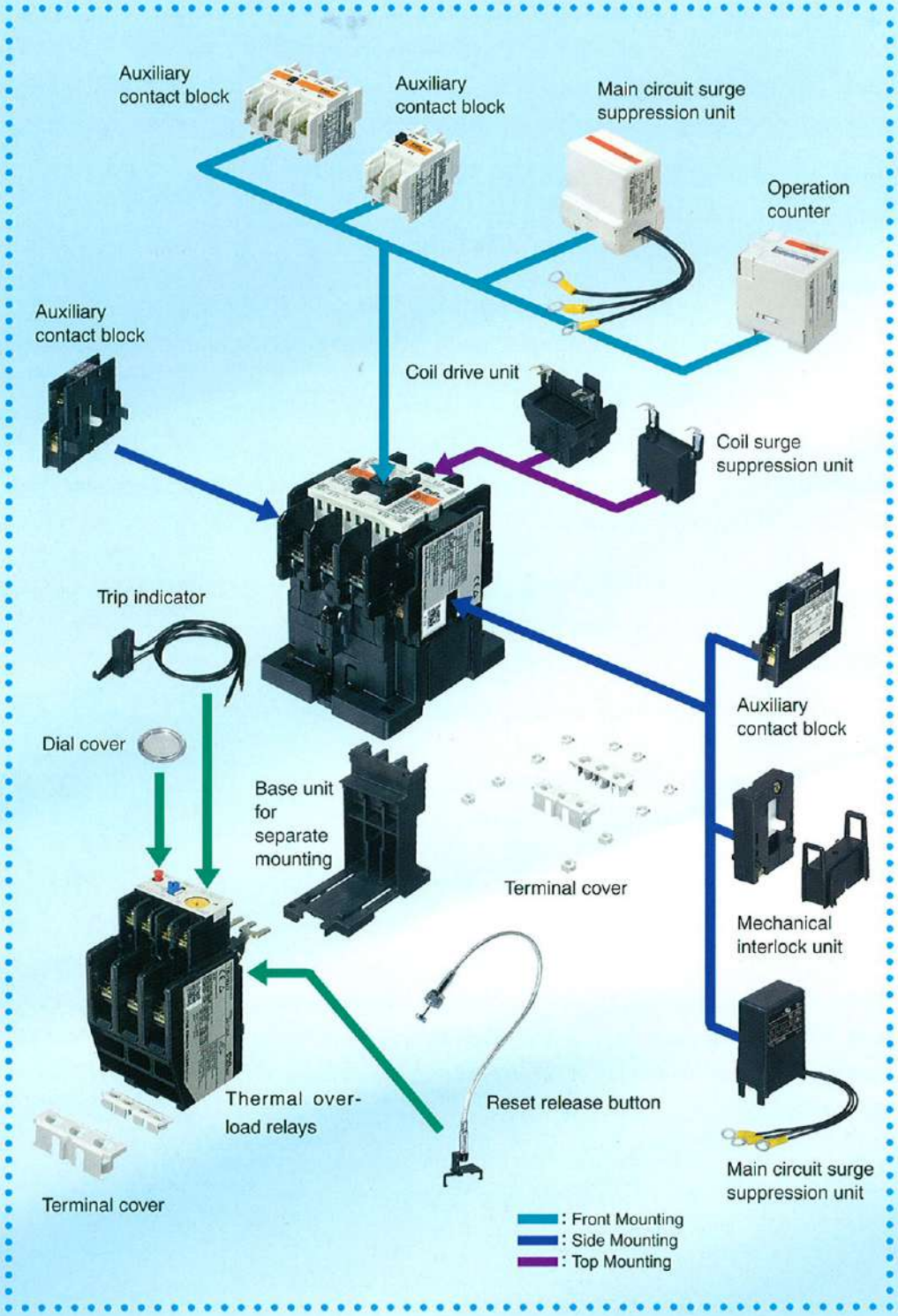
Unified Mounting Hole Sizes of Contactors and Motor Starters

The sizes of the mounting holes of contactors and motor starters have been standardized. This enables the contactor and the motor starter to be fixed to the same mounting holes. (The holes for SC-N1 to N7 are as same as those for SW-N1/3H to N7/3H respectively.)



NEW SC Series

NEW SC Series(SC-N1 to N3)Options



: Used with SC-03 to N3

: Used with SC-03 to N3 and SC-N4 to N12



Auxiliary contact blocks (Front mount type) (Type SZ-A ☐)

A 2- or 4-contact auxiliary contact block with Bifuricated contacts standard. It allows one-touch mounting to a contactor.



Auxiliary contact block (Side mount type) (Type SZ-AS ☐)

2-contact (1NO, 1NC) auxiliary contact block with high-reliability auxiliary contacts.
It allows one-touch mounting to a contactor.



Operation counter (Type SZ-J)

Counts and displays the number of contact switching operations of the contactor.



Main circuit surge suppression unit (Front mount and side mount types) (Type SZ-ZM ☐)

A CR element has been built in for switching surge absorption with a 3-phase motor.



Mechanical interlock unit (Type SZ-RM)

Links two contactors for mechanical interlocking. A reversible type can be easily field assembled.



Power connection kit (Type SZ-RW ☐)

A reversible circuit wiring kit for connecting the primary circuit terminals of two contactors.



3-phase parallel terminal (Type SZ-SP ☐)

Attaching this terminal to a primary circuit enables a contactor to be configured for a single-phase resistance load.



Coil drive unit for IC output (Top mount and side mount types) (Type SZ-CD ☐)

An interface unit for driving a control coil through an output of a PC transistor.



Coil surge suppression unit (Type SZ-Z ☐)

Incorporates a device (varistor, CR) for absorbing surge voltage when the coil is switched off.



Terminal cover (Type SZ-T ☐)

Covers the terminals for protection, resulting in safer maintenance and service activities.



Insulation barrier (Type SZ-B ☐)

Protects against short circuits due to falling objects.



Live section cover (Types SZ-JC ☐ and JW ☐)

Covers the live parts in order to protect service engineers against injury.



Base unit for separate mounting (Type SZ-H ☐)

Allows for a screw mounted or rail mounted separate thermal overload relay to be assembled.



Trip indicator (Type SZ-L ☐)

Reports any tripping action at a thermal overload relay through its LED display.



Reset release button (Type SZ-R ☐)

Resets a thermal overload relay from the rear side of the board or a distant location.



Dial cover (Type SZ-DA)

Protects the settling current value of a thermal overload relay from being changed unintentionally.

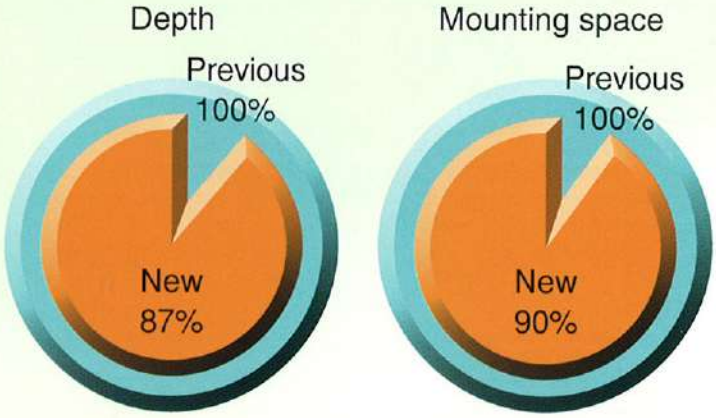
NEW SC Series

Reduced Size and Space of Contactor

By introducing a highly efficient electromagnet (using 3D magnetic field analysis technology,) the depth size and mounting space of the contactor has been reduced.



SC-N5



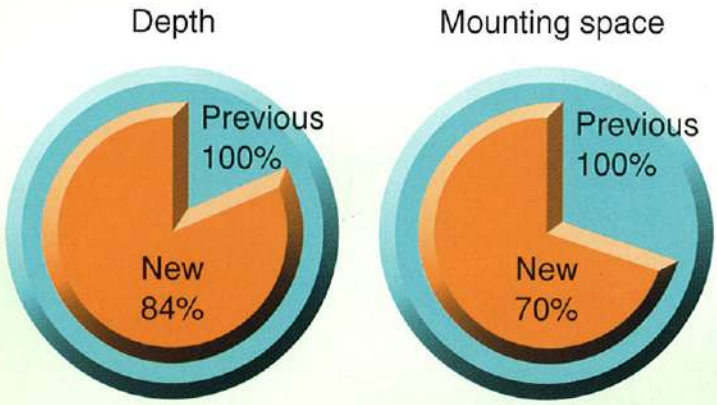
Average value for Types SC-N4 to N7

Reduced Size and Space of Motor Starter

The depth and mounting spaces of the motor starters and thermal overload relays have been reduced by combining them into one unit without a mounting plate.



SW-N5/3H

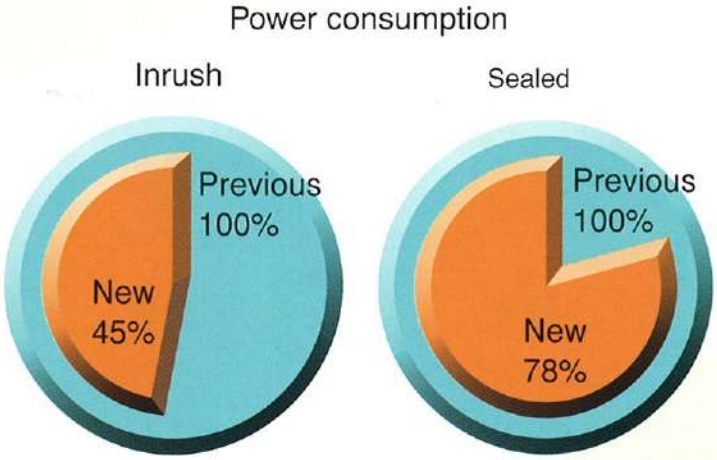


Average value for Types SW-N4/3H to N7/3H

Reduced Power Consumption

By introducing a new type of super magnet (Using 3D electromagnetic field analysis technology,) power consumption have been greatly reduced.

Average value for Types SC-N4 to N7



Material designation indication

To facilitate use in recycling, recyclable materials are indicated as so on parts such as the terminal covers.



Motor Starter Manufactured at ISO9001 and ISO14001-certified Factory

Fuji Electric has been certified for both ISO9000 Series and ISO14000 Series compliance. Both standards are established by the International Organization for Standardization (ISO). The former is for quality control and quality assurance, while the latter is for environmental management systems.
Certified for ISO9001 and ISO14001, our Fukiage Plant, which manufactures motor starters, puts great effort into establishing a highly reliable quality assurance system and a development and production structure which takes environmental protection into account.

〈Certified for ISO14001 · ISO9001〉





NEW SC Series Contactors and Motor Starters

Series			SC series						NEW SC series		
Frame size			03	0	05	4-0	4-1	5-1	N1	N2	N2S
Contactors			 (No.AF88-475)	 (No.AF88-476)	 (No.AF88-477)	 (No.AF88-478)	 (No.AF88-479)	 (No.AF88-1345)	 (No.AF00-136)	 (No.AF00-135)	 (No.AF00-134)
Motor starters			 (No.AF88-1400)	 (No.AF88-1374)	 (No.AF88-1401)	 (No.AF88-1357)	 (No.AF88-1358)	 (No.AF88-1359)	 (No.AF00-128)	 (No.AF00-127)	 (No.AF00-126)
Thermal overload relays				 (No.AF88-1383)			 (No.AF88-1379)			 (No.AF00-144)	 (No.AF00-143)
Contactors (Open type)	Type		SC-03	SC-0	SC-05	SC-4-0	SC-4-1	SC-5-1	SC-N1	SC-N2	SC-N2S
	Ordering code ❶		SC11AA-■	SC13AA-■	SC14AA-■	SC18AA-■	SC19AA-■	SC20AA-■	SC25BAA-■	SC35BAA-■	SC50BAA-■
Starters (Open type)	Type		SW-03/3H	SW-0/3H	SW-05/3H	SW-4-0/3H	SW-4-1/3H	SW-5-1/3H	SW-N1/3H	SW-N2/3H	SW-N2S/3H
	Ordering code ❶		SC11AAN-■△◇	SC13AAN-■△◇	SC14AAN-■△◇	SC18AAN-■△◇	SC19AAN-■△◇	SC20AAN-■△◇	SC25BAAN-■△◇	SC35BAAN-■△◇	SC50BAAN-■△◇
Auxiliary contact arrangement			1NO,1NC	1NO,1NC	1NO+1NC	1NO,1NC	1NO,1NC	1NO+1NC	2NO+2NC	2NO+2NC	2NO+2NC
Thermal overload relays	TR series		TR-0N/3			TR-5-1N/3			TR-N2/3		TR-N3/3
	Ordering code ❶		TR13DW-◆			TR20DW-◆			TR35BDW-◆		TR65BDW-◆
	TK series		TK-0N			TK-5-1N			TK-N2		TK-N3
	Ordering code ❶		TR13EW-◆			TR20EW-◆			TR35BEW-◆		TR65BEW-◆
Max. motor capacity (kW) (AC-3) IEC Operational current (A)	200-240V		2.5kW 11A	3.5kW 13A	3.5kW 13A	4.5kW 18A	5.5kW 22A	5.5kW 22A	7.5kW 32A	11kW 40A	15kW 50A
	380-440V		4kW 9A	5.5kW 12A	5.5kW 12A	7.5kW 16A	11kW 22A	11kW 22A	15kW 32A	18.5kW 40A	22kW 50A
	500-550V		4kW 7A	5.5kW 9A	5.5kW 9A	7.5kW 13A	11kW 17A	11kW 17A	15kW 24A	18.5kW 29A	25kW 38A
	600-690V		4kW 5A	5.5kW 7A	5.5kW 7A	7.5kW 9A	7.5kW 9A	7.5kW 9A	11kW 15A	15kW 19A	22kW 26A
Thermal current			20A	20A	20A	25A	32A	32A	50A	60A	80A
Life expectancy (operations)	Mechanical		10 million	10 million	10 million	10 million	10 million	10 million	10 million	10 million	5 million
	Electrical	200V	2 million	2 million	2 million	1.5 million	1.5 million	1.5 million	1.5 million	1.5 million	1.5 million
		400V	1.75 million	1.5 million	1.5 million	1 million	1 million	1 million	1.5 million	1.5 million	1.5 million
Dimension (mm)	Contactors (Open type) ❷		43×80×80	43×80×80	53×80×80	53×80×81	53×80×81	64×80×81	74×87×96	74×87×96	88×110×111
	Starters (Open type) ❷		44×120×80	44×120×80	53×120×80	53×126×81	53×126×81	64×126×81	74×146×97	74×146×97	88×177×111
Thermal overload relays	Setting range (A) ❸		0.1 −0.15 [A] 0.13−0.2 [B] 0.15−0.24 [C] 0.2 −0.3 [D] 0.24−0.36 [E] 0.3 −0.45 [F] 0.36−0.54 [G] 0.48−0.72 [H] 0.64−0.96 [J] 0.8 −1.2 [K] 0.95−1.45 [L] 1.4 −2.2 [M] 1.7 −2.6 [N] 2.2 −3.4 [P] 2.8 −4.2 [R] 4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V]	0.1 −0.15 [A] 0.13−0.2 [B] 0.15−0.24 [C] 0.2 −0.3 [D] 0.24−0.36 [E] 0.3 −0.45 [F] 0.36−0.54 [G] 0.48−0.72 [H] 0.64−0.96 [J] 0.8 −1.2 [K] 0.95−1.45 [L] 1.4 −2.2 [M] 1.7 −2.6 [N] 2.2 −3.4 [P] 2.8 −4.2 [R] 4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W]	0.1 −0.15 [A] 0.13−0.2 [B] 0.15−0.24 [C] 0.2 −0.3 [D] 0.24−0.36 [E] 0.3 −0.45 [F] 0.36−0.54 [G] 0.48−0.72 [H] 0.64−0.96 [J] 0.8 −1.2 [K] 0.95−1.45 [L] 1.4 −2.2 [M] 1.7 −2.6 [N] 2.2 −3.4 [P] 2.8 −4.2 [R] 4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W]	0.1 −0.15 [A] 0.13−0.2 [B] 0.15−0.24 [C] 0.2 −0.3 [D] 0.24−0.36 [E] 0.3 −0.45 [F] 0.36−0.54 [G] 0.48−0.72 [H] 0.64−0.96 [J] 0.8 −1.2 [K] 0.95−1.45 [L] 1.4 −2.2 [M] 1.7 −2.6 [N] 2.2 −3.4 [P] 2.8 −4.2 [R] 4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W] 12 −18 [X]	0.1 −0.15 [A] 0.13−0.2 [B] 0.15−0.24 [C] 0.2 −0.3 [D] 0.24−0.36 [E] 0.3 −0.45 [F] 0.36−0.54 [G] 0.48−0.72 [H] 0.64−0.96 [J] 0.8 −1.2 [K] 0.95−1.45 [L] 1.4 −2.2 [M] 1.7 −2.6 [N] 2.2 −3.4 [P] 2.8 −4.2 [R] 4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W] 12 −18 [X] 16 −22 [Q]	0.1 −0.15 [A] 0.13−0.2 [B] 0.15−0.24 [C] 0.2 −0.3 [D] 0.24−0.36 [E] 0.3 −0.45 [F] 0.36−0.54 [G] 0.48−0.72 [H] 0.64−0.96 [J] 0.8 −1.2 [K] 0.95−1.45 [L] 1.4 −2.2 [M] 1.7 −2.6 [N] 2.2 −3.4 [P] 2.8 −4.2 [R] 4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W] 12 −18 [X] 16 −22 [Q]	4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W] 12 −18 [X] 18 −26 [B] 24 −36 [E]	4 −6 [S] 5 −8 [T] 6 −9 [U] 7 −11 [V] 9 −13 [W] 12 −18 [X] 18 −26 [B] 24 −36 [E] 32 −42 [I]	7 −11 [V] 9 −13 [W] 12 −18 [X] 18 −26 [B] 24 −36 [E] 28 −40 [F] 34 −50 [G] 45 −65 [J]
Approved standard											

❶ Ordering codes: ···□: Coil voltage, ■: Auxiliary contact arrengement, △: Thermal overload relay ampere setting range, ◇: No.of heater element and reset method, ◆: Thermal overload relay ampere setting range and reset method
❷ Dimension : width (W) x height (H) x depth (D) mm.
❸ [ ] : Ampere setting code
❹ Separate mounting only

NEW SC series

N3	N4	N5	N6	N7	N8	N10	N11	N12	N14	N16
 (No.AF00-133)	 (No.AF00-132)	 (No.AF00-131)	 (No.AF00-130)	 (No.AF00-129)	 (No.AF00-120)	 (No.AF00-119)	 (No.AF00-118)	 (No.AF00-117)	 (No.AF00-351)	 (No.AF00-352)
 (No.AF00-125)	 (No.AF00-124)	 (No.AF00-123)	 (No.AF00-122)	 (No.AF00-121)	 (No.AF00-116)	 (No.AF00-115)	 (No.AF00-114)	 (No.AF00-113)	 (No.AF00-350)	—
 (No.AF00-143)	 (No.AF98-142)		 (No.AF00-142)	 (No.AF00-140)	 (No.AF00-139)	 (No.AF00-138)	 (No.AF00-137)		 (No.AF98-333)	—
SC-N3	**SC-N4**	**SC-N5**	**SC-N6**	**SC-N7**	**SC-N8**	**SC-N10**	**SC-N11**	**SC-N12**	**SC-N14**	**SC-N16**
SC65BAA-◨	SC80BAA-◨	SC93BAA-◨	SC1CBAA-◨	SC1FBAA-◨	SC1JBAA-◨	SC2CBAA-◨	SC3ABAA-◨	SC4ABAA-◨	SC6ABAA-◨	SC8ABAA-◨
SW-N3/3H	**SW-N4/3H**	**SW-N5/3H**	**SW-N6/3H**	**SW-N7/3H**	**SW-N8/3H**	**SW-N10/3H**	**SW-N11/3H**	**SW-N12/3H**	**SW-N14/3H**	—
SC65BAAN-◨△◇	SC80BAAN-◨△◇	SC93BAAN-◨△◇	SC1CBAAN-◨△◇	SC1FBAAN-◨△◇	SC1JBAAN-◨△◇	SC2CBAAN-◨△◇	SC3ABAAN-◨△◇	SC4ABAAN-◨△◇	SC6ABAAN-◨△◇	—
2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC	2NO+2NC
TR-N3/3	**TR-N5/3**		**TR-N6/3**	**TR-N7/3**	**TR-N8/3**	**TR-N10/3**	**TR-N12/3**		**TR-N14/3**	—
TR65BDW-◆	TR93BDW-◆		TR1CBDW-◆	TR1FBDW-◆	TR1JBDW-◆	TR2CBDW-◆	TR4ABDW-◆		TR6ABDW-◆	—
TK-N3	**TK-N5**		**TK-N6**	**TK-N7**	**TK-N8**	**TK-N10**	**TK-N12**		**TK-N14**	—
TR65BEW-◆	TR93BEW-◆		TR1CBEW-◆	TR1FBNW-◆	TR1JBEW-◆	TR2CBEW-◆	TR4ABEW-◆		TR6ABEW-◆	—
18.5kW	22kW	30kW	37kW	45kW	55kW	65kW	90kW	120kW	160kW	220kW
65A	80A	105A	125A	150A	180A	220A	300A	400A	600A	800A
30kW	40kW	55kW	60kW	75kW	90kW	110kW	160kW	220kW	315kW	440kW
65A	80A	105A	125A	150A	180A	220A	300A	400A	600A	800A
37kW	37kW	55kW	60kW	75kW	130kW	132kW	160kW	250kW	400kW	500kW
60A	60A	85A	90A	120A	180A	200A	230A	360A	600A	720A
30kW	37kW	55kW	60kW	90kW	132kW	132kW	200kW	300kW	480kW	500kW
38A	44A	64A	72A	103A	150A	150A	230A	360A	600A	630A
100A	135A	150A	150A	200A	260A	260A	350A	450A	660A	800A
5 million	5 million	5 million	5 million	5 million	5 million	5 million	5 million	5 million	5 million	2.5 million
1.5 million	1 million	1 million	1 million	1 million	1 million	1 million	1 million	500,000	500,000	250,000
1.5 million	1 million	1 million	1 million	1 million	1 million	1 million	1 million	500,000	500,000	250,000
88×110×111	88×127×117	88×127×132	100×144×138	115×156×140	138×209×174	138×209×174	148×240×195	148×240×195	290×332×327	290×332×327
88×177×111	88×189×117	88×189×132	100×225×138	115×237×140	138×305×174	138×287×174	148×360×195	148×360×195	290×463×327	—
7 −11 [V] 9 −13 [W] 12 −18 [X] 18 −26 [B] 24 −36 [E] 28 −40 [F] 34 −50 [G] 45 −65 [J] 48 −68 [O]❶ 53 −80 [L]❶ 65 −95 [M]❶ 85 −105 [I]❶	18−26 [B] 24−36 [E] 28−40 [F] 34−50 [G] 45−65 [J] 53−80 [L]	18−26 [B] 24−36 [E] 28−40 [F] 34−50 [G] 45−65 [J] 53−80 [L] 65−95 [M] 85−105 [I]	45−65 [J] 53−80 [L] 65−95 [M] 85−125 [N] 110−160 [P]❶	45 −65 [J] 53 −80 [L] 65 −95 [M] 85 −125 [N] 110−160 [P]	65 −95 [M] 85 −125 [N] 110−160 [P] 125−185 [R]	85 −125 [N] 110−160 [P] 125−185 [R] 160−240 [S]	110−160 [P] 125−185 [R] 160−240 [S] 200−300 [T]	160−240 [S] 200−300 [T] 240−360 [U] 300−450 [V]	240−360 [U] 300−450 [V] 400−600 [W]	—

SC, NEW SC Series Optional unit

Various optional units		Auxiliary contact blocks				Operation counter unit	
Type		SZ-A□, A□H		SZ-AS1, AS1H, AS2, AS2H	SZ-A3H	SZ-J, J□	
Ordering code		SZ1A□, A□H		SZ-AS1, AS1H, SZ2AS2, AS2H	SZ2AS3H	SZ1J, J□	
Mountings		Front mounting		Side mounting		Front mounting	
Description		· 4-pole (4NO, 3NO+1NC, 2NO+2NC) ·Bifurcated contact ·Terminal number conforms to IEC standard ·With overlap contact is also available	· 2-pole (2NO, 1NO+1NC, 2NC) ·Bifurcated contact ·Terminal number conforms to IEC standard ·With overlap contact is also available	· 2-pole (1NO+1NC) ·Bifurcated contact ·Terminal number conforms to IEC standard	· 2-pole (1NO+1NC) ·Bifurcated contact	·Mechanical type counter ·Without output contact and with output contact 1NO ·Number of digits : 7 digits ·Counting speed : Max 10cps	
Outside appearance		 (No.AF99-51)	 (No.AF99-51)	 (No.AF00-258)		 (No.AF99-170)	
Approved standard						—	
Dimension (W) × (H) × (D) (mm)		43×47.5×32	24×47.5×32	12×59.5×45	15.5×92×72	43×38.5×45 (SZ-J)	
Mass (g)		36	20	30	75	35 (SZ-J)	
Contactors and Starters	SC (SC-03 to 5-1)	○	○	○	—	○	
	NEW SC (SC-N1 to N16)	○ (N1 to N3)	○ (N1 to N3)	○ (N1 to N12)	○ (N14, N16)	○ (N1 to N3) (SZ-J)	
Auxiliary relays	SC (SH-4, 5)	○	○	○	—	○	
Thermal overload relays	SC (TR-0N, 5-1N)	—	—	—	—	—	
	NEW SC (TR-N2~N14)	—	—	—	—	—	

Various optional units		Coil surge suppression unit		Contact welding detector	Abnormality detector unit	Prevention of transition phenomenon unit	
Type		SZ-Z□		SZ-BW2□	SY-F-□/M	SZ-RC□	
Ordering code		SZ1Z□, SZ2Z□		SZ1BW2□	SY2F0-□M	SZ1RC□	
Mounting		Front mounting		Used with	Used with	Used with	
Description		·Varistor type surge suppression unit ·LED operating indicator is also available	·CR type surge suppression unit ·LED operating indicator is also available	· When welding of a main contact occurs a trip signal is sent to the line-side breaker · Power supply : 100-250V AC	·Abnormality of line voltage on load side of electromagnetic motor starter is detected and relay output is made.	·Prevention of transition phenomenon of contact of electromagnetic motor starter due to fixing of opening/closing phase of AC load.	
Outside appearance		 (No.AF88-985)	 (No.AF99-219)	 (No.AF91-626)	 (No.AF91-904)	 (No.AF93-208)	
Approved standard				—	—	—	
Dimension (W) × (H) × (D) (mm)		26×37×14 (SZ-Z1)	36.5×40×13.5 (SZ-Z35)	25×98×68	25×98×68	25×98×68	
Mass (g)		14 (SZ-Z1)	14 (SZ-Z35)	120	120		
Contactors and Starters	SC (SC-03 to 5-1)	○	○	○	○	○	
	NEW SC (SC-N1 to N16)	○ (N1 to N4)	○ (N1 to N4)	○	○	○	
Auxiliary relays	SC (SH-4, 5)	○	○	○	○	○	
Thermal overload relays	SC (TR-0N, 5-1N)	—	—	—	—	—	
	NEW SC (TR-N2 to N14)	—	—	—	—	—	

	Main circuit surge suppression unit		Mechanical interlock unit	Power connection kit for reversing	Parallel plate terminals for attaching to contactor	Coil drive unit for IC output	
	SZ-ZM□		SZ-RM	SZ-RW□	SZ-SP□	SZ-CD□, 03/CD2-24	SZ-CD□
	SZ1ZM□, SZ2ZM□		SZ1RM	SZ1RW□, SZ2RW□	SZ1SP□, SZ2SP□	SZ1CD□, 03CD224, SZ2CD□	SZ2CD□
	Front mounting	Side mounting	Side mounting	Main terminals	Main terminals	Top mounting unit	Side mounting ／Used with
	・Consists of delta connected capacitor (C) and resister (R) ・Voltage : 250V AC 50/60Hz ・Motor capacity : 200V AC 0.1 to 3.7kW	・Consists of delta connected capacitor (C) and resister (R) ・Voltage : 250V AC 50/60Hz ・Motor capacity : 200V AC 0.1 to 3.7kW	・This unit is used to interlock two contactors for reversing	・This unit is used to connect two contactors main terminals for reversing ・ULNo.1015 AWG14(φ1.6)	・This kit modifies a 3-pole contactor to a single-pole contactor for resistive load	・This unit controls ON-OFF operation for contactor by the DC output of electric equipment ・Power consumption of 24V DC 8.3mA ・With relay output With SSR output	・This unit controls ON-OFF operation for contactor by the DC output of electric equipment ・Power consumption of 24V DC 8.3mA ・With relay output With SSR output ・Side mounting ／Used with : (N4 to N12) ・Only used with : (N1 to N3)
	 (No.AF88-763)	 (No.AF88-764)	 (No.AF99-47)	 (No.AF88-509)	 (No.AF99-173)	 (No.AF00-253)	
				—	—	—	—
	43X38.5X45	22X39X60	25X36X47	—	—	32X29X46 (SZ-CD1)	17.1X75X60.2
	60	60	22			26 (SZ-CD1)	45
	○	○	○	○	○	○	—
	○ (N1, N2)	○ (N1, N2)	○ (N1 to N3)	○ (N1 to N3)	○	○ (N1 to N3)	○ (N1 to N12)
	—	—	—	—	—	○	—
	—	—	—	—	—	—	—
	—	—	—	—	—	—	—

	Base unit for separate mounting	Thermal overload relay Trip indicator	Reset release button	Dial cover	Terminal cover		Insulation-barrier	Live section cover	Off-delay release unit
	SZ-H□	SZ-L□	SZ-R□	SZ-DA	SZ-T□	SZ-□T	SZ-B□	SZ-□J	SZ-DE□, □DE
	TZ1H□, TZ2H□	TZ1L□, TZ2L□	TZ1R□, TZ2R□	SZ1DA	SZ1T□, SZ2T□, TZ1□	SZ2□T	SZ2B□	SZ1□J, SZ2□J	SZ1DE□, SZ2□DE
	Thermal overload relay	Thermal overload relay	Thermal overload relay	Thermal overload relay	Contactors, starters and Auxiliary relay Thermal overload relay	Contactors and starters Thermal overload relay	Contactors and starters	Contactors and starters	Used with
	・This unit is used when OLR is required to be mounted independently	・This unit indicates OLR tripping status ・100V AC 200V AC	・This unit is used to reset the OLR remotely ・Lead length : 300mm 500mm 700mm	・For protection against the current setting being changed in error	・These covers conform to IEC60529 DIN57106/ VDE0106 Teil 100	・Magnetic contactors and starters ・IEC60529 DIN57106/ VDE0106 Teil 100	・Prevents a short circuit	・This cover prevents exposure of the live section for increased safety	・This unit prevents circuit opening due to a instantaneous voltage drop
	 (No.AF00-159)	 (No.AF00-291)	 (No.AF00-332)	 (No.AF88-1056)	 (No.AF99-50)	 (No.AF99-164, 163)	 (No.AF99-53)	 (No.AF00-286)	 (No.AF89-76)
		—					—	—	—
	44X72X83 (SZ-HD)	11X26X11 (SZ-L200)							81X122X166 (SZ-DE100)
	40 (SZ-HD)	20 (SZ-L200)							850 (SZ-DE100)
	—	—	—	—	○	—	—	○	○
	—	—	—	—	○ (N1 to N3)	○ (N4 to N12)	○ (N4 to N12)	○ (N1 to N12)	○ (N1 to N14)
	—	—	—	—	○	—	—	○	○
	○	○	○	○	○	—	—	—	—
	○ (N2, N3)	○	○	○ (N2 to N12)	○ (N2, N3)	—	○ (N6 to N12)	—	—

Type number nomenclature

● Contactor and motor starter

SW — N10 [ ] RM C / [ ] [ ] [ ]

Basic type	
SC	Contactor
SW	Motor starter

Frame size
03 to N16

Auxiliary contact		
Blank	Bifurcated contact (Standard)	03 to N12
	Single button contact	N14, N16
H	Single button contact	03 to N12

Non-reversing or reversing		
Blank	Non-reversing	03 to N16
RM	Reversing	03 to N14

Enclosure		
Blank	Open	03 to N16
C	Enclosed	03 to N14
LG	Enclosed, dust-tight and light corrosion resistant	03 to N10

Terminal cover		
Blank	Without terminal cover	03 to N16
T	With terminal cover	03 to N3

Thermal overload relay		
Blank	Standard, 2-element	03 to N14
3H	Standard, 3-element	03 to N14
2L	For starting heavy duty, 2-element	03 to N14
3L	For starting heavy duty, 3-element	03 to N14
3Q	Quick operating	03 to N5
2E	With open-phase protective device	03 to N14

Operating method		
Blank	AC operated	03 to N4
	AC/DC operated	N5 to N16
G	DC operated	03 to N3
SE	AC/DC operated	N1 to N4
V	Mechanical latch, AC operated	03 to 5-1
VG	Mechanical latch, DC operated	03 to 5-1
VS	Mechanical latch, AC/DC operated	N1 to N14
U	With extra pick-up operation coil	03 to N4

● Thermal overload relay

TR — N2 [ ] H / 3 A

Basic type	
TR	Standard type
TK	With open-phase protective device

Frame size
0N to N14

Operation		
Blank	Standard operation	0N to N14
L	Long time operation	0N to N14
Q	Quick operation	0N to N5

Reset	
Blank	Manual reset
A	Auto reset

No. of heater elements		
Blank	2-element	TR
	3-element	TR-Q
		TK
3	3-element	TR

Mounting		
Blank	On-contactor mounting	0N to N14
H	Separate mounting	0N to N14

Ordering information

●Contactor (Open)

SC-N1 AC200V 2a2b

- SC-N1 — ① Type
- AC200V — ④ Operational coil voltage
- 2a2b — ⑤ Auxiliary contact arrangement

●Motor starter (Open)

SW-N1 Main circuit AC200V 18A AC200V 2a2b

- SW-N1 — ① Type
- Main circuit AC200V — ② Operational main circuit voltage
- 18A — ③ Thermal overload relay ampere setting range
- AC200V — ④ Operational coil voltage
- 2a2b — ⑤ Auxiliary contact arrangement

Coil voltage

● Frame size 03 to N4 (AC Operated)

Type	Order voltage (V)	Order voltage code	Coil operating voltage and frequency AC	Identification by coil color
SC-03	AC 24	E	24V 50Hz / 24-26V 60Hz	White
SC-0	AC 48	F	48V 50Hz / 48-52V 60Hz	White
SC-05	AC100	1	100V 50Hz / 100-110V 60Hz	Green
SC-4-0	AC110	H	100-110V 50Hz / 110-120V 60Hz	White
SC-4-1	AC120	K	110-120V 50Hz / 120-130V 60Hz	White
SC-5-1	AC200	2	200V 50Hz / 200-220V 60Hz	Yellow
SC-N1	AC220	M	200-220V 50Hz / 220-240V 60Hz	White
SC-N2	AC240	P	220-240V 50Hz / 240-260V 60Hz	White
SC-N2S	AC380	S	346-380V 50Hz / 380-420V 60Hz	White
SC-N3	AC400	4	380-400V 50Hz / 400-440V 60Hz	Purple
SC-N4	AC440	T	415-440V 50Hz / 440-480V 60Hz	White
	AC500	5	480-500V 50Hz / 500-550V 60Hz	White

Note: · Other voltages are available in 24 to 600v ranges upon request.
· Use the coil order voltage, not specifying your actual voltage when ordering. Contactors with a coil voltage range which corresponds to an order voltage you specified, will be shipped from factory
The above coil operating voltage and frequency (not order voltage) are shown on the products.

● Frame size SC-N5 to N16, SC-N1/SE to N4/SE (AC/DC Operated)

Type	Order voltage (V)	Order voltage code	Coil operating voltage and frequency AC	DC	Identification by coil color
SC-N5, SC-N14	24 ❶	E	24-25V 50/60Hz	24V	White
SC-N6, SC-N16	48 ❶	F	48-50V 50/60Hz	48V	White
SC-N7, SC-N1/SE	100	1	100-127V 50/60Hz	100-120V	Green
SC-N8, SC-N2/SE	200	2	200-250V 50/60Hz	200-240V	Yellow
SC-N10, SC-N2S/SE	300	3	265-347V 50/60Hz	—	White
SC-N11, SC-N3/SE	400	4	380-450V 50/60Hz	—	Purple
SC-N12, SC-N4/SE	500	5	460-575V 50/60Hz	—	White

Note: · The coil are AC/DC common use (rated voltage 200v or less)
· The above coil operating voltages and frequencies (not voltage code) are shown on the products.
❶ Frame sizes N14 to N16 are not available.

● Frame size SC-03/G to N3/G (DC Operated)

Type	Order voltage (V)	Order voltage code	Coil operating voltage DC	Identification by coil color
SC-03/G	DC12	B	12V	White
SC-0/G	DC24	E	24V	
SC-05/G	DC48	F	48V	
SC-4-0/G	DC60	G	60V	
SC-4-1/G	DC100	1	100V	
SC-5-1/G	DC110	H	110V	
SC-N1/G	DC120	K	120V	
SC-N2/G	DC200	2	200V	
SC-N2S/G	DC210	Y	210V	
SC-N3/G	DC220	M	220V	

Note: · Other voltages are available in 24 to 600v ranges upon request.

⚠ Safety Considerations

- For safe operation, before using the product read the instruction manual or that comes with the product carefully or consult the Fuji sales representative from which you purchased the product.
- Some of the products listed in this catalog may have limits on their use or location or may require periodic inspections. Call Fuji's sales representative for further information.
- For safe operation, wiring should be conducted only by qualified engineers who have sufficient technical knowledge about electrical work or wiring.

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Reliable and High Performance Power Capacitors



Reliable and high-quality power capacitors

Product quality is essential for a long operating life and maximum use. This is especially true for power capacitors. They combine both high loading capacity and high levels of safety on overload or possible failure. Today's needs to withstand the harmonics of our power network system make these characteristics indispensable in meeting the increasing demands of the future.

Power capacitors are, thus, highly efficient components providing 15 kvar of reactive power within 1 litre volume due to their very low dissipation factor: $2*10^{-4}$ in the capacitor coil and less than $5*10^{-4}$ at the terminals. This also applies to the efficiency of dielectric used with test field strengths of up to 200 V/µ = 200.000 V per mm! If a long operating life is to be guaranteed, then, partial discharges - which are very low electrical discharges within the dielectric - must be suppressed despite the high load capacity of the dielectric. This is done using state-of-the-art technology for the manufacture of FRAKO capacitors as well as using non-toxic and environmentally sound materials.

The FRAKO LKI capacitor, for instance, contains an impregnation agent with an exceptionally high flash point of more than 250°C. When compared with other impregnation agents, e.g. those in older power capacitors containing a mineral oil with a flash point of roughly 130 °C, this impregnation agent can be considered non-inflammable.

The dry FRAKO LKT power capacitor has no liquid filling, resin, gel or jelly-like compound nor gas filling of SF6 or other similar materials, but has a flame retardant filler with a mineral-based stabiliser.

Field-tried-and-tested operating life

Tests are described in the VDE and IEC regulations that are often used to specify the operating life expectancy. For example, with VDE 0560 Part 8, the expected operating life is calculated from the length of the test multiplied by $(U_{test}/U_N)^7$. This coefficient $(U_{test}/U_N)^7$ was first used with old paper capacitors which had dissipation factors of approximately 0.5%. For modern MKP capacitors, with a dissipation of ten times lesser, this is no longer justified. Furthermore only 3% of the samples were permitted to fail the tests.

Such a test may be adequate for defining general quality of capacitors. However, it does not give any information about the operating life expectancy of a power capacitor. For this reason, FRAKO does not support these tests for defining the expected operating life but instead is concerned with the actual characteristics of capacitors in the field.

type	Failure rate (ppm)	Failure quota* (% / 1000 h)	MTBF (h)
LKI 1991	200	0,00912	10.967.593
LKI 1992	300	0,01369	7.304.471
LKI 1993	87	0,00397	25.199.600
LKI 1994	358	0,01635	6.114.480
LKI 1995	256	0,01169	8.557.955
LKI 1996	185	0,00843	11.858.452
LKI 1997	41	0,00188	53.204.590
total	200	0,00229	43.738.030

* at 4380 operating hours per year

The FRAKO LKI power capacitors produced between 1983 and 1985 have shown no increase in failure rate up to now, 13 to 15 years later, and thus are far from the end of their expected operating life. Meantime, the fourth generation of LKI capacitors has now been produced - with a significant increase in load capacity when compared with the first generation in 1983. Our FRAKO Quality Management Department is collecting and analysing all failed components which have been returned or else reported in the field. All the results since 1991 (when this documentation first began) to the present have shown a failure rate of only 200 ppm (parts per million). Assuming that 1/3 of all failures have been reported to FRAKO, these power capacitors show **a failure rate of just 1% in 15 years**.

Safety first

Even with the highest quality and expected service life, individual capacitors are still capable of failing. These should, however, not affect the environment - by exploding, burning or giving off flammable gases, regardless as to whether the capacitor has been in operation for many years and the guarantee is no longer valid.

Right from the start, construction and internal capacitor design must take into account any possible failure. Therefore FRAKO power capacitors have two integrated safety features: Self-healing metallization and an internal overpressure disconnector.

FRAKO power capacitors are metallized with a self-healing property so that no failure occurs due to transient surges. Any breakdown in the dielectric is isolated by this self-healing characteristic. The resulting loss in capacity with a self-healing breakdown is only about one ten-millionth (10^{-7}) of the nominal rating.

FRAKO power capacitors are equipped with an internal overpressure disconnector which is well established and has been available for more than 15 years. FRAKO overpressure disconnectors are continuously being improved upon so that they isolate the power network with maximum reliability.

FRAKO capacitors are, therefore, not filled with gas as the necessary pressures to activate the disconnector will only be built up once there is advanced damage to the dielectric. Consequently, FRAKO does not produce capacitors filled with gel or jelly-type filling as any gas produced due to damage in the lower part of the capacitor would not activate the overpressure switch.

The most costly, but effective, overpressure disconnector device is the diaphragm cover. An aluminium can and the cover are rolled and then secured together using an elastic sealant. The rate of return for leaking power capacitors has been negligible over the years.

The diaphragm cover keeps the connecting terminal fixed during normal operation. The cover curves outwards with a displacement of approx. 10 mm when the pressure builds up inside the capacitor. In most cases, the connecting wires are disconnected with a displacement of just 5 mm and isolated from the network. The reliability of this function during production is monitored in type tests and also regular random sampling tests. These test procedures conform to EN 60831 and IEC 831. The capacitors, therefore, provide the highest possible level of safety on overload right to the end of their operating life (Fig. 1).

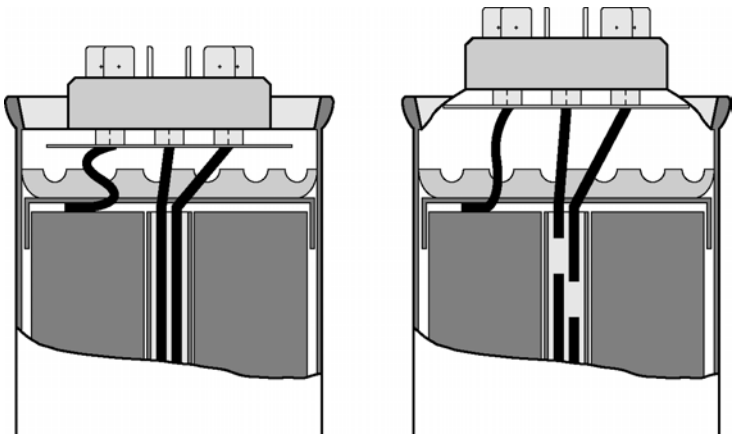


Fig. 1 FRAKO overpressure disconnector

Load capacity is a feature of quality...

Resonances with overvoltages and very high RMS currents can be expected with harmonic loads in the mains network. If, for example, approx. 8% of the 11th harmonic occur, then the effective value of the RMS voltage is about 0,3% higher but the capacitor current is 1.33 times of the capacitor current rating (Fig. 2). Thus a higher current load capacity is much more important than

the voltage load capacity. Consequently, with 400 V power networks, power capacitors with a nominal voltage of at least 440 V are used by FRAKO. But their current load limit is

- **at least 2.0 times the nominal current at 400 V continuous load and**
- **at least 300 times the nominal current for transient current peaks.**

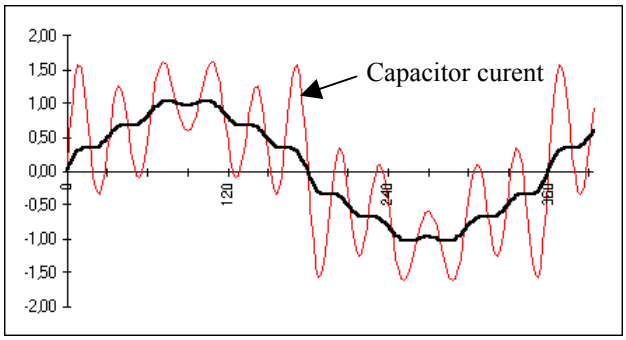


Fig. 2: Voltage and capacitor current with high harmonic content.

....just as a highly rated acceptable case temperature.

It is generally true, that power capacitors have a higher service life when operating at lower temperatures. Chemical changes in the dielectric as well as corrosion proceed only half as fast at about 10 °C lower temperatures (Fig. 3)

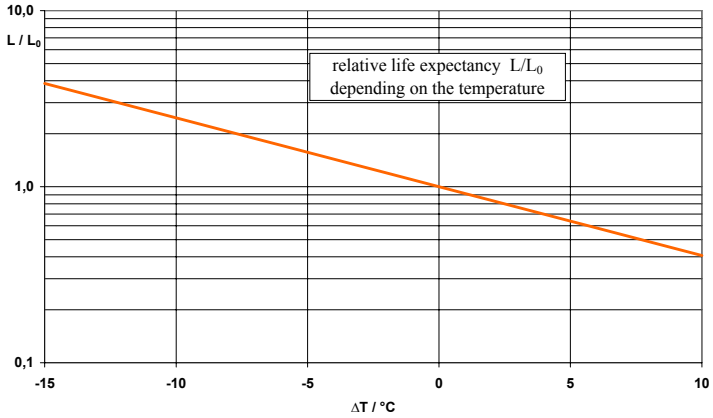


Fig. 3: Life expectancy depending on temperature.

FRAKO power capacitors have low intrinsic warming. The case temperature is mostly affected by the ambient temperature as well as by the heat of other components with high levels of heat dissipation (harmonic filter chokes, fuses, etc.). Especially harmonic filter chokes should always be installed in such a way to ensure that their heat does not significantly affect the power capacitors. This is always taken into account with FRAKO Power Factor Correction Systems.

FRAKO power capacitors are specified to withstand **case temperatures of up to 75 °C**. Therefore FRAKO Power Factor Correction Systems are so designed, that with natural cooling in the control cabinet a maximum permissible ambient temperature of 60 °C is provided.

Measurable quality

Load capacity and quality are measurable variables which can be validated:

- by trained production personnel who are totally familiar with working procedures,
- by monitoring consistent sample testing during the production phase (capacitor coils are checked on a daily basis to see if the sample withstands a current surge of 500 times nominal current),

- by regular and repeated checks to indicate approximately what the capacitor actually withstands, e.g. a current load test with 2.5 nominal current, a voltage test at 600V to 700V for at least 1000 h at capacitors with 440 V nominal voltage,
- or by 100% final testing which goes far beyond what is specified in the EN 60831 or IEC 831 standards.
- The dissipation factor of the polypropylene dielectric of the MKP capacitors is about $2*10^{-4}$ or 0.2W/kVAr. The metallization, contacts and current paths in the capacitor increase the dissipation factor - measured at the capacitor connection terminal - to a maximum $5*10^{-4}$ or 0.5W/kVAr (Fig. 4). With routine check testing, the dissipation factor is monitored at a measuring frequency of 1 kHz. This value represents the ohmic resistors in the capacitor which, for a maximum effective current load, is as low as possible.

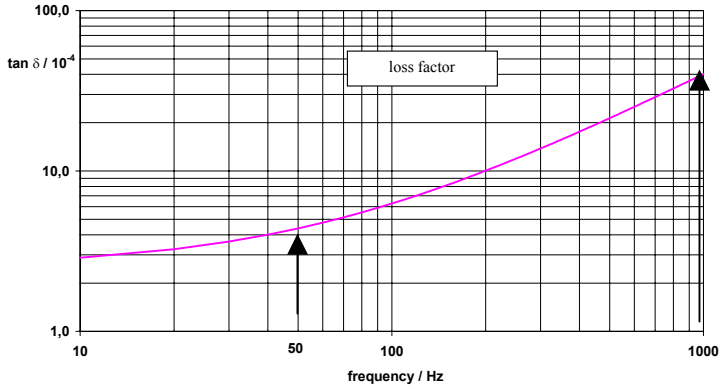


Fig. 4 Loss factor depending on frequency

In its quality policy FRAKO always **focus on the value of the complete Power Factor Correction System** and not just on the value of the Power Capacitors alone. The FRAKO LKI and LKT type capacitors are used in FRAKO's own Power Factor Correction Systems. This ensures users of FRAKO LKI and LKT that they have chosen capacitors with an extremely long operating life while being operationally safe and able to withstand high overloads.

FRAKO power capacitors:

	Power at 400 V	Nominal voltage of capacitor	Capacitor current at 400V / 50 Hz	Permissible continuous current		Permissible peak current	
	Q_{400} / kVAr	U_N / V	I_N / A	I_{max} / A	I_{max} / I_N	I_S / A	I_S / I_N
LKI 7.6-440-D50	6.25	440	9.0	18.0	2.0	2,990	331
LKI 9.1-440-D50	7.5	440	10.9	21.5	2.0	3,580	330
LKI 12.1-440-D52	10.0	440	14.4	28.5	2.0	4,760	330
LKI 15.1-440-D52	12.5	440	18.0	35.5	2.0	5,940	330
LKT 13.8-470-D52	10.0	470	14.4	28.5	2.0	4,760	330
LKT 17.3-470-D52	12.5	470	18.0	35.5	2.0	5,940	330
LKI 4,3-525-D50	2.5	525	3.6	8.8	2.4	1,420	394
LKI 8,6-525-D50	5.0	525	7.2	18.0	2.5	2,840	394

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ESP M2/M4 Series



LPZ $0_A \rightarrow 3$

FULL MODE Bonding + Equipment Protection

MAINS TEST TYPE 1 + 2 + 3

e ENHANCED Low let-through voltage

ACTIVE VOLT-FREE CONTACT

3-WAY + N-E FAULT STATUS INDICATION

Combined Type 1, 2 and 3 tested protector (to BS EN 61643-11) for use on the main distribution board directly feeding electronic equipment such as computers, communication and control equipment, particularly where a structural Lightning Protection System (LPS) is employed. For use at boundaries up to LPZ 0_A to protect against flashover (typically the main distribution board location) through to LPZ 3 to protect sensitive electronic equipment.

Features and benefits

- ✔ Very low let-through voltage between all sets of conductors (phase to neutral, phase to earth and neutral to earth)
- ✔ Full mode design capable of handling high energy partial lightning currents as well as allowing continual operation of protected equipment
- ✔ Innovative multiple thermal disconnect technology, for safe disconnection from faulty or abnormal supplies (without compromising protective performance)
- ✔ Three way visual indication of protection status
- ✔ Advanced pre-failure warning so you need never be unprotected
- ✔ Remote indication facility allows pre-failure warning to be linked to a building management system, buzzer or light
- ✔ Changeover active volt free contact enables the protector to be used to warn of phase loss (i.e. power failure, blown fuses, etc)
- ✔ Unique flashing warning of potentially fatal neutral to earth supply faults (caused by incorrect earthing, wiring errors or unbalanced conditions)
- ✔ Robust steel housing
- ✔ Protector base provides ultra low inductance earth bond to metal panels
- ✔ Convenient holes for flat mounting

For main distribution boards with multiple metallic services (gas, water, telecom/data lines) entering and for sub-distribution boards, the ESP M1 Series are more suited. If your supply is fused at 16 amps, or less, the in-line protection (ESP 240 (or 120-5A (or -16A) and ready-boxed derivatives) may be suitable. If you need to mount the the display panel separately from the main protector unit, use the ESP XXX M2R or ESP XXX M4R.

Application

Use ESP M2 versions on main distribution panel for buildings with a Class III or IV structural LPS fitted or exposed 3 phase power lines where no LPS is fitted. Use ESP M4 versions on main distribution panel for buildings with a Class I or II LPS fitted.

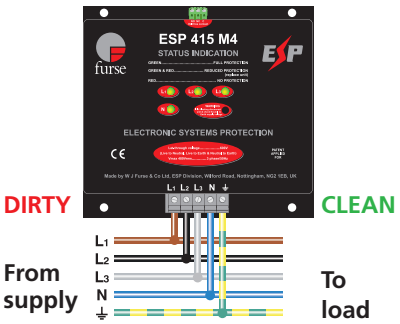
Installation

Install in parallel, within the power distribution board, either on the load side of the incoming isolator, or on the closest outgoing way to the incoming supply.



Live connecting leads should be fused accordingly

Connect, with very short connecting leads, to phase(s), neutral and earth. Phase/live connecting leads should be fused with high rupture capacity (HRC) fuses, a switchfuse, MCCB or type 'C' MCB.



Parallel connection to three phase star (4 wire and earth) supplies (fuses not shown for clarity)

Accessories

Weatherproof enclosures

WBX M2
For use with the ESP XXX M2

WBX M4
For use with the ESP XXX M4

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Electrical specification	IMPROVED ESP 415 M2	IMPROVED ESP 415 M4	NEW ESP 480 M2	NEW ESP 480 M4
Nominal voltage - Phase-Neutral *Uo* (RMS)	240V	240V	277V	277V
Maximum voltage - Phase-Neutral *Uc* (RMS)	280V	280V	350V	350V
Temporary Overvoltage TOV *Ut*[1]	350V	350V	405V	405V
Short circuit withstand capability	25kA, 50Hz			
Working voltage (RMS)	346-484V	346-484V	402-600V	402-600V
Frequency range	47-63Hz			
Max. back-up fuse (see installation instructions)	200A	315A	200A	315A
Leakage current (to earth)	<500µA	<1000µA	<500µA	<1000µA
Indicator circuit current	<20mA	<40mA	<20mA	<40mA
Volt free contact[2] **– current rating** **– nominal voltage** (RMS)	Screw terminal 1A 250V			

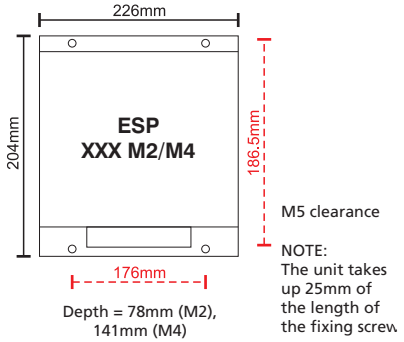
[1] Temporary Overvoltage rating is for a maximum duration of 5 seconds tested to BS EN/EN/IEC 61643.
[2] Minimum permissable load is 5V DC, 10mA to ensure reliable operation.

Transient specification ***Type 1 (BS EN/EN), Class I (IEC)***	ESP 415 M2	ESP 415 M4	ESP 480 M2	ESP 480 M4
Nominal discharge current 8/20µs (per mode) *In*	40kA	80kA	40kA	80kA
Let-through voltage *Up* at *In*[1]	900V	900V	1kV	1kV
Impulse discharge current 10/350µs *Iimp* (per mode)[2]	8kA	16kA	8kA	16kA
Let-through voltage *Up* at *Iimp*[1]	750V	750V	850V	850V
Impulse discharge current (per phase) *Iimp*[3]	12.5kA	25kA	12.5kA	25kA
Type 2 (BS EN/EN), Class II (IEC)				
Nominal discharge current 8/20µs (per mode) *In*	40kA	80kA	40kA	80kA
Let-through voltage *Up* at *In*[1]	900V	900V	1kV	1kV
Maximum discharge current *Imax* (per mode)[2]	80kA	160kA	80kA	160kA
Maximum discharge current *Imax* (per phase)	160kA	320kA	160kA	320kA
Type 3 (BS EN/EN), Class III (IEC)				
Let-through voltage *Up* at *Uoc*[1] of 6kV 1.2/50µs and *Isc* of 3kA 8/20µs (per mode)[4]	590V	570V	670V	650V

[1] The maximum transient voltage let-through of the protector throughout the test (±5%), phase to neutral, phase to earth and neutral to earth.
[2] The electrical system, external to the unit, may constrain the actual current rating achieved in a particular installation.
[3] Rating is considered as the current capability of the protector for equipotential bonding near the service entrance.
[4] Combination wave test within BS 6651:1999 App. C, Cats C-Low & B-High, IEEE C62.41-2002 Location Cats C1 & B3, SS CP 33:1996 App. F, AS 1768-1991 App. B, Cat B, UL1449 mains wire-in.

Mechanical specification	ESP 415 M2	ESP 415 M4	ESP 480 M2	ESP 480 M4
Temperature range	–40 to +70°C			
Connection type	Screw terminal			
Conductor size (stranded)	25mm²	50mm²	25mm²	50mm²
Earth connection	Screw terminal			
Volt free contact	Connect via screw terminal with conductor up to 2.5mm² (stranded)			
Degree of protection (IEC 60529)	IP20			
Case material	Steel			
Weight – unit	2.35kg	3.9kg	2.35kg	3.9kg
– packaged	2.5kg	4.2kg	2.5kg	4.2kg

Dimensions



TSC-0808 Web updated 31.01.11

ANDRASS

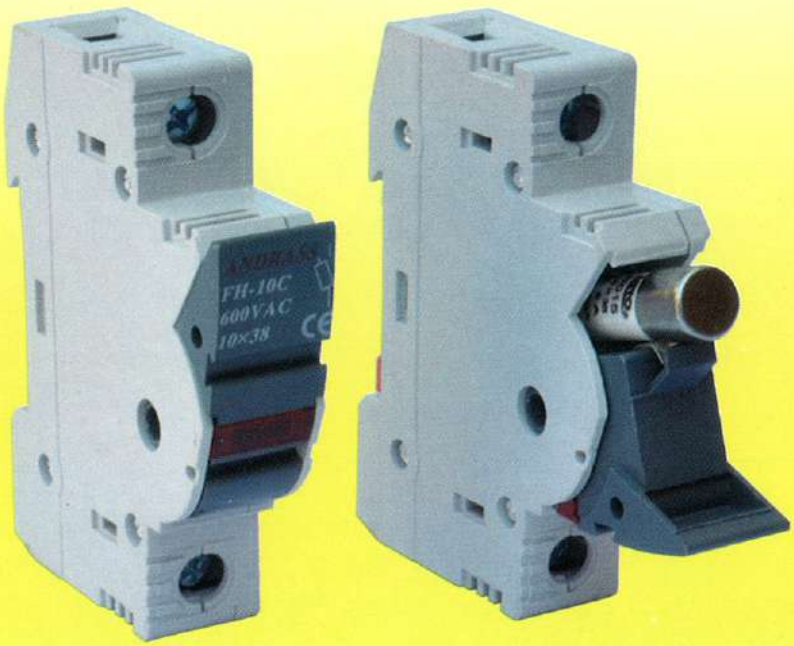
FUSE HOLDER FH-10C

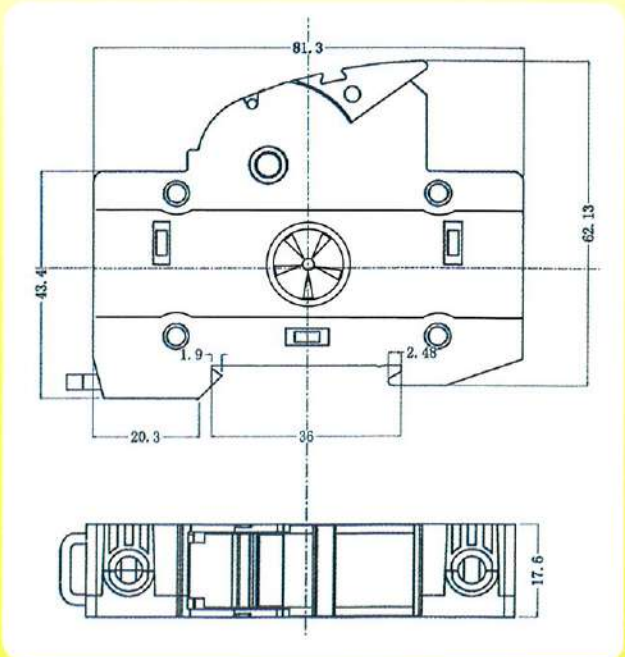
Applications

The fuse holder, is supported with fuse of 10x38mm and capable of working under heat caused by rated current, short impact current up to 100KA, it can also use as a fuse disconnecting switch by multi-phase combination. The holder is Din Rail type which is equipped with lamp against wrong operation in the breaking state.

Basic Data

- Rated insulated voltage up to 660V.
- Working frequency 50Hz/60Hz.
- Can be fitted with fuse 10x38mm, 6A-32A.
- Compliant with GB13539.6, GB14048.3, IEC60269-1, IEC60269-2, IEC602269-2-1.



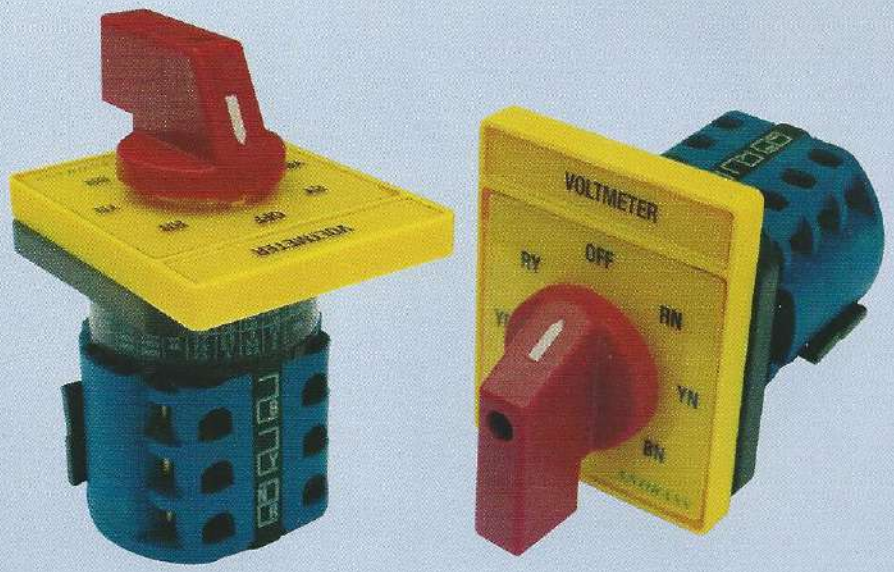


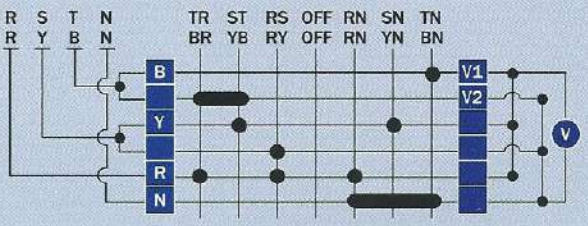
ANDRASS

SELECTOR SWITCH / ROTARY CAM SWITCH

RATING : AC1 : 20A 250V
AC3 : 16A 250V

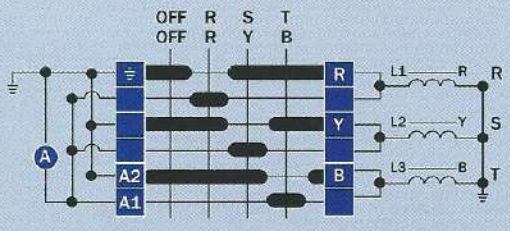
STANDARD : IP20
SIZE : 48 X 60mm or 48 X 48mm





Voltmeter Switch CA10-VS
- Phase to phase
- Phase to neutral



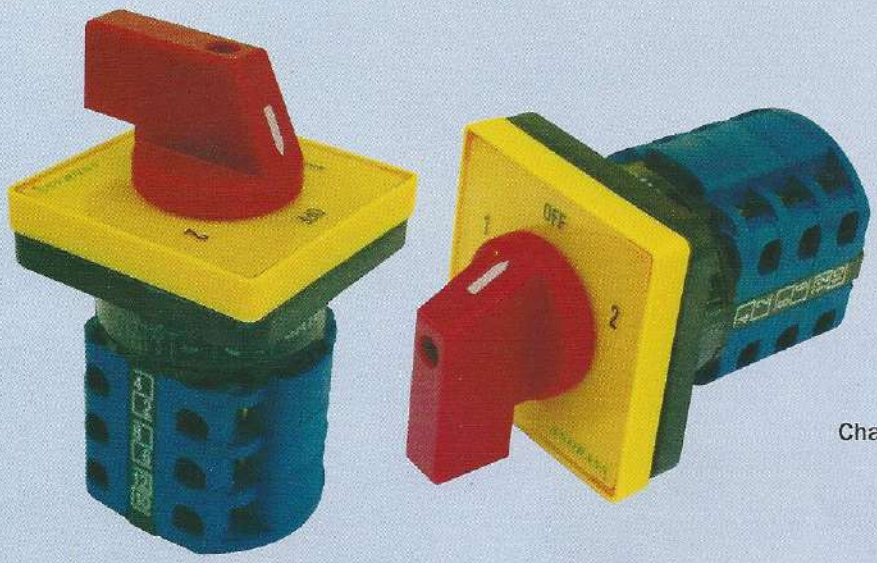


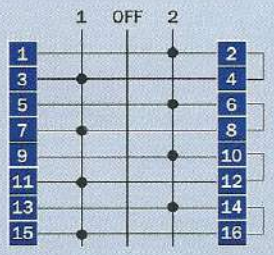
Ammeter Switch CA10-AS
- 3 phase current
- 3 C/T

POMACK-AK ELECTRIC CO. LTD.

ANDRASS

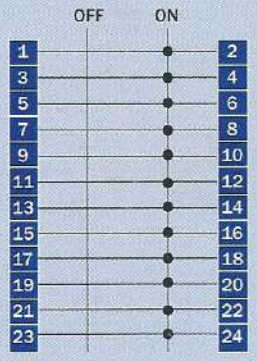
SELECTOR SWITCH / ROTARY CAM SWITCH



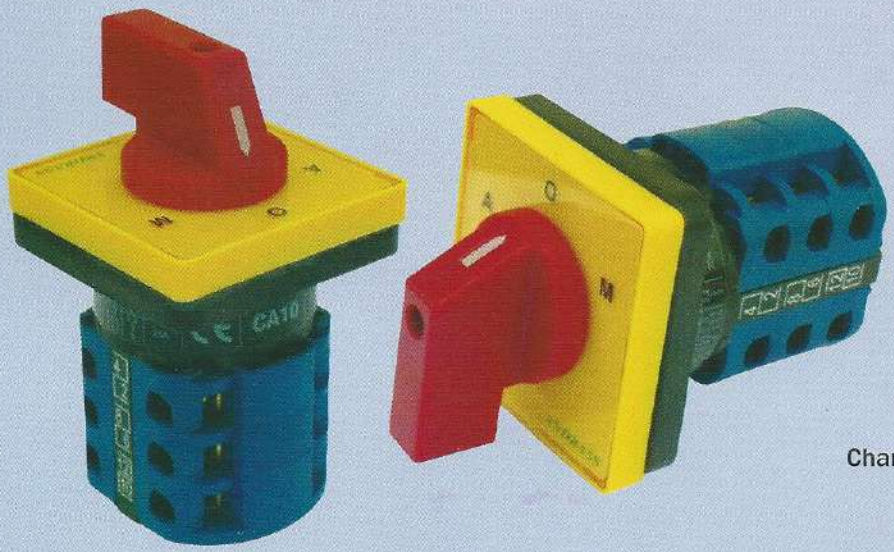


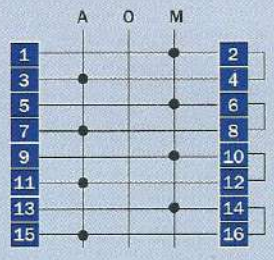
Changeover Switch with Common incoming - 60°
Switching 1 - 4 Pole





ON / OFF - 60°
Switching 1 - 2 Pole





Changeover Switch with Common incoming - 60°
Switching 1 - 4 Pole

POMACK-AK ELECTRIC CO. LTD.

AMICO LED Type Indicator

Main Specifications

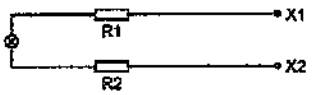
1. Dielectric property: 2.5kV, 1min
2. Insutation Resistancd ≥ 2mΩ
3. AC Indicative Light Voltage ± 20%
4. Ebdurance ≥ 3000h
5. Brightness ≥ 60cd/m2
6. Leakage Index: CT1 ≥ 100
7. Top protection class IP65
8. Frequency: AC 50-60Hz

Environment condition

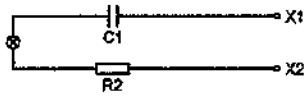
1. Ambient temperature: -25°C ±55°C
2. Relative humidity: 98%
3. Working under vibration frequency 2-80Hz, acceleration at 0.7g
4. Pollution: class III installation: type III

Environment condition

AC, DC indicator (DC, AC 6V-DC, AC240V)



AC indicator (AC220V-AC415V)

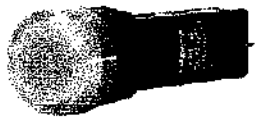




ø22 D



ø22 D

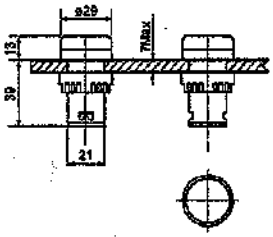


ø16 D

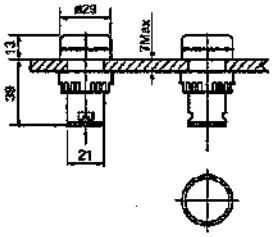


ø16 D

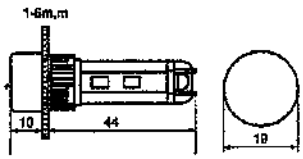
Dimension



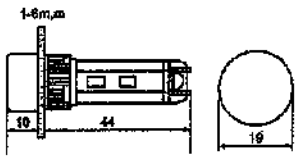
Dimension



Dimension



Dimension



Model

PL16-22D/ □ S

Voltage

12V AC/DC
24V AC/DC
110V AC
240V AC
415 AC

Colour

● R ● G ○ Y
○ W ● B ◎ A

Model

PL16-22D/ □ S

Voltage

12V AC/DC
24V AC/DC
110V AC
240V AC
415 AC

Colour

● R ● G ○ Y
○ W ● B ◎ A

Model

PL16-16D/ □

Voltage

12V AC/DC
24V AC/DC
110V AC
240V AC
415 AC

Colour

● R ● G ○ Y
○ W ● B ◎ A

Model

PL16-16D/ □

Voltage

12V AC/DC
24V AC/DC
110V AC
240V AC
415 AC

Colour

● R ● G ○ Y
○ W ● B ◎ A

Design

The combined overcurrent and earth-fault relay is a secondary relay to be connected to the current transformers of the object to be protected. The three-phase overcurrent unit and the earth-fault unit continuously measure the phase currents and the neutral current of the object. On detection of a fault the relay starts, trips the circuit breaker, provides an alarm signal, records fault data, etc., in accordance with the requirements of the application and the relay configuration.

When the phase current exceeds the set start current of the low-set stage I>, the overcurrent unit starts and, after a preset start time, it delivers a start signal. When the set operate time, at definite time operation, or the calculated operate time, at inverse time operation, elapses, the overcurrent unit operates. In the same way, the high-set stage I>> of the overcurrent unit starts when the set start current is exceeded and delivers a start signal after the preset (~40 ms) start time. When the set operate time has elapsed, the overcurrent unit operates.

When the earth-fault current exceeds the set start current of the low-set stage I_0>, the earth-fault unit starts and, after a preset start time, it delivers a start signal. When the set operate time, at definite time operation, or the calculated operate time, at inverse time operation, elapses, the earth-fault unit operates. In the same way, the high-set stage I_0>> of the earth-fault unit starts, when the set start current is exceeded, and delivers a start signal after the preset (~50 ms) start time. Once the set operate time has elapsed, the earth-fault unit operates.

The low-set stage of the overcurrent unit and the low-set stage of the earth-fault unit may be given definite time or inverse definite minimum time (IDMT) characteristic. The IDMT characteristic includes six time/current curve sets. Four of the curve sets comply with the BS 142 and IEC 255 and are named “Normal inverse”, “Very inverse”, “Extremely inverse” and “Long-time inverse”. The two additional inverse time curve sets comply with ABB standards and are called “RI” and “RXIDG”.

By appropriate configuration of the output relay matrix, the start signals of the overcurrent and earth-fault units are obtained as contact functions. The start signals can be used for blocking co-operating protection relays, and for signalling.

The relay includes one external binary input, which is controlled by an external control voltage. The function of the control input is determined by a selector switch in the protection relay module. The control input can be used for blocking the operation of one or more protection stages, for resetting a latched output relay in the manual reset mode or for switching between main and second setting banks.

Data communication

The relay is provided with a serial interface on the rear panel. By means of a bus connection module type SPA-ZC 17 or SPA-ZC 21 the relay can be connected to the fibre-optic SPA bus. The bus connection module type SPA-ZC 21 is powered from the host relay, whereas the bus connection module SPA-ZC 17 is provided with a built-in power unit, which can be fed from an external secured power source. The relay communicates with higher-level data acquisition and control systems over the SPA bus.

Self-supervision

The relay incorporates a sophisticated self-supervision system with auto-diagnosis, which increases the availability of the relay and the reliability of the system. The self-supervision system continuously monitors the hardware and the software of the relay. The system also supervises the operation of the auxiliary supply module and the voltages generated by the module.

When a permanent internal relay fault is detected, the IRF indicator on the relay front panel is lit. At the same time the output relay of the self-supervision system operates and a fault message is transmitted to the higher-level system over the serial bus. Further, in most fault situations, a fault code is shown in the display of the protection relay module. The fault code indicates the type of the fault that has been detected.

Auxiliary supply voltage

The auxiliary supply of the relay is obtained from an internal plug-in type power supply module. Two auxiliary power module versions are available: type SPTU 240R1 for the supply voltage range 80…265 V ac/dc and type SPTU 48R1 for the supply voltage range 18…80 V dc. The power supply module forms the internal voltages required by the protection relay and the I/O module.

Technical data

Table 1: Energizing inputs, overcurrent unit

Terminals		1-3, 4-6, 7-9	1-2, 4-5, 7-8
Rated current I_n		1 A	5 A
Thermal withstand capability	continuously	4 A	20 A
	for 10 s	25 A	100 A
	for 1 s	100 A	500 A
Dynamic current withstand capability	Half-wave value	250 A	1250 A
Input impedance		<100 mΩ	<20 mΩ
Rated frequency f_n, according to order		50 Hz or 60 Hz	

Table 2: Energizing inputs, earth-fault unit

Terminals		25-26	25-27
Rated current I_n		1 A	5 A
Thermal withstand capability	continuously	4 A	20 A
	for 10 s	25 A	100 A
	for 1 s	100 A	500 A
Dynamic current withstand capability	Half-wave value	250 A	1250 A
Input impedance		<100 mΩ	<20 mΩ
Rated frequency f_n, according to order		50 Hz or 60 Hz	

Table 3: Output contact ratings

Type of contact		Tripping	Signalling
Terminals		65-66, 74-75	70-71-72, 68-69, 77-78, 80-81
Rated voltage		250 V ac/dc	
Continuous carry		5 A	5 A
Make and carry for 0.5 s		30 A	10 A
Make and carry for 3 s		15 A	8 A
Breaking capacity for dc, when the control/ signalling circuit time constant L/R ≤ 40 ms, at the control voltages	220 V dc	1 A	0.15 A
	110 V dc	3 A	0.25 A
	48 V dc	5 A	1 A
Contact material		$AgCdO_2$	

Technical data (cont'd)

Table 4: Control input, communication and power supply

External control input	Terminals		10-11
	Control voltage level		18…265 V dc or 80…265 V ac
	Current drain at activated input		2…20 mA
Data communication	Transmission mode		Fibre-optic serial bus
	Data code		ASCII
	Selectable data transfer rates		4800 or 9600 Bd
	Bus connection module, powered from the host relay	for plastic core cables	SPA-ZC 21BB
		for glass fibre cables	SPA-ZC 21MM
	Bus connection module, powered from the host relay or from an external power source	for plastic core cables	SPA-ZC 17BB
		for glass fibre cables	SPA-ZC 17MM
Auxiliary supply modules	Power supply and I/O modules, rated voltages and operative range	SPTU 240R1	110/120/230/240 V ac, 110/125/220 V dc, 80…265 V ac/dc
		SPTU 48R1	24/48/60 V dc, 18…80 V dc
	Power consumption	under quiescent conditions	~4 W
		under operating conditions	~6 W

Table 5: Relay module SPCJ 4D29, overcurrent unit

Features		Stage I>	Stage I>>
Start current	at definite time	0.5…5.0 × I_n	0.5…40.0 × I_n and ∞
	at inverse time	0.5…2.5 × I_n	–
Start time, typically		50 ms	40 ms
Operate time at definite time characteristic		0.05…300 s	0.04…300 s
Time/current characteristic at inverse mode		Extremely inverse Very inverse Normal inverse Long-time inverse RI type inverse RXIDG type inverse	–
Time multiplier k		0.05…1.0	–
Reset time, typically		40 ms	40 ms
Retardation time		<30 ms	
Reset ratio, typically		0.96	
Operate time accuracy at definite time mode		±2% of set value or ±25 ms	
Accuracy class index E at inverse time mode		5	–
Operation accuracy		±3% of set value	±3% of set value

Table 6: Relay module SPCJ 4D29, earth-fault unit

Features	Stage I_0>	Stage I_0>>
Start current	0.1…0.8 × I_n	0.1…10.0 × I_n and ∞
Start time, typically	60 ms	40 ms
Operate time at definite time characteristic	0.05…300 s	0.05…300 s
Time/current characteristic at inverse time mode	Extremely inverse Very inverse Normal inverse Long-time inverse RI type inverse RXIDG type inverse	–
Time multiplier k	0.05…1.0	–
Reset time, typically	40 ms	40 ms
Retardation time	<30 ms	–
Reset ratio, typically	0.96	0.96
Operate time accuracy at definite time mode	±2% of set value or ±25 ms	
Accuracy class index E at inverse time mode	5	–
Operation accuracy	±3% of set value	±3% of set value

Table 7: Tests and standards

Test voltages	Dielectric test voltage (IEC 255-5)	2.0 kV, 50 Hz, 1 min
	Impulse test voltage (IEC 255-5)	5 kV, 1.2/50 µs, 0.5 J
	Insulation resistance (IEC 255-5)	>100 MΩ, 500 V dc
Interference tests	High-frequency (1 MHz) disturbance test (IEC 255-22-1), common mode	2.5 kV
	High-frequency (1 MHz) disturbance test (IEC 255-22-1), differential mode	1.0 kV
	Fast transients (IEC 255-22-4, class III and IEC 801-4, level 4), power supply inputs	4 kV, 5/50 ns
	Fast transients (IEC 255-22-4, class III and IEC 801-4, level 4), other inputs	2 kV, 5/50 ns
	Electrostatic discharge (IEC 255-22-2 and IEC 801-2, class III), air discharge	8 kV
	Electrostatic discharge (IEC 255-22-2 and IEC 801-2, class III), contact discharge	6 kV
	RF electromagnetic field test (IEC 1000-4-3 and ENV 50140)	10 V/m, f = 80…1000 MHz
	Conducted RF disturbance test (IEC 1000-4-6 and ENV 50141)	10 V, f = 150 kHz…80 MHz
Power supply test, power supply variation	Variation voltage	68…265 V
	Interruption 80 V - 50%	0…200 ms
	Interruption 80 V - 100%	0…30 ms
	Interruption 255 V - 100%	0…160 ms

Block diagram (cont'd)

Table 7: Tests and standards

Mechanical test	Seismic test (ANSI/IEEE C37.98-1987), operating basis earthquake test	0.5…5.25 g
	Seismic test (ANSI/IEEE C37.98-1987), safe shut down earthquake test	0.5…7.5 g
	Vibration test	2…13.2 Hz, ±1.0 mm 13.2…100 Hz, ±0.7 g
	Shock/bump test (IEC 255-21-2)	20 g, 1000 bumps/direction
	Corrosion test	Battelle test
Environmental conditions	Service temperature range	-10…+55°C
	Transport and storage temperature range (IEC 68-2-8)	-40…+70°C
	Damp heat test (IEC 68-2-3)	<95%, +40°C, 96 h
	Degree of protection by enclosure when panel mounted	IP 54
	Weight	~3.5 kg

Block diagram

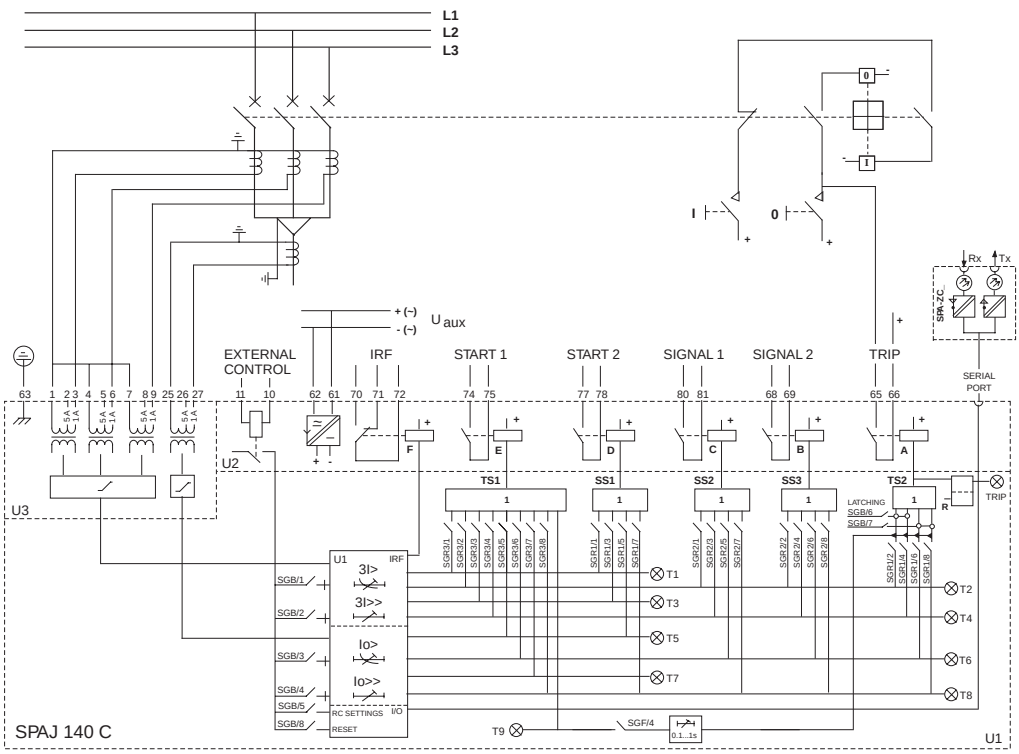


Fig. 1 Block diagram and sample connection diagram

Mounting and dimensions

Flush mounting

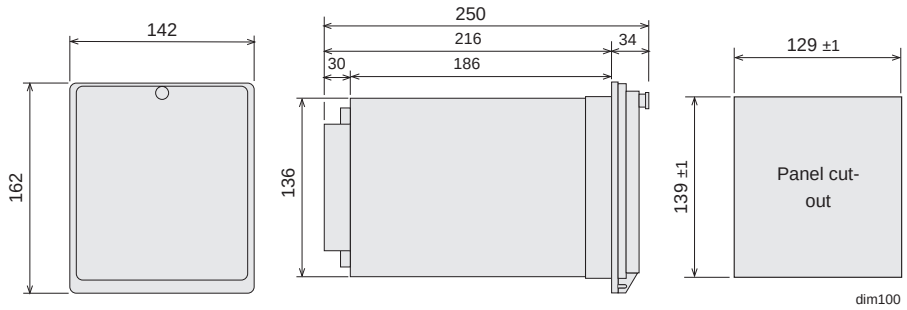
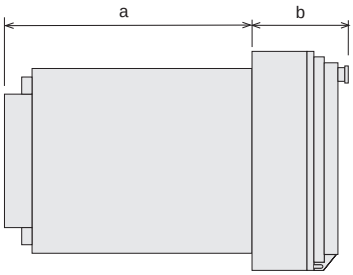


Fig. 2 Flush-mounting relay case (dimensions in mm)

Semi-flush mounting



Raising frame	a	b
SPA-ZX 111	176	74
SPA-ZX 112	136	114
SPA-ZX 113	96	154

Fig. 3 Semi-flush mounting relay case (dimensions in mm)

Mounting in 19 inch cabinets and frames

An ancillary mounting plate, height 4U (~177 mm), is recommended to be used when the protection relays are to be mounted in 19 inch frames or cabinets. The ancillary mounting plate type SPA-ZX 104 accommodates three relays, type SPA-ZX 105 two relays and type SPA-ZX 106 one relay.

Projecting mounting

When projecting mounting is preferred, a relay case type SPA-ZX 110 is used. The relay case for projecting mounting is provided with front connectors.

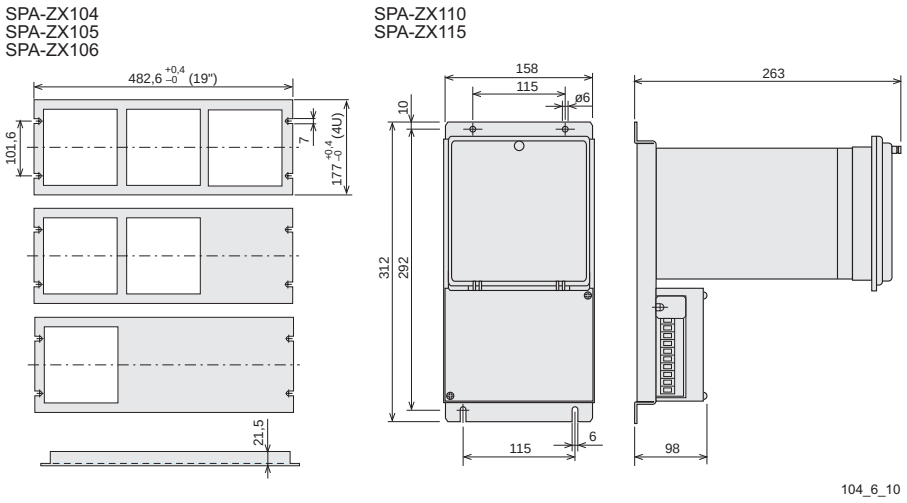


Fig. 4 Mounting cabinets and frames as well as projecting mounting (dimensions in mm)

Ordering

When ordering, please specify:

Ordering information	Ordering example
1. Type designation and quantity	SPAJ 140 C, 5 pieces
2. Order number	RS 611 006-AA
3. Rated values	I_n=5 A, f_n=50 Hz
4. Auxiliary voltage	U_{aux} =110 V dc
5. Accessories	-
6. Special requirements	-

Order numbers

Combined overcurrent and earth-fault relay SPAJ 140 C without test adapter	RS 611 006-AA, CA, DA, FA
Combined overcurrent and earth-fault relay SPAJ 140 C including test adapter RTXP 18	RS 611 206-AA, CA, DA, FA
The last two letters of the order number indicate the rated frequency f_n and the auxiliary voltage U_{aux} of the relay as follows:	AA equals f_n = 50 Hz and U_{aux} = 80…265 V ac/dc
	CA equals f_n = 50 Hz and U_{aux} = 18…80 V dc
	DA equals f_n = 60 Hz and U_{aux} = 80…265 V ac/dc
	FA equals f_n = 60 Hz and U_{aux} = 18…80 V dc

References

Additional information

Brochure “Combined overcurrent and earth-fault relays”	1MRS 750190-MDS EN
User’s manual and technical description “Combined overcurrent and earth-fault relay SPAJ 140 C”	1MRS 750629-MUM EN

ABB Substation Automation Oy
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DAEWOO

Engine Operation & Maintenance Manual

6 DWD -430, 455, 510

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1. Instructions

Danger:
This refers to working and operating procedures which must be complied with in order to rule out the risk to persons.

Caution:
This refers to working and operating procedures which must be complied with in order to prevent damage to or destruction of material.

Note:
Explanation useful for understanding the working or operating procedure to be performed.

Fitting flat seals /gaskets
Flat seals /gasket are often inserted with sealing agents or adhesives to make fitting them easier or to achieve better sealing. Flat seals may slip in operation due to the "sewing–machine" effect, in particular if they are used between parts with different rates of linear expansion under heat (e.g. aluminum and cast iron), and leaks may then occur.

Example:
The cap of the front crankshaft seal: If a sealing agent or an adhesive is used here the flat seal will move inwards in the course of time as a result of the different expansion rates of the materials. Oil will be lost, for which the shaft seal may be thought to be responsible.

Flat seals / gaskets can be fitted properly only if the following points are observed:
- Use only genuine Daewoo' s seals / gasket
- The sealing faces must be undamaged and cleaned
- Do not use any sealing agent or adhesive – as an aid to fitting the seals a little grease can be used if necessary so that the seal will stick to the part to be fitted
- Tighten bolts evenly to the specified torque

Fitting O ring
- Original O ring / gasket can only be used from Daewoo
- The sealing faces must be undamaged and clean
- To seal O-ring coated with oil before fitting

2. Safety regulations

2.1 General Notes

Day-to-day use of power engines and the service products (fuels, lubricants, coolants) necessary for running them presents no problems if the persons occupied with their operation, maintenance and cares are given suitable training and think as they work.

This summary is a compilation of the most important regulations. These are broken down into main sections which contain the information necessary for preventing injury to persons, damage to property and pollution. In addition to these regulations those dictated by the type of engine and its site are to be observed also.

Important: If, despite all precautions, an accident occurs, in particular through contact with caustic acids, fuel penetrating the skin, scalding from hot oil, anti-freeze being splashed in the eyes etc.. ***Consult a doctor immediately.***

1. Regulations designed to prevent accidents with injury to persons

The work of check debugging and repair must be authorized by the professional and technical personnel.

• When carrying out repair and maintenance work, ensure that the engine cannot be started by unauthorized persons. • The engine must be started and operated only by authorized personnel. • When the engine is running, do not get too close to the rotating parts Wear close-fitting clothing.	
• Do not touch the engine with bare hands when it is warm from operation risk of burns. • There is enough space around the engine. Keep vicinity of engine, ladders and stairways free of oil and grease. Accidents caused by slipping can have serious consequences.	
• Do not stand below the engine which is hanging hook. Be careful of checking the lifting hook, make it be in good condition.	
• If opening while the engine is still warm is unavoidable, comply with the instructions in the chapter entitled "Maintenance and Care". • Neither tighten up nor open pipes and hoses (lube oil circuit, coolant circuit and any additional hydraulic oil circuit) during the operation. The fluids which flow out can cause injury. • When checking nozzle of fuel, don't hold up the fuel injection port. Do not inhale fuel spray.	
• When operating electrical system, disconnecting the battery system in the first, connecting it before work has done, preventing short circuit. • When you are dealing with battery, please follow the manufacturer's instructions.	
Caution: • Accumulator acid is toxic and caustic. Battery gases are explosive. • When welding, please follow the" welder matters needing attention".	

2. Regulations designed to prevent damage to engine and premature wear

- ***Before repairing the engine, that must be thoroughly cleaned, which ensure that dirt, sand or other impurities will not fill into engine.***

- Do not demand more from the engine than it is able to supply in its intended application. Find the cause immediately and have it eliminated in order to prevent more serious damage.

- Use only genuine Daewoo spare parts. Daewoo will accept no responsibility for damage resulting from the installation of other parts which are supposedly "just as good".

- Never let the engine run when dry, i.e. without lube oil or coolant.
  If the engine hasn't been ready to run, please paste the warning mark.

- Use only Daewoo -approved service products (fuel, engine oil, anti-freeze and anti-corrosion agent). Pay attention to cleanliness. The Diesel fuel must be free of water. See "Maintenance and care".

- ***Do not add so much engine oil that the oil level rises above the max marking on the dipstick. Do not exceed the maximum permissible tilt of the engine.*** Serious damage to the engine may result if these instructions are not adhered to.

- Always ensure that the testing and monitoring equipment (for battery charge, oil pressure, and coolant temperature) function satisfactorily.

- Comply with instructions for operation of the alternator.

3. Regulations designed to prevent pollution

Engine oil and filter elements/cartridges, fuel / fuel filter

- Take old oil only to the old oil collection point.
- Take strict precautions to ensure that no oil or diesel fuel gets into the drains or the ground.
- The drinking water supply could be contaminated.

Caution:

- Be careful of not contaminating drinking water
- Filter elements are classed as dangerous waste and must be treated as relevant regulation.

Coolant

- Treat undiluted anti-corrosion agent and / or anti-freeze as dangerous waste.
- When disposing of spent coolant comply with the regulations of the relevant local authorities.

4. Notes on safety in handling used engine oil *

Prolonged or repeated contact between the skin and any kind of engine oil decreases the skin. Drying, irritation or inflammation of the skin may therefore occur. Used engine oil also contains dangerous substances which have caused skin cancer in animal experiments. If the basic rules of hygiene and health and safety at work are observed, health risks are not to the expected as a result of handling used engine oil.

Health precautions:

- Avoid prolonged or repeated skin contact with used engine oil.
- Protect your skin by means of suitable agents (creams etc.) or wear protective gloves.

- Clean the skin which has been in contact with engine oil.
  - Wash thoroughly with soap and water. A nailbrush is an effective aid.
  - Certain products make it easier to clean your hands.
  - Do not use petrol, Diesel fuel, gas oil, thinners or solvents as washing agents.

- After washing apply a fatty skin cream to the skin.
- Change the oil-soaked clothe and shoes.
- Do not put oily rags into your pockets.

- Ensure that used engine oil is disposed of properly
- Engine oil can endanger the water supply-

For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

Collect and dispose of used engine oil carefully. For information on collection points please contact the seller, the supplier or the local authorities.

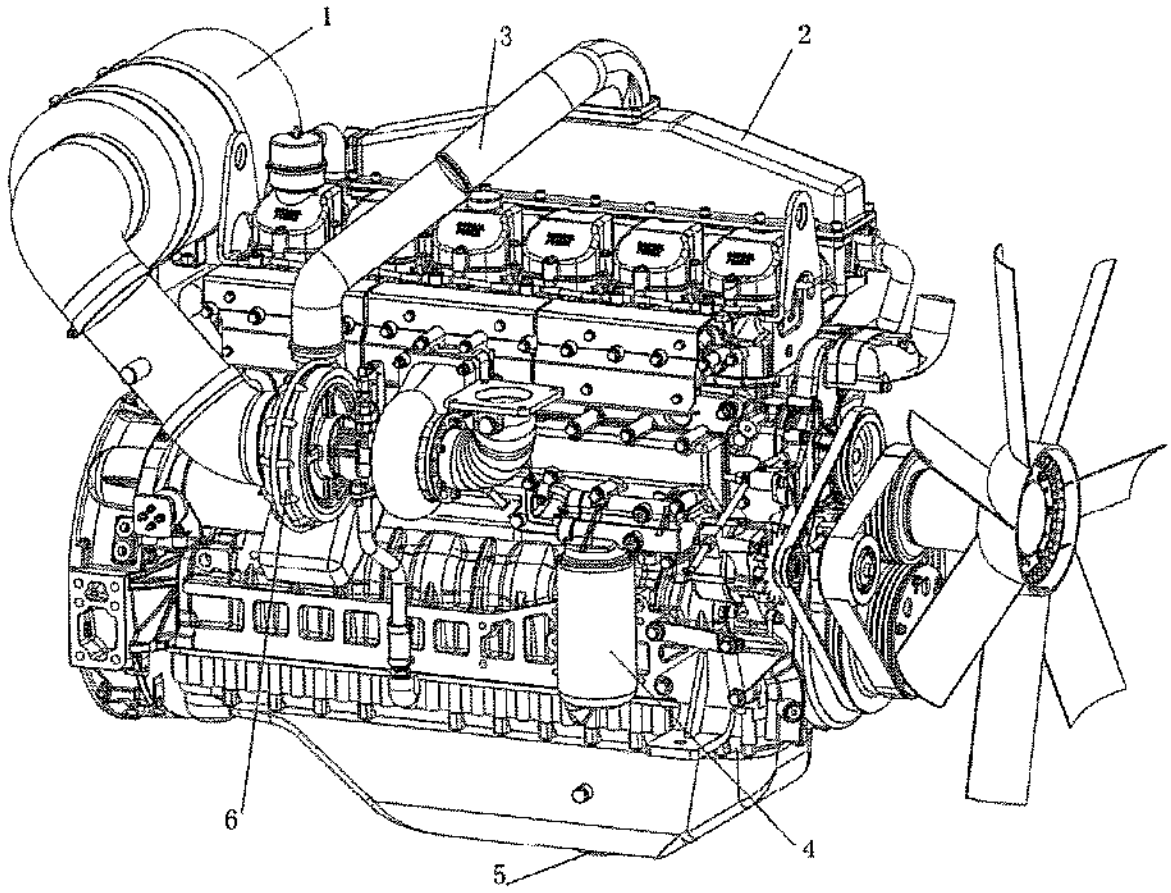
*Adapted from "Notes on handling used engine oil"

3. Technical data

Engine Type	6DWD-410/430	6DWD-455/510
Cylinder arrangement	in-line vertical	
Cycle	4-stroke Diesel with turbocharger and intercooler	
Aspiration	Turbocharged, air to water CAC	Turbocharged, air to air CAC
Injection system	direct injection	
Number of cylinders	6	
Bore x Stroke	128 mm x 166 mm	
Swept volume	12.8 L	
Compression ratio	15.5 : 1	
Firing order	1-5-3-6-2-4	
Valve clearance (IN / EX)	0.50 mm / 0.60 mm (cold engine)	
Valve timing - Intake opens - Intake closes - Exhaust opens - Exhaust closes	23° before TDC 12° after BDC 60° before BDC 30° after TDC	
Fuel Injection system	In-line, Mechanical type pump ,	
Governor	Electronic speed governor (GAC)	
Fuel Injectors	six-hole nozzles	
Opening pressure of injector	30+1 M Pa	
Fuel Injection Timing at 1500 rpm / at 1800 rpm	18 ° BTDC / 21+1° BTDC	
Lubrication System	force feed Type	
Oil capacity in oil sump .	Min. Level 34 liters / Max. Level 40 liters	
Oil change quantity (with filter)	43 liters	
Oil pressure during operation	must be monitored by oil pressure monitors/gauges (depending on oil temperature ,oil viscosity class and engine rpm)	
Oil filter	Full-flow filter with paper filter elements	
Engine cooling system	Liquid cooling	
Coolant temperature	80-90℃, temporarily 95℃ allowed	
Starter	24 V; 6.6 kW	
Alternator	28 V; 35 A	

4. Engine views

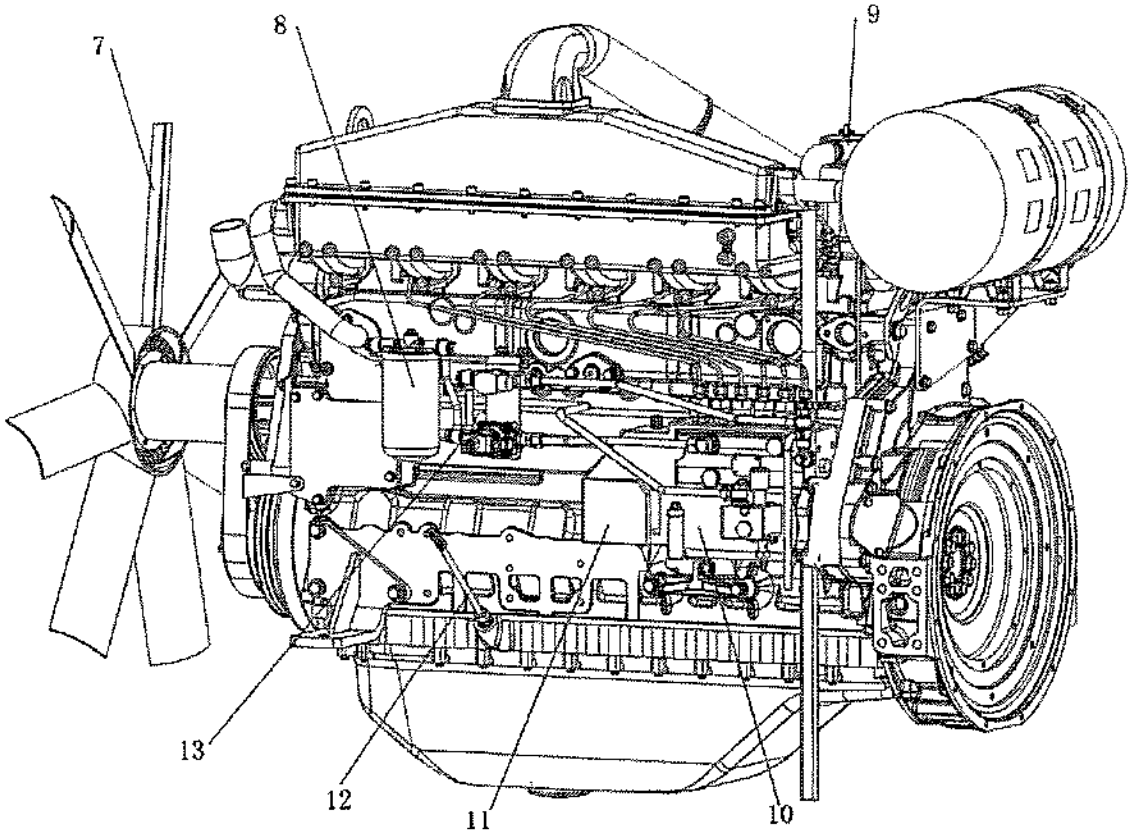
6 DWD - 410, 430 model only (1/2)
(Air to Water intercooler Application)



1 AIR FILTER
2 INTERCOOLER
3 CONNECTING PIPE
4 OIL FILTER
5 OIL DRAIN PLUG
6 TURBOCHARGER

Engine views

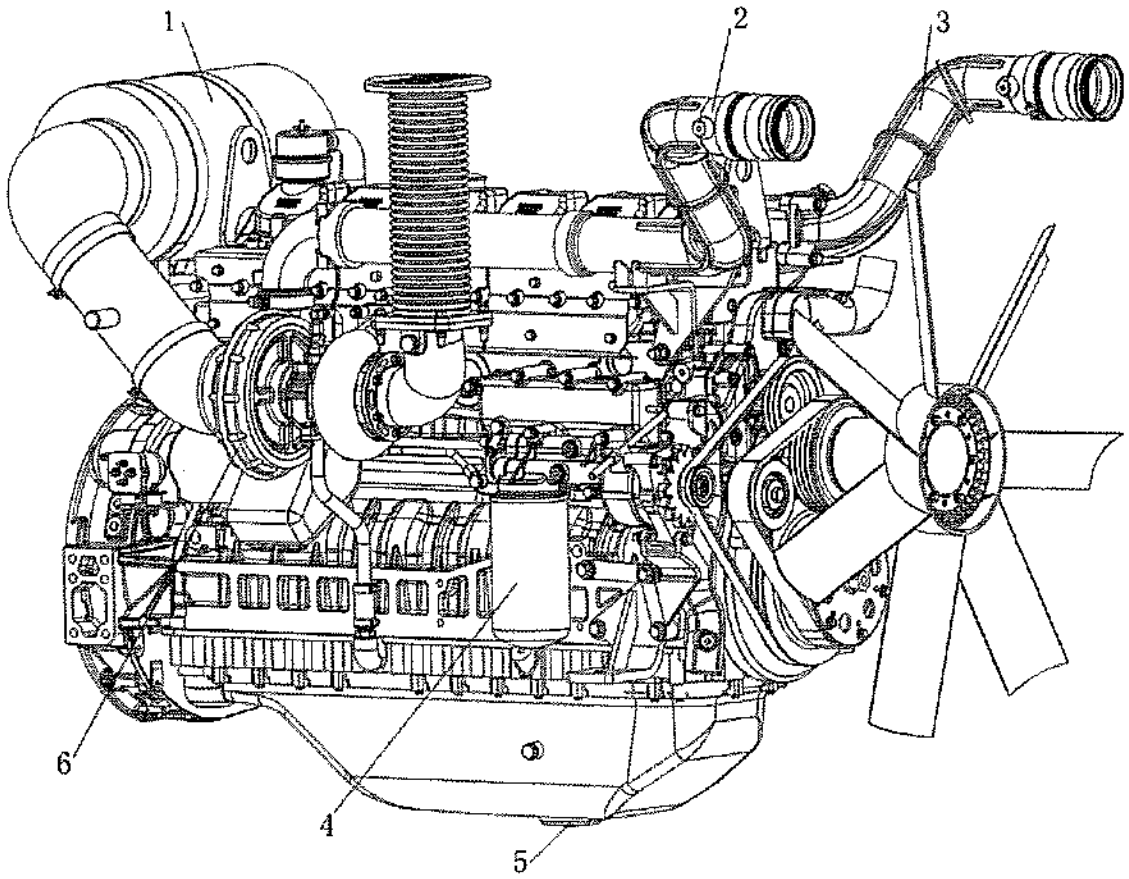
6 DWD - 410, 430 model only (2.2)
(Air to Water intercooler Application)



7 FAN
8 FUEL FILTER
9 BREATHER
10 INJECTION PUMP
11 ACTUATOR
12 OIL DIPSTICK
13 SHUTOFF VALVE

Engine views

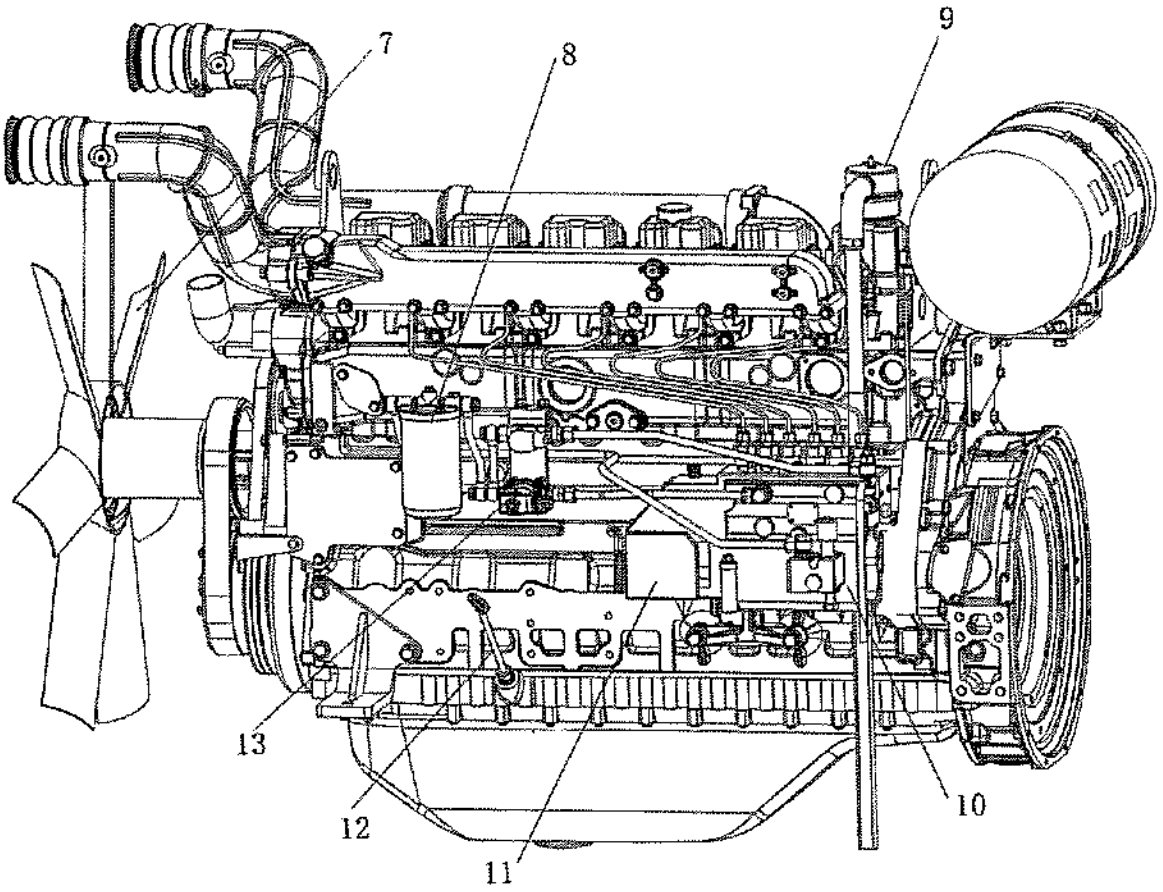
6 DWD - 455, 510 model only (1/2)
(Air to Air intercooler Application)



1 AIR FILTER
2 ELBOW (INTERCOOLER AIR PIPES)
3 ELBOW (AIR DISTRIBUTOR PIPE AND INTERCOOLER ELBOW)
4 OIL FILTER
5 OIL DRAIN PLUG
6 TURBOCHARGER

Engine views

6 DWD - 455, 510 model only (2/2)
(Air to Air intercooler Application)



7 FAN
8 FUEL FILTER
9 BREATHER
10 INJECTION PUMP
11 ACTUATOR
12 OIL DIPSTICK
13 SHUTOFF VALVE

5. Commissioning and operation

5.1 First commissioning

At the time of initial commissioning of a new or overhauled engine make sure to have observed the "Technical Information for the installation of Daewoo Diesel engines".

It is recommended that new or overhauled engines should not be operated at a load higher than about 75% maximum load during the first few hours of operation. Initial run-in should be at varying speeds. After this initial run-in, the engine should be brought up to full output gradually.

Caution:
Use only approved fuels, lubricants etc. Otherwise the manufacturer's warranty will become null and void.
Filling with fuel

Caution:
Fill the tank only when the engine is switched off. Pay attention to cleanliness. Do not spill fuel.
Use only approved fuels.

Filling-in of coolant
Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycol basis or anti-corrosion agent.

- Pour in coolant slowly via water tank inlet.
- For coolant filling quantity, see "Technical data".

Filling with engine oil

Caution:
Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

The engines are as a rule supplied without oil.
Pour oil into engine via filler neck. For the quantity required see "Technical Data'.

5.2 Commissioning and operation

Before daily starting the engine, check fuel level, coolant level and engine oil level and replenish, if necessary.

Use only approved fuels, lubricants etc. Otherwise the manufacturer's warranty will become null and void.

Checking oil level

Check the oil level when the engine is horizontal, but only if at least 20 minutes have passed since the machine was switched off.

◆ Pull out dipstick
◆ Wipe it with a clean, lint free cloth and push it in again up to the stop
◆ Pull out dipstick again

The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary..

Caution:
Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

Ensure outmost cleanliness when handling fuels, lubricants and coolants.

5.3 Starting

Danger !
Before starting make sure that no-one is in the engine`s danger area.

Caution:
When starting, do not use any additional starting aids.

◆ Ensure that no load is on the engine before starting it, e.g., switch off load, disengage clutch, put gearbox into neutral etc.

With engines without starting aid or at temperatures above 5-10℃ or when engine without flame starter is already hot:
• Insert starter key in starting lock
• Press starter button until engine starts

With engines with starting aid (flame starter), at temperatures around 0℃ an below:
◆ Insert starter key in starting lock
◆ Switch on flame starter; signal lamp "Preheating" is on
◆ Signal lamp "Preheating" is flashing; press starter button until engine starts

Caution:
◆ When engine starts, release starter button immediately
◆ If engine does not start, actuate starter for about 10 seconds, wait for 30 seconds and then attempt to start engine again and so on

With engine with automatic starting (e.g. standby power units) it is indispensable that none of the moving parts be accessible. Warning signs "Unit starts automatically" are to be attached to the engine. Regulations on this which may apply locally are to be satisfied.

When engine is running, tube oil pressure must build up at the oil pressure gauge. If not, switch off engine immediately.

Avoid running the cold engine for any length of time since in any internal combustion engine this is liable to cause increased wear due to corrosion. Prolonged idling is harmful to the environment.

5.4 Operation monitoring system

Caution:
Do not overload the engine. Do not exceed the maximum permissible engine tilt. If faults occur, find their cause immediately and have them eliminated in order to prevent more serious damage!

During operation the oil pressure in the engine lubrication system must be monitored. If the monitoring devices register a drop in the lube oil pressure, switch off the engine immediately.

5.5 Shutting down

Do not switch off engine immediately operation at high loads, but let it idle for about 5 minutes to achieve a temperature equalization.

Then switch off the engine via the shut-off device provided (shut-off solenoid, electric speed governor etc.).

Danger:
Ensure that the engine cannot be started by unauthorized persons.

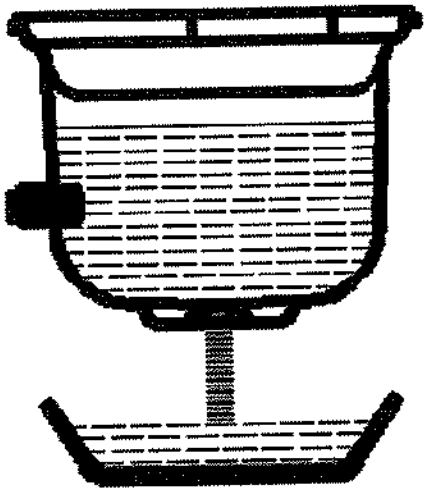
6. Maintenance and care

6.1 Lubrication system

Ensure outmost cleanliness when handling fuels, lubricants and coolants.

Caution:
Use only approved fuels, lubricants etc. Otherwise the manufacturer's warranty will become null and void.

Engine oil change



Danger:
The oil is hot- risk of scalding. Do not touch the oil drain plug with bare fingers. Oil is an environmental hazard. Handle it with care!

With the engine at operating temperature, remove the oil drain plugs on the oil sump and the oil filter bowl and allow the old oil to drain off completely.

Use a vessel of sufficient size to ensure that the oil does not overflow.
As the oil drain plug is often not accessible, a manually operated vane pump may be attached to the engine for draining the oil.

Pump the old oil out of the sump while the engine is still warm. Remove oil drain plugs in oil filter bowl and let old oil drain out of oil filters. Refit the oil drain plugs with new gaskets.



Note:
Change the oil filter elements every time the engine oil is changed

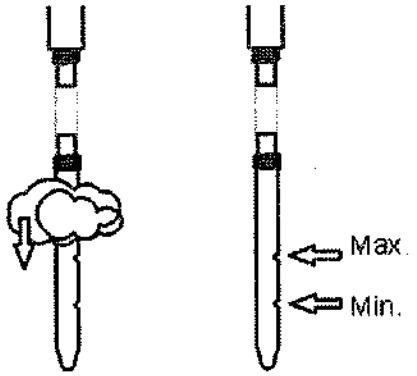
Refilling with oil

Caution:
Do not add so much engine oil that the oil level rises above the max marking on the dipstick. Overfilling will result in damage to the engine.

Refill with fresh engine oil at the oil filler neck (arrow). After filling start the engine and let it run for a few minutes at low speed.

Caution:
If no oil pressure builds up after approx. 10 seconds switch off the engine immediately.

Check oil pressure and check that there is no oil leakage.
Then shut down the engine. After about 20 minutes, check the oil level.



- Pull out dipstick
- wipe it with a clean, lint free cloth
- and push it in again up to the stop
- Pull out dipstick again

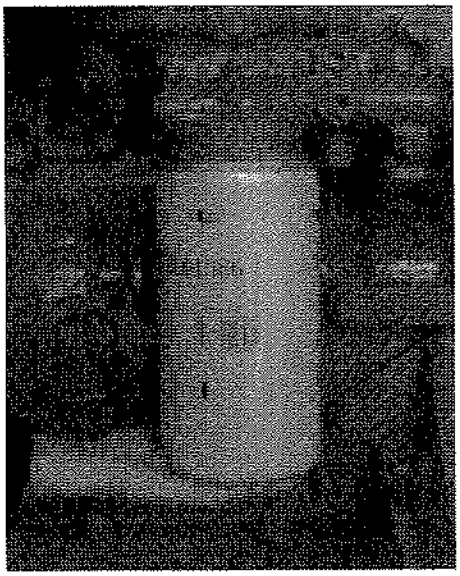
The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.



Changing oil filter

Caution:
Used oil and oil filters are classed as dangerous waste and must be disposed of accordingly, to prevent environment from polluting.
Loosen and then remove the oil filter, as shown in the figure.

Notes:
When changing the filter every time, the connector should be checked and torque should be mounted, it is between 45Nm and 55Nm. If the tightened torque is lower than the stipulated range, it will result in joint looseness and oil leakage.
Fill with oil to the Filter element.
The filter element is installed to oil filter joint, as shown in the figure. Tighten by hand until the sealing ring and the filter connector contact position, and then tighten to between 1/2ring and the 3/4ring.



Notes:
Tool tighten may enable thread deformation or damage filter seal ring.
Start engine, check for leakage or not.
Check the oil level once again. If necessary, add oil, in order to make the oil level maintain in the specified range.

Recommended oil

Single grade oil

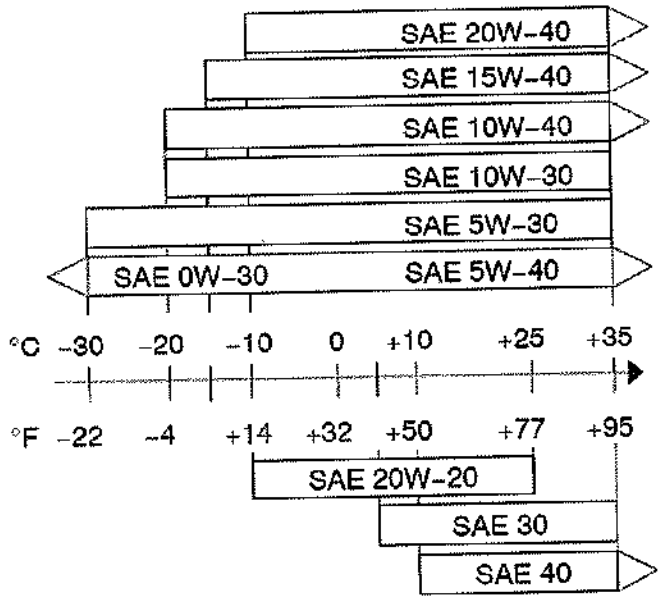
Do not recommend using single grade oil. Only in the absence of multistage oil situations or is required that you must use single grade oil, you may use the SAE 30 or SAE 40 single grade engine oil.
Pay attention to operating temperature range.

Multistage oil

Operating conditions is in a normal environment temperature (temperature at -15℃), it is recommended that use the SAE15W/40 viscosity grade engine oil. The use of multistage oil can reduce the formation of sediment, improve the engine under the condition of low temperature starting function and ensure the lubrication under the condition of high temperature and improve engine durability. Proved by practice, the use of multistage oil with single stage oil, when the low load, the fuel consumption can be reduced by about 30%.

Low temperature climate conditions can use the lower viscosity of multistage oil, such as SAE15W/30 oil.

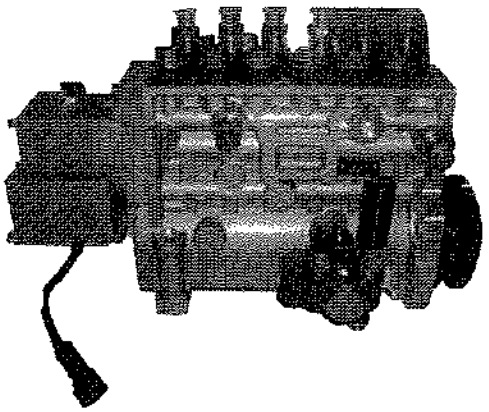
SAE
The grade of SAE viscosity depends on environment's temperature (see below).



Oil change period

Generally speaking, Oil change period is 250 hours or 6 months.

6.2 Fuel system



Fuel pump
Do not remove the fuel pump without permit.. If the seal is damaged, the company shall not be responsible for it.

If faults occur:
Any troubles of oil pump are required only by the professional technicians of company or the company. The company will not be responsible for unauthorized disassembly and the damage caused by nonprofessional person.

Changing fuel filter
Do it only when engine is switched off.

Caution:
Used fuel filter are classed as dangerous waste and must be disposed of accordingly.

- Loosen filter cartridge by means of wrench and then take it off.
- Moisten the seals on new filter cartridge with clean fuel.
- Screw on the filter cartridges and tighten them vigorously by hand.
- Bleed fuel system.
- Check filter for leaks.

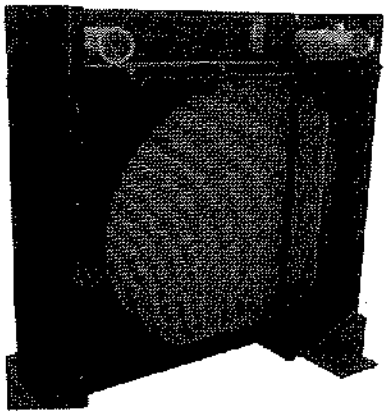
Fuel
If diesel fuel which contains moisture is used the injection system and the cylinder liners/pistons will be damaged .This can be prevented to same extent by filling the tank as soon as the engine is switched while the fuel tank is still warm(formation of condensation is prevented) Drain moisture from storage tanks regularly. Installation of a water trap upstream of the fuel filter is also advisable. Do not use any additives to improve flow properties in winter.

The diesel fuels used for Daewoo' s engines must meet the requirement as follows:
- GB/T 19147-2003
- EN 590
- DIN EN 590
- ASTM D 975 No.1 D
- BS 2869 Part 1 Class A 1

Use the diesel fuels containing low sulphur or sulphur-free because of environmental protection, suggested by Daewoo.
Low sulphur , S＜50 mg/kg，according to EN 590
Sulphur-free, S＜10 mg/kg，according to DIN EN 590

Caution:
Use only approved fuels, lubricants etc. Otherwise the manufacturer's warranty will become null and void.

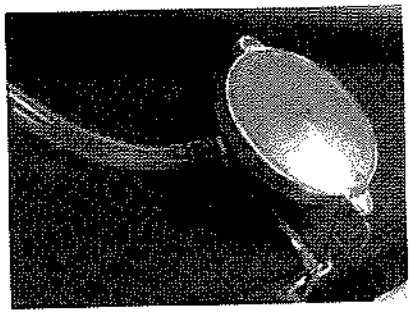
6.3 Cooling system



Danger
Draining hot coolant involves a risk of scalding

Fill / bleed the cooling system
(Only when engine has cooled down)
Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene-glycole basis or anti-corrosion agent.

Caution:
Use only approved fuels, lubricants etc. Otherwise the manufacturer's warranty will become null and void.



Coolant must be added at the filler neck only.
Do not put cold coolant into an engine which the temperature is more than 50℃ from operation.
Ensure that the ratio of water to anti-freeze is correct

- Remove cap (large cap)
- Fill up with coolant slowly until correct coolant level is reached
- Refit end cover
- Run the engine briefly and then check coolant level once more

Danger:
If, in an **exceptional** case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap with safety valve to the first stop, let off pressure, then open carefully.

Cooling liquid

Preparation Table

Temperature outside dropped to (℃)	Water (%)	Antifreeze (%)
- 27	60	40
- 31	55	45
- 37	50	50

If cooling water containing the wrong antifreeze is used, or an error of ratio/non-uniform, the parts of a cooling equipment and pipes will be corroded and damaged easily. Therefore, the troubles will be taken place. In the meantime, the heat-insulating layer may be deposited on the heat conducting element. It will lead to faults eventually because of a high engine temperature.

Make sure that the engine can run reliably. Cooling liquid must be a mixture of 60% water and 40% antifreeze all the year round. So it can prevent the engine corroding enough. The anti-corrosive agent can be used in some especial cases.

Remember not to use the emulsion preservative oil. It is a most basic principle.

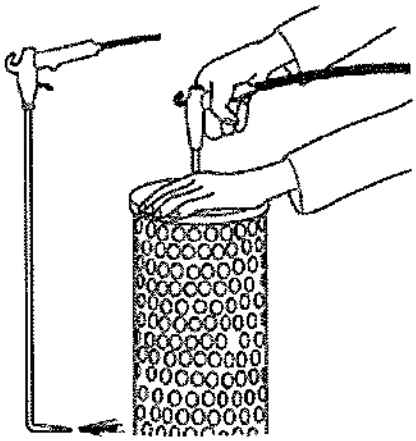
6.4 Air filter

Note:
Do not service or wash out the filter.
The filter must be changed after every 200 hours of operation.



Cleaning the cartridge

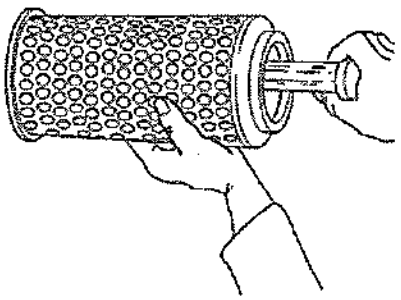
Caution:
The filter cartridge should normally be changed. Clean it only in emergencies (e.g. when no replacement is available).



Blowing out (wear goggles)
To do this fit a pipe to the compressed air gun. The end of the pipe should be bent by approx. 90°. The pipe must be long enough to reach the bottom of the cartridge.

Blow the cartridge out from the inside with dry compressed air (max.5 bar) by moving the pipe up and down inside the cartridge until no more dust is released.

Checking the cartridge

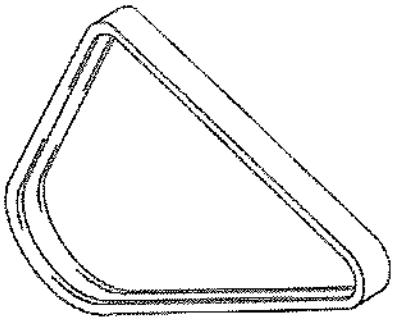


When a cartridge has been cleaned it must be examined for damage before it is refitted, e.g. damage to the paper bag and rubber seals. Check also for compression of or dents in the metal jacket.

Tears and holes in the paper bag can be found by shining a torch into the bag.

On no account re-use damaged cartridges. If in doubt fit a new cartridge.

6.5 Checking V-belts

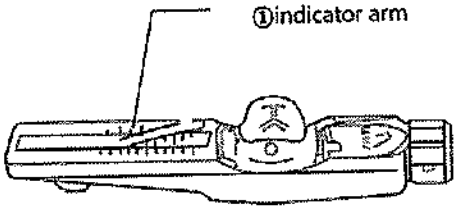


Checking condition

◆Checking V-belts for cracks, oil, overheating and wear.
◆Change damaged V-belts.

Checking tension

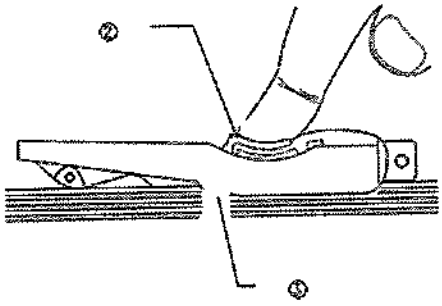
Use V-belts tension tester to check V-belts tension.



◆Lower indicator arm ① into the scale.
◆Apply tester to belt at a point midway between two pulleys so that edge of contact surface is flush with the V-belts.
◆Slowly depress pad until the spring can be heard to disengage. This will cause the indicator to move upwards.

If pressure is maintained after the spring has disengaged a false reading will be obtained.

Reading of tension

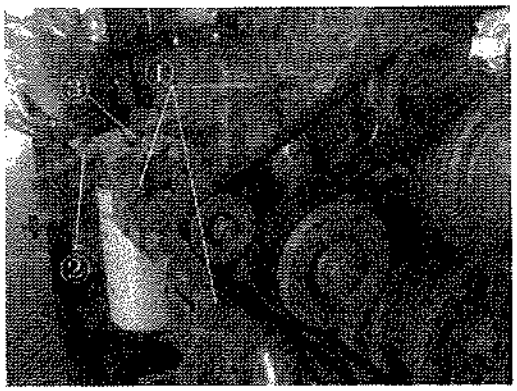


◆Reading of the tensioning force of the belt at the point where the top surface of the indicator arm intersects with the scale.
◆Before taking readings make ensure that the indicator arm remains in its position

If the value measured deviates from the setting value specified, the V-belt tension must be corrected.

Drive Belt width	Tensioning force (kg)		
	New installation		When servicing after long running time
	Installation	After10min. running time	
2/3 VX	90-100	70-80	60
4/3 VX	180-200	140-160	120

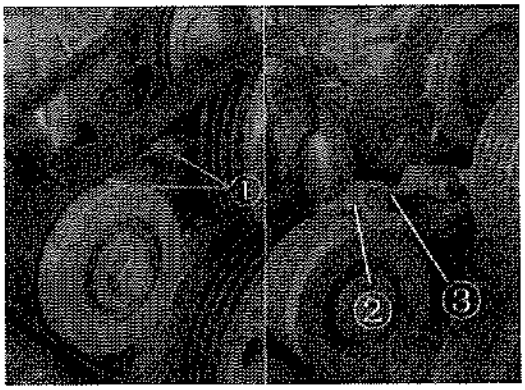
Tensioning and changing V-belt



Water pump - Alternator

- Remove fixing bolts① .
- Remove lock-nut ②
- Adjust nut ③ until V-belts have correct tensions.
- Retighten lock-nut and fixing bolts

To replace the V-belts loosen lock-nut and swing alternator inwards.

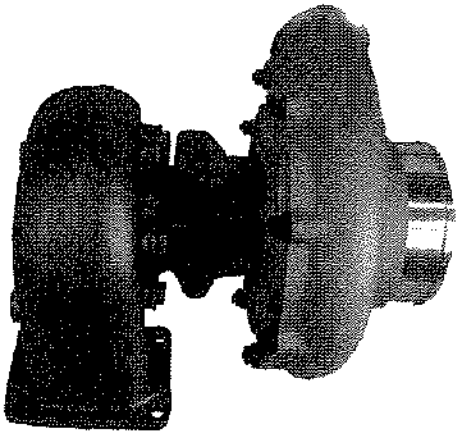


Fan - tensioning pulley

- Remove fixing bolts ①
- Remove lock-nut ②
- Adjust nut③ until V-belts have correct tensions
- Retighten lock-nut and fixing bolts

To change the V-belts turn the adjusting nut back and swing the tension pulley inwards.

6.6Turbocharger



At every engine oil change check the oil pipes for leaks and constrictions.

Furthermore, a regular check should be kept on charge air and exhaust gas pipes. Any leakages should be attended turbocharger to at once because they are liable to cause overheating of the engine.

The use of turbocharger and daily inspection and maintenance can be seen in "Turbocharger Instruction".

6.7Starter motor



Check that the electric cables are properly fastened and that contacts and plug connections are secure.

In engines fitted with electronic speed pickups at the gear ring (e.g. electronic speed governor and EDC), the speed pickup are to be cleaned too and metal chips that may adhere are to be removed.

Add lubricating oil regularly to the copper sleeve at the both ends of the starter motor, gears, gear tooth surface and so on.

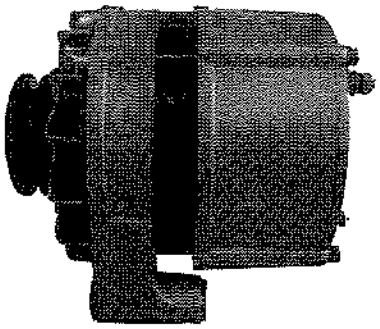
Regularly check if the commutator surface is smooth, the brush in the brush box is stuck, brush spring pressure is normal, and remove dust. In case of brush wear is too much, the commutator surface singeing seriously and other faults, the turbocharger should be removed for repair.

Regularly check the contact of electromagnetic switch, if its erosion is serious, it should be polished.

It should be overhauled every six months, depending on the use, this may be appropriate to shorten or extend the cycle.

Caution:
Always disconnect the battery earth cable before starting work on the electrical system. Connect up the earth cable last, as there is otherwise a risk of short-circuits.

6.8Alternator



The alternator is maintenance-free.
Nevertheless, it must be protected against dust and, above all, against moisture.
In order to avoid damage to the alternator, observe the following instructions.
While the engine is running

- Do not de-energize the main battery switch.
- Do not disconnect the battery or pole terminals or the cables.
- If, during operation, the battery charge lamp suddenly lights up, stop the engine immediately and remedy the fault in the electrical system!
- Do not run the engine unless the battery charge control is in satisfactory order!
- Do not short-circuit the connections of the alternator with those of the regulator or said connections with ground, not even by briefly bringing the connections into connect.
- Do not operate the alternator without battery connection!

7. Temporary decommissioning of engines

Temporary anti-corrosion protection according to Daewoo works norm is required for engines which are to be put out of service for fairly long periods.

The works standard can be obtained from our **After-Sales Service** department.

8. Torque guidance values

Notes:
All the nipples omitted below must be tightened in accordance with the torque values provided by Daewoo (see Page 31) . Oil the bolts a little during the installation.

Plug screw

M10x1, M12x1.5	50 Nm
M14x1.5, M16x1.5	80 Nm
M18x1.5, M22x1.5	100 Nm
M24x1.5, M26x1.5	120 Nm
M30x1.5	150 Nm

Cylinder body, Crankshaft drives

Bell housing to cylinder body M14, 12.9	225 Nm
Bell housing to cylinder body M10, 12.9	75 Nm
Peep hole cover to bell housing M10, 12.9	75 Nm
Main bearing cap to cylinder body	75 Nm
Initial torsion	300-330 Nm
Tightened angle	90-100°
Bumper to crankshaft M16 x 1.5. 10.9	260 Nm
Flywheel to crankshaft M16 x 1.5.	
Initial torsion	100-110 Nm
Tightened angle for the stage 1	90-100°
Tightened angle for the stage 2	90-100°
Connecting rod bearing cap M14 x 1.5	
Initial torsion	100-110 Nm
Tightened angle	90-100°

Cylinder cover

Rocker arm abutment to cylinder cover	65 Nm
Locknut on the adjusting screw of air valve	50 Nm

Lubrication system

.Oil pump to cylinder body M8, 8.8	22 Nm
Oil pump cover M8, 8.8	22 Nm
Oil cooler to oil filter bases M8, 8.8	22 Nm
Oil pump to oil filter box	30 Nm
Oil pump to cylinder body	22 Nm
Drain plug to sump M26 x 1.5	80 Nm
Piston cooling nozzle: flange to cylinder body M14 x 1.5	70 Nm

Exhaust/Intake manifold

Exhaust manifold to cylinder cover M10	
Initial torsion	60-65 Nm
Tightened angle	90-100°
Intake-tube to cylinder cover M8, 8.8	22 Nm

Fuel system

Fuel pump drive gear M8, 12.9	38 Nm
Fuel pump to cylinder body M10, 10.9	75 Nm
Fuel injector to cylinder cover M28 x 1.5	120-125 Nm
Spray nozzle locknut	45 Nm
High-pressure fuel pipe to fuel pump	
Initial torsion	10 Nm
Mounting rotary angle for the first time	60°
Assemble sequence rotary angle	30°

Starting motor

Starting motor to bell housing M12 x 1.5	80 Nm

Torque guidance values

Socket head screw or outside hex bolts/nut ,
without the pad or without flange

Thread specification x Pitch diameter	Grade/Tightened torsion（Nm）		
	8.8 / 8	10.9 / 10	12.9 / 12
M4	2.5	4.0	4.5
M5	5.0	7.5	9.0
M6	9.0	13.0	15.0
M7	14.0	20.0	25.0
M8	22.0	30.0	35.0
M8x1	23.0	35.0	40.0
M10	45.0	65.0	75.0
M10x1.25	45.0	65.0	75.0
M10x1	50.0	70.0	85.0
M12	75.0	105.0	125.0
M12x1.5	75.0	110.0	130.0
M12x1.25	80.0	115.0	135.0
M14	115.0	170.0	200.0
M14x1.5	125.0	185.0	215.0
M16	180.0	260.0	310.0
M16x1.5	190.0	280.0	330.0
M18	260.0	370.0	430.0
M18x2	270.0	290.0	450.0
M18x1.5	290.0	410.0	480.0
M20	360.0	520.0	600.0
M20x2	380.0	540.0	630.0
M20x1.5	400.0	570.0	670.0
M22	490.0	700.0	820.0
M22x2	510.0	730.0	860.0
M22x1.5	540.0	770.0	900.0
M24	620.0	890.0	1040.0
M24x2	680.0	960.0	1130.0

9. Trouble-shooting table

Fault	Reason
Engine does not start , or starts only with difficulty	Fuel tank empty Fuel cock closed Air in fuel system Fuel pre-filter /pre-cleaner clogged Condensation in fuel Air filter clogged Electric circuit interrupted Batteries flat Starter /solenoid switch defective Start of delivery not correct / incorrectly set Injection nozzles clogged Internal damage to engine (piston seized , possibly caused by water in fuel) Valve clearance incorrect
Engine starts but does not reach full speed or stalls	Fuel pre-filter /pre-cleaner clogged Air filter clogged Fuel quality not in accordance with specifications or fueled severely contaminated
Engine idles out of true when warm , misfiring	Air in fuel system Fuel pre-filter /pre-cleaner clogged Start of delivery not correct / incorrectly set Lower idling speed set too low Valve clearance incorrect Injection nozzles of injection pipes leaking
Engine speed fluctuates during operation	Air in fuel system Too little fuel in tank Rotating speed counter defective Injection nozzles defective or carbonized
Power output unsatisfactory	Air in fuel system Fuel pre-filter /pre-cleaner clogged Air filter clogged Fuel quality not in accordance with specifications or fueled severely contaminated Engine being asked to do more than it has to Fuel supply faulty , fuel too warm Oil level in sump too high Incorrect rated speed setting

Trouble-shooting table

Fault	Reason
Coolant temperature too high ,coolant being lost	Coolant level too low Air in coolant circuit Radiator very dirty Tension of coolant-pump V-belts incorrect (slip) Cap with working valves on expansion tank / radiator defective or leaking Temperature gauge defective Coolant pipes leaking , blocked or twisted
Lube oil pressure too low	Oil level in sump too low Engine temperature too high Oil filter clogged Oil pressure gauge defective Selected oil viscosity not suitable for ambient temperature (oil too thin) Oil in sump too thin (mixed with condensation or fuel)
Lube oil pressure too high	Oil pressure gauge defective Selected oil viscosity not suitable for ambient temperature (oil too thin) Engine cold
Black smoke accompanied by loss of power	Air filter clogged Start of delivery not correct / incorrectly set Injection nozzles defective or carbonized
Blue smoke	Oil level in sump too high Engine , coolant or intake air still to cold Lube oil getting into combustion chamber (piston worn , piston rings worn or broken) Overpressure in crankcase (crankcase breather clogged) Long operation under a low load
White smoke	Air in fuel system Fuel pre-filter /pre-cleaner clogged Start of delivery not correct / incorrectly set Fuel quality not in accordance with specifications or fueled severely contaminated Injection nozzles defective or carbonized Engine , coolant or intake air still to cold Coolant getting into combustion chamber (cylinder head / gasket leaking)
Knocking in the engine	Start of delivery not correct / incorrectly set Valve clearance incorrect Engine operating temperature incorrect
Engine " too loud "	Valve clearance incorrect Intake or exhaust pipe leaking

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ECO - ECP

SELF-REGULATING ALTERNATORS SERIES ECO-ECP — GB
OPERATING AND MAINTENANCE INSTRUCTIONS

ALTERNATORI AUTOREGOLATI SERIE ECO-ECP — IT
ISTRUZIONI PER L'USO E LA MANUTENZIONE

ALTERNATEURS AUTO-REGULES SERIE ECO-ECP — F
MANUEL D'INSTRUCTION ET DE MAINTENANCE

SELBSTREGELNDER GENERATOR SERIE ECO-ECP — D
BETRIEBS-UND WARTUNGSANLEITUNG

ALTERNADORES AUTOREGULADOS SERIE ECO-ECP — E
INSTRUCCIONES PARA USO Y MANTENIMIENTO

自调节式发电机 ECO-ECP系列 — CN
操作及保养手册

САМОРЕГУЛИРУЕМАЯ ГЕНЕРАТОРЫ СЕРИИ ECO-ECP — RU
ЭКСПЛУАТАЦИЯ И ТЕХНИЧЕСКОЕ ОБСЛУЖИВАНИЕ ИНСТРУКЦИЯ

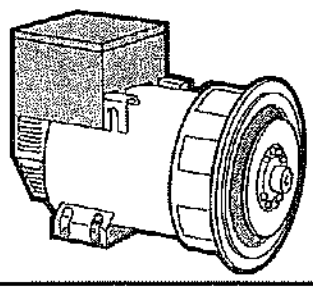
SAMOREGULAČNÍ ALTERN SERIES ECO-ECP — CZ
OPERACE A ÚDRŽBU

ÖNSZABÁLYOZÓ GENERÁTOR SERIES ECO-ECP — HU
ÜZEMELTETÉSI ÉS KARBANTARTÁSI UTASÍTÁSOK

SAMOREGULUJĄCY SERIES ALTERNATORY ECO-ECP — PL
OPERACJE I KONSERWACJI

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OPERAȚIUNI INSTRUCȚIUNILOR DE ÎNTREȚINERE ȘI

SAMOREGULAČNÉ ALTERNA SERIES ECO-ECP — SK
OPERÁCIE A ÚDRŽBU

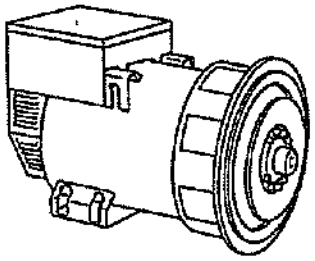


CE SA® cULus INSULATION SYSTEM

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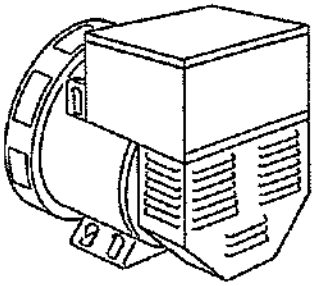
MACHINE DESCRIPTION



ECO-ECP 2 and 4 pole alternators are brushless, self-regulating and incorporate a rotating inductor with damper cage winding and a fixed stator with skewed slots.

The stator windings have a shortened pitch to reduce the harmonic content of the output waveform.

The alternators are made in compliance with the 2006/42, 2006/95, 2004/108 CEE directives and their amendments, and the CEI 2-3, EN 60034-1, IEC 34-1, VDE 0530, BS4999-5000, CAN/CSA-C22.2 N°14 -N°100 regulations.

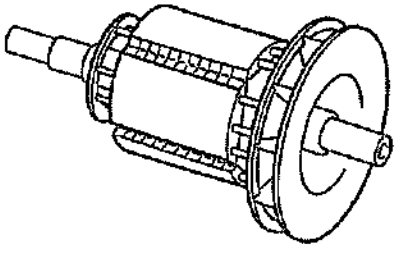


Tests to verify the electromagnetic compability have been carried out in the foreseen conditions by the standards with the neutral connected to the earth.

On customer's request alternators can be manufactured according to different specifications.

The robust mechanical construction gives good access to the generator output connections, and allows the user to inspect the various components with ease.

The casing is made of steel, the shields of cast iron, and the shaft of C45 steel and it has a keyed fan.



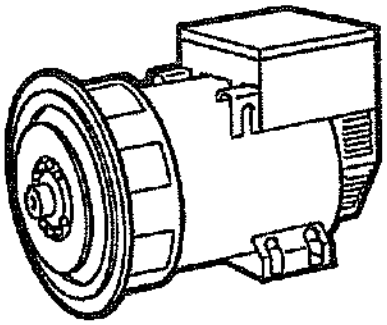
The mechanical protection level meets standard IP21 (upon request higher levels of protection can be supplied).

Insulation materials meet Class H requirements, and all rotating components are epossy resins impregnated; higher voltage parts, such as the stators, are vacuum-treated (special treatments are available on request).

INTRODUCTION

The ECO-ECP alternators comply with the EEC 2006/42, 2006/95, 2004/108 directives and their amendments; therefore they pose no danger to the operator if they are installed, used and maintained according to the instructions given by Mecc Alte and provided the safety devices are kept in perfect working conditions.

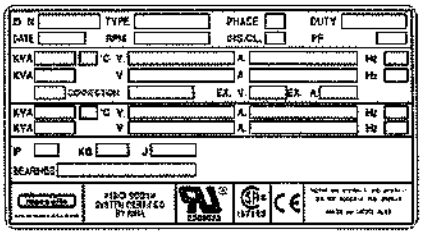
Therefore a strict observance of these instructions is required.



Any reproduction of this manual is forbidden.

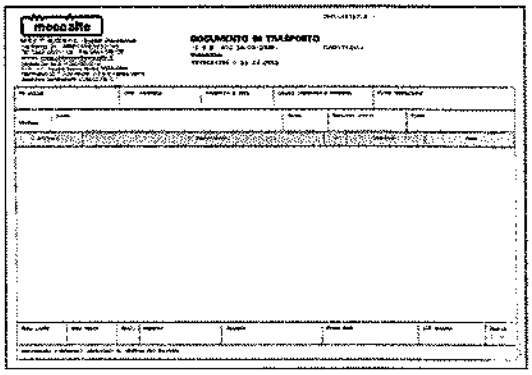
MACHINE IDENTIFICATION

Always indicate the generator type and code when contacting Mecc Alte or the authorized after sales service centres.



INSPECTION ON DELIVERY

When the alternator is delivered, check that unit conforms with the delivery note and ensure that there are no damaged or defective parts; should there be any, please inform the forwarding agent, the insurance company, the seller or Mecc Alte immediately.



SAFETY REQUIREMENTS

Before any cleaning, lubrication or maintenance operation, ensure that the generator is stationary and disconnected from the power supply.

When stopping the generator, ensure the compliance with the procedures for stopping the prime mover.

The generator, in fact, has no Emergency Stop, but is controlled by the device arranged by the installer.



In consulting this use and maintenance manual, you will find several symbols, which have a specific meaning, as illustrated below.

CONVENTIONAL SYMBOLS AND SYMBOL DESCRIPTION

IMPORTANT

This symbol warns the personnel concerned that the described operation may cause damages to the machine if it is not carried out according to the safety standards.



CAUTION

This symbol warns the personnel concerned that the described operation may cause damages to the machine and/or injures to the personnel if it is not carried out according to the safety standards.



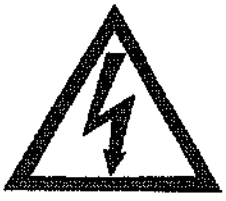
WARNING

This symbol warns the personnel concerned that the described operation may cause serious injuries or death to the personnel if it is not carried out according to the safety standards.



DANGER

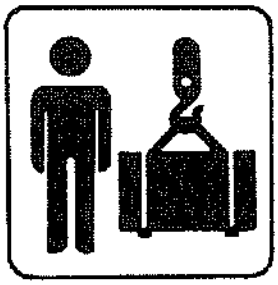
This symbol warns the personnel concerned that the described operation may immediately cause serious injuries or death to the personnel if it is not carried out according to the safety standards.



HANDLER

This symbol identifies the type of operator in charge of the operation described.

This qualification requires a complete knowledge and understanding of the information contained in the manufacturer's instruction manual as well as specific skills about the hoisting means, slinging methods and features and safe handling procedures.



MECHANICAL SERVICE MAN

This symbol identifies the type of operator in charge of the operation described.

This qualification requires a complete knowledge and understanding of the information contained in the manufacturer's instruction manual as well as specific skills necessary to perform installation, adjustment, maintenance, cleaning and/or repair operations.



ELECTRICAL SERVICE MAN

This symbol identifies the type of operator in charge of the operation described.

This qualification requires a complete knowledge and understanding of the information contained in the manufacturer's instruction manual as well as specific skills necessary to perform electrical operations such as connections, adjustment, maintenance and/or repair.

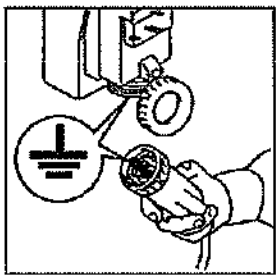
The electrical service man must be able to work even in case electrical cabinets and panels are live.



In case of exceptional operations and upon written request of servicing operations please apply to Mecc Alte authorized centers.

Before installing the generator, arrangements must be made to earth the machine.

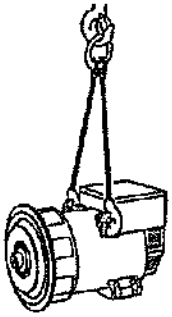
This is the reason why you must make sure that the grounding system is in good conditions and in compliance with the regulations of the country where the generator will be installed.





CAUTION

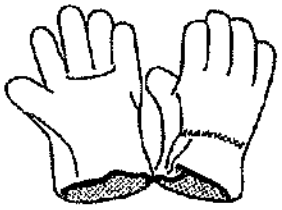
THE FINAL INSTALLER IS RESPONSIBLE FOR THE INSTALLATION OF ALL THE PROTECTIONS (SECTIONING DEVICES, PROTECTIONS AGAINST DIRECT AND INDIRECT CONTACTS, OVERCURRENT AND OVERVOLTAGE PROTECTIONS, EMERGENCY STOP, ETC.) NECESSARY FOR THE MACHINE TO COMPLY WITH THE EXISTING INTERNATIONAL/EUROPEAN SAFETY REGULATIONS.





For handling the unpacked generators, always use the special eyebolts only; use ropes having a suitable carrying capacity and do not lift the generator too much from the floor (max 30 cm.).

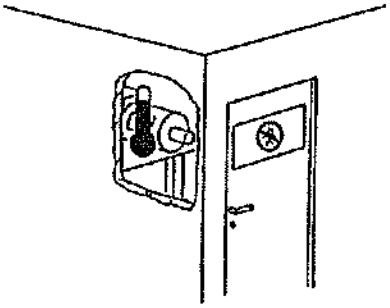
When the machine is worn cut, contact the companies in charge of the disposal of ferrous material and do not throw away its parts into the environment.



The operators in charge of the installation, operation and maintenance of the generators must be skilled technicians who know the characteristics of the generators.

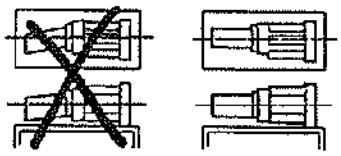


The people in charge of the handling must always wear work gloves and safety shoes. In case the generator or the whole plant must be lifted from the floor, the operators must wear a safety helmet.

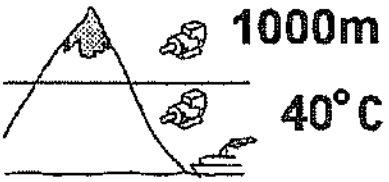


The generator must be installed in an airy room. If there is not enough air, a malfunction or an overheating may occur (table 25 pag. 44). All entry doors into generator room should be clearly marked "Authorized persons only".
Make sure that genset foundations and baseframe are suitable to bear the combined weight of the alternators and prime mover.

The installer is responsible for the correct coupling of the generator to the engine and for the performance of all precautions necessary to guarantee the correct operation of the generator and avoid abnormal stress, which could damage the generator (such as vibrations, misalignment, strange noises or vibrations, etc.)



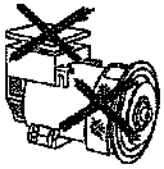
The machine was designed to guarantee the nominal power in environments with a maximum temperature of 40° C, at altitudes lower than 1000 m asl (EN60034-1), unless otherwise specified; for different operating conditions, see the commercial catalogue (brochure).



No person must wear fluttering clothes (such as scarves, etc.) near the machine and any garment must be fastened with elastic bands at its ends.



The generators must never and for no reason run whith following guards removed:
-) terminals cover
-) front covers
-) fan guards.



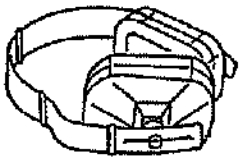
During assembling and disassembling operations, hold carefully both ends of the protection grid as the related material elasticity can be harmful.



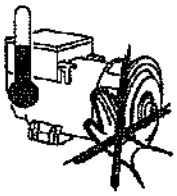
In some machines the regulators are equipped with 3 leds which can be seen from the outside (as standard equipment on large machines, as optional equipment on small machines):

Green led - correct operation
Yellow led - overload protection on
Red led - low speed protection on.

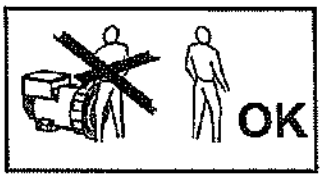
The generators are noisy (table 25 pag. 44); even if the sound level is certainly lower than that of the prime motor, they must be installed in soundproof rooms (room, engine room, etc.) where it is necessary to wear antinoise protectors.



The generators produce heat proportional to the output.
Therefore, do not touch the generator if you do not wear antiscorch gloves and, after switching it off, do not touch it until it has cooled down.



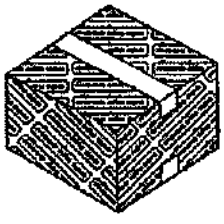
Even if all the machine components are protected, keep away from the machine.
Do not lean or sit on the generator for whatever reason.



Do not remove the labels for whatever reason; on the contrary, if necessary, replace them.

DANGER OF SHORT CIRCUIT

The degree of protection of the generator is IP21; therefore it is made prohibition to use whichever type of hydrocleaner and to spray liquids over the parts containings electrical components.



In case of replacement of spare parts, use original spare parts only.

For the replacement of worn parts, carefully follow the maintenance instructions; these operations must be carried out by skilled technicians.

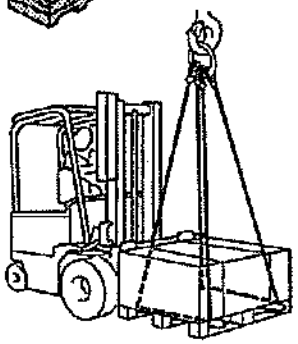
TRANSPORT AND STORAGE



Alternators will be packed for shipment in a manner suitable to their mode of transport and final destination.

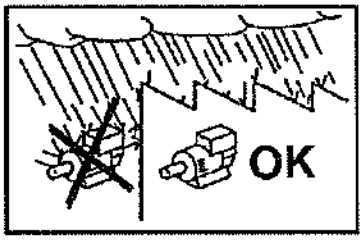


Prior to handling goods, please ensure that lifting equipment is of sufficient capacity. Under lifting conditions machinery should be elevated to a minimal distance from the ground.

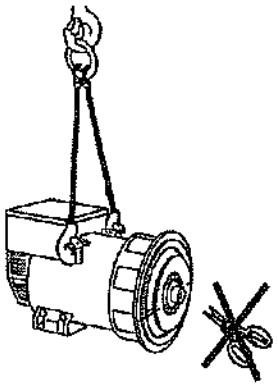


When lifting or moving goods by forklift apparatus, care should be taken to ensure that forks are correctly positioned to prevent slipping or falling of pallet or crate.

Both packed and unpacked alternators shall be stored in a cool and dry room, and shall never be exposed to the inclemency of the weather.



With regard to single bearing alternators (form MD35) please ensure that the rotor fixing clamps is in place. Failure to do so may lead to slippage or assembly.



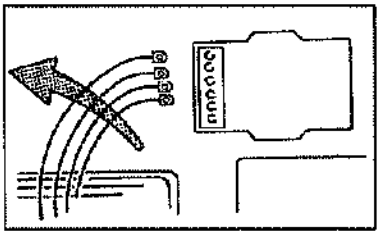
When installing the alternators, always lift them by using their eyebolts (table 25 pag 44).

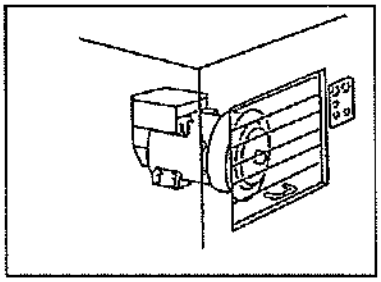
IMPORTANT :

AFTER PROLONGER STORAGE OR IF THE MACHINES SHOW SIGNS OF CONDENSATION, ALL WINDINGS SHOULD BE SUBJECTED TO INSULATION TESTS PRIOR TO OPERATING.

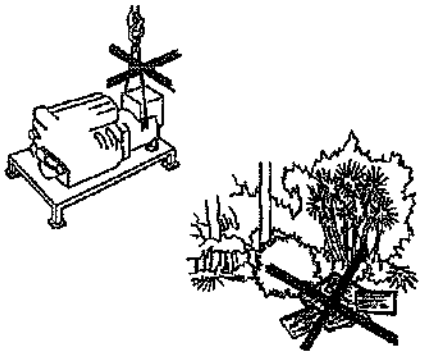
THE INSULATION TEST SHALL BE MADE BY SKILLED PERSONNEL.

BEFORE CARRYING OUT THE TEST, THE VOLTAGE REGULATOR MUST BE DISCONNECTED; IF THE TEST RESULTS ARE TOO LOW (LOWER THAN 1 MΩ)(EN60204-1) THE ALTERNATOR MUST BE DRIED IN AN OVEN AT 50-60°C.





Once the generator is coupled with an engine, mounted on a baseframe, or installed on a complete generating set, it cannot be lifted by its lifting bolts. The relevant instructions for lifting complete generating set should be followed.



Any packing materials should be disposed of via correct waste disposal methods. Do not discard waste materials into the environment.

MECHANICAL COUPLING



For transit and storage purposes the generator flange spigot and the generator end shaft (for the generators in B3-B14 construction form) have been coated with a rust preventer that can be removed easily.
This MUST BE removed before assemblying to the engine.

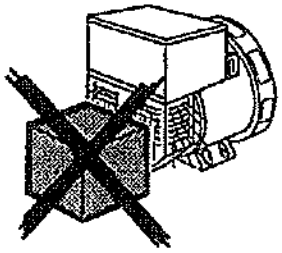
The mechanical coupling is under the sole responsibility of the final user, and has to be done at his discretion (for tightening torque see tab. 24 pag. 43).

A bad alignment may cause vibrations and bearing damages. It is advisable to verify the compatibility of the engine / generator torsional characteristics (by the customer).

The necessary data for this verification are available on the concerning documentation.

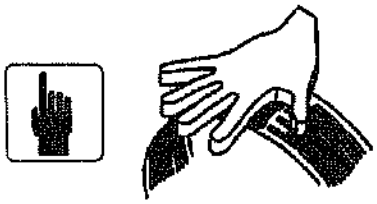
Warnings:

BEFORE STARTING THE ALTERNATOR, CHECK THAT THE AIR INLETS AND OUTLETS ARE FREE OF ANY OBSTRUCTIONS.

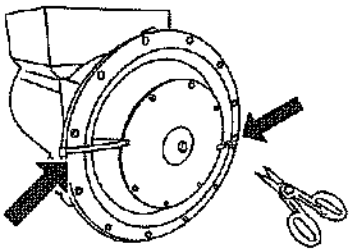


THE AIR INLETS SHOULD NOT BE NEAR ANY HEATING SOURCES. IN ANY CASE, IF NOT SPECIFICALLY REQUESTED, THE COOLING AIR TEMPERATURE MUST BE EQUAL TO THE ENVIRONMENT TEMPERATURE AND NEVER HIGHER THAN 40°C.

DURING ASSEMBLING AND DISASSEMBLING OPERATIONS, HOLD CAREFULLY BOTH ENDS OF THE PROTECTION GRID AS THE RELATED MATERIAL ELASTICITY CAN BE HARMFUL.



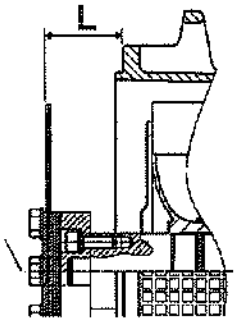
BEFORE MECHANICAL COUPLING OF SINGLE BEARING ALTERNATORS, REMOVE THE ROTOR SECURING DEVICE, IF FITTED, PLACED THERE TO PREVENT ROTOR FROM SLIPPING.



INSTRUCTIONS FOR THE ASSEMBLING OF GENERATORS WITH MD35 FORM

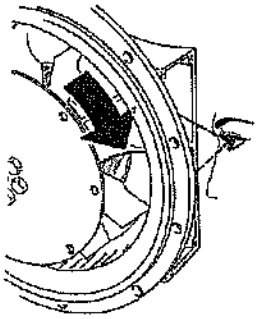
A bad alignment may cause vibrations and bearing damages. It is advisable to verify the compatibility of the engine / generator torsional characteristics (by the customer).

The necessary data for this verification are available on the concerning documentation.



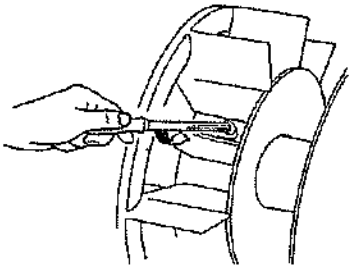
For the coupling of a generator with MD35 form, proceed as follows:

a) according to the type of the coupling, verify the correct placement of the discs (dimension "L") (table 24 pag. 43); if necessary restore the "L" dimension moving gently and axially the rotor. In the right position the clearance of rear bearing should be from 0.5 to 2 mm.

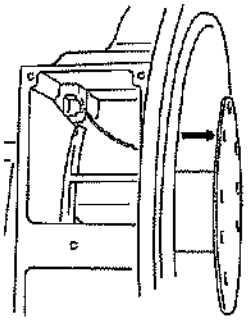


b) (For series 28) through one of the two lateral openings, and by manually rotating the rotor, detect the relevant clamp screw on the fan hub

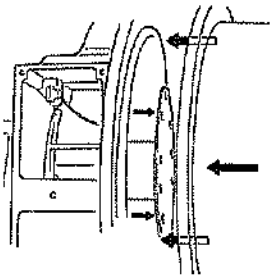
c) (For series 28) let the fan be free to rotate by slackening the M8 screw by means of an hexagonal wrench, possibly having an articulated head



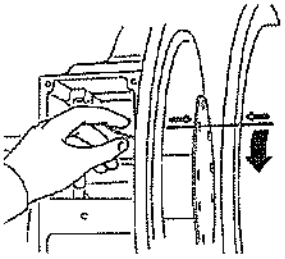
d) (For series 28) position one of the disk holes near the upper part of one of the side openings and place the slit that is on one of the fan blades, in the same position



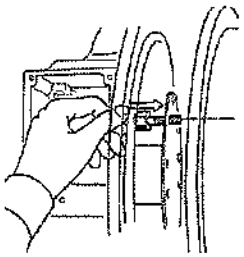
e) move the generator close to the coupling engine

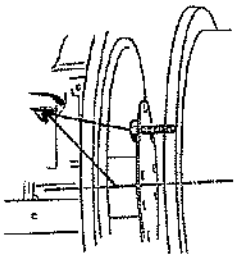


f) align one of the flywheel disk fastening holes with the holes of the previously positioned disks (point "d")

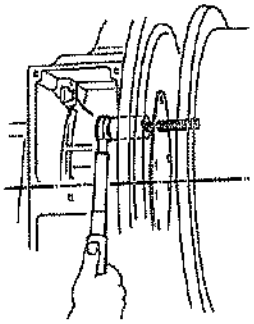


g) Insert and partially tighten the screws that lock the disks to the flywheel. Keeping the fan still (ECP28), turn the flywheel until another two holes are in the same position and partially tighten the screw. Repeat this operation for all the other holes

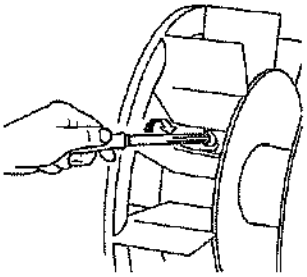




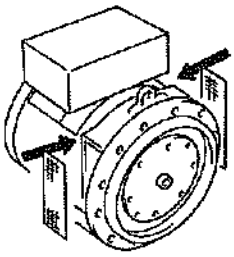
h) after inspecting the correct centring of the disks on the engine flywheel, the screws must be completely tightened



i) (For series 28) once the clamping of the disks is over, stop the fan once again by tightening the screw with a torque wrench setting adjusted at 16 Nm ± 10%; the radial position of the fan is not binding for the correct operation of the system

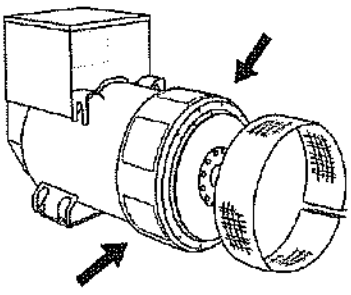


l) fix the protection grids supplied with the generator.



Compliance with items "i" and "l" is of the utmost consequence in order to avoid serious damages to the generator or hazardous situations for people or objects.

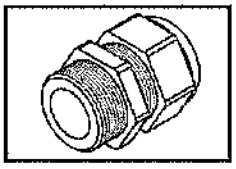
Only after a correct mechanical coupling, proceed with the electrical connections



ELECTRICAL CONNECTIONS

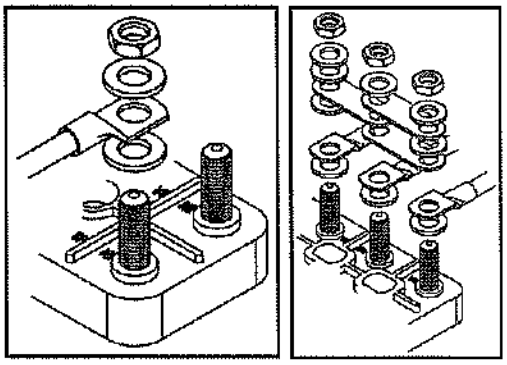


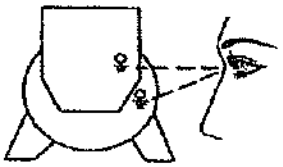
All electrical output connections are the responsibility of, and are at the discretion of, the end user.
When making terminal box connections, all cable and terminal lugs should meet the relevant standards of the country of final destination.

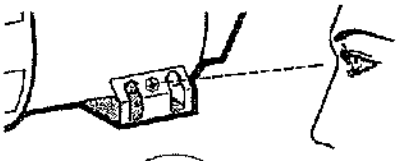


WINDINGS CONNECTION

All alternators feature both star with neutral (Y) and delta (Δ) connections (table. 2 pag.31).
To reconnect from a star to delta connection (for ex. from 400V to 230V), modify the linking arrangements on the output terminal board (see diagram on table 2 page 31).
It is not necessary to adjust the voltage regulator.
Standard alternators are equipped with 12 cables to offer different voltages (ex.230 / 400 / 460 / 800V).
The alternator must always be earthed by sufficiently rated cable, using one of the inside or outside terminals. For the electrical connections use wires suitable for the power of the generator and connect them to the terminal board as indicated on table 12 or 17.
After completing output connections (for tightening torque see tab. 24 pag. 43), ensure that the terminal box cover is securely in place.

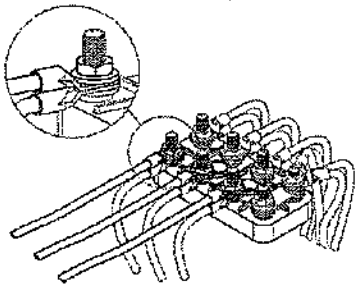


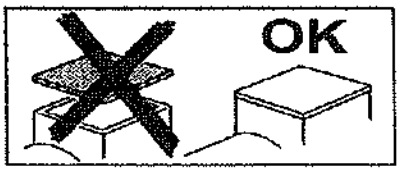




IMPORTANT: frequency variations.

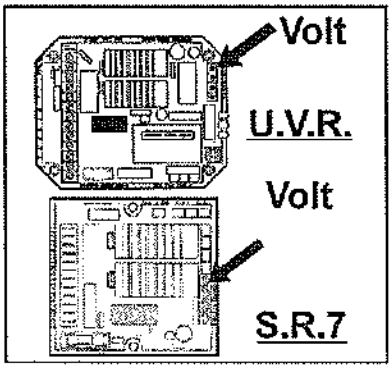
A standard production machine wound for 50 Hz can also function at 60 Hz (and vice versa) by resetting the A.V.R. voltage potentiometer to the new nominal voltage value. When changing from 50 to 60 Hz the alternator power, and nominal voltage will increase by 20%, but the current does not change from 50 Hz value. Should voltage stay at 50 Hz nominal value, then the output power may be increased by 5% due to improved ventilation.
For machines wound for 60 Hz, changing to 50 Hz, the voltage and power values have to decrease by 20% of 60 Hz value.





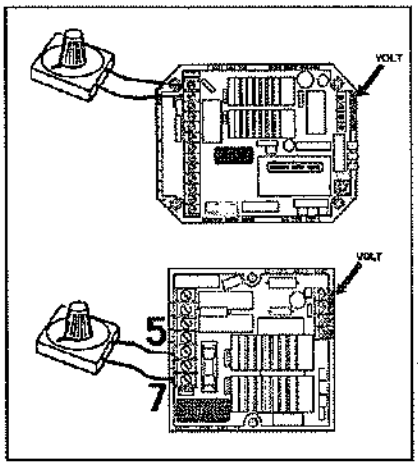
REGULATORS (table 3 pag 31)

Either U.V.R.6/1-F and S.R.7/2-G regulators can be used on the ECO-ECP series without affecting performances.
The U.V.R.6/1-F is a standard feature on the 38 - 40 - 43 - 46 models whereas the S.R.7/2-G is standard on the 28 - 31 - 32 - 34 series.
The two regulators ensure the same level of performance but have different signal systems and references.



IMPORTANT:
the generator output voltage must be checked under no-load conditions, with the correct setting of frequency.

The voltage may be adjusted by ± 5% of the nominal, by acting upon the voltage potenziometer on the electronic regulators.



It is possible to get a remote voltage regulation of ± 5% inserting in the proper terminals a 100K potentiometer (for the 6 lead units) or a 100K potentiometer with a 100K resistance in series (for the 12 lead units)

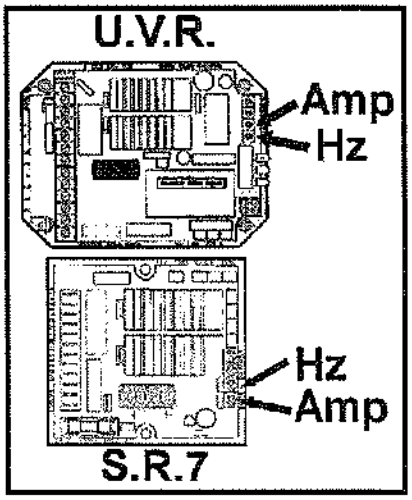
Instructions to follow for the external potentiometer connection :

CAUTION: in order to get a correct working of the alternator, it is necessary to follow the following procedure, connecting the external potentiometer.

1) Turn the VOLT trimmer of the electronic regulator completely anticlockwise.
2) Set the external potentiometer at half turn and connect it to the proper terminals of the electronic regulator.
3) Adjust the voltage at the nominal value by the VOLT trimmer of the electronic regulator.

PROTECTIONS
U.V.R.6/1-F - S.R.7/2-G

Both regulators are provided with an underspeed protection with an intervention threshold which can be adjusted by the potentiometer marked "Hz". This protection intervenes instantaneously by reducing the alternator voltage to a safe value when frequency falls below 10% of the nominal value. These regulators also have inherent overload protection which senses the exciter field voltage value. Should this field voltage value exceed the nominal value for a period of more than 20 seconds, then again the alternator voltage is automatically reduced to a safe operating level. This overload function has a built-in delay to allow for the overload when starting motors (normally 5-10 seconds). The operating threshold of this protection device is adjustable by the potentiometer marked "AMP".

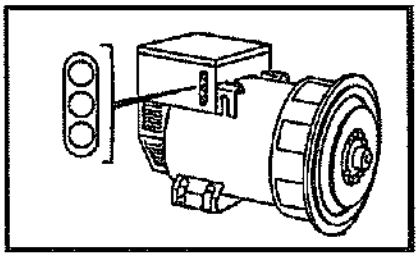


NOTE : When using the machine in single phase, or for voltages different from the one pre-set at the factory, recalibration of the AMP and STAB potentiometers could be necessary.

U.V.R.6/1-F

Aside from the above mentioned characteristics, the U.V.R.6/1-F regulator also offers the following:

1 - possibility to have single-phase as well as three-phase sensing.
2 - led indicators for self-diagnosis which indicate the unit's operational conditions: a green led which when lit confirms the alternator's normal functioning; a red led indicates the underspeed protection is on; a yellow led indicates the overload protection is on.



IMPORTANT

In normal functioning, only the green led has to be lit.

All these indicators can be remotely controlled and adjusted, for any type of use, by utilizing the SPD96/A accessory which is available on request.

INTERVENTION OF PROTECTION DEVICES CAUSES.

Underspeed protection instantaneous intervention:

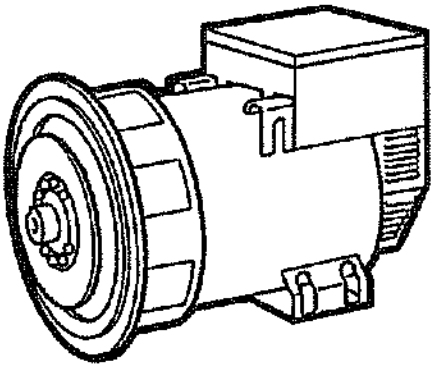
1 - speed reduced by 10% of nominal RPM.

Delayed intervention of overload protection:

2 - overload by 20% of nominal rating.
3 - power factor (cos φ) lower than the nominal-one.
4 - ambient temperature above 50°C.

Intervention of both protections:

5 - combination of factor 1 with factors 2, 3, 4.



In case of intervention the output voltage will drop down to a value which will depend on the fault.

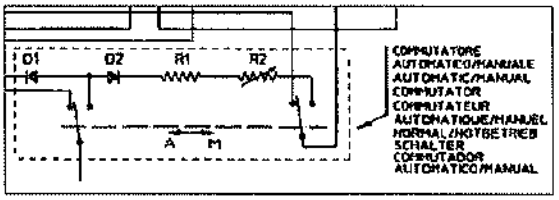
The voltage will return automatically to its nominal value as soon as the fault is removed.



For further details on regulators, please see the specific manual.

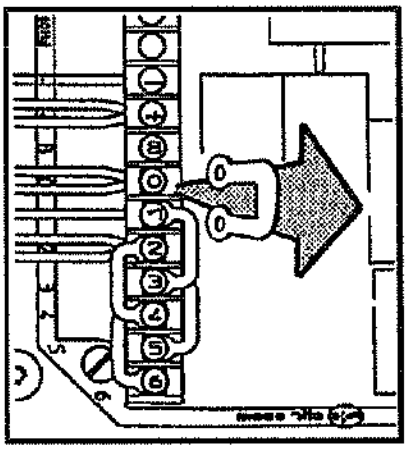
OPTIONALS :

All ECO-ECP series alternators can function with manual regulation, without assistance from any external source, by using a rheostat (tab. 10-11 pag. 36).

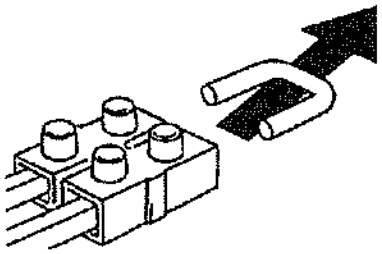


PARALLEL OPERATION

Should the alternators be required to operate in parallel, it is necessary to add a paralleling device to ensure equal droop of generator output voltages.
This ensures that if the machines are operated separately, the voltage droop (4% approx.) is equal when switching from no-load to full load.
The parallel device is fitted as standard on 40 - 43 - 46 models, therefore when two or more of these units must function in parallel, it is sufficient to remove the bridge which shortcircuits the secondary winding of the parallel device.



On smaller models this device is mounted on request or it can be added (except for ECP28/4) by the client himself following the instructions of tables 14-16-18-20.
After the device has been mounted, check whether the connection has been properly made; make sure that there is a voltage drop of approximately 4% in the machines when they function individually switching at rated speed and cosφ 0.8 from no-load to full load operation.



HOW TO MOUNT THE PARALLEL DEVICE

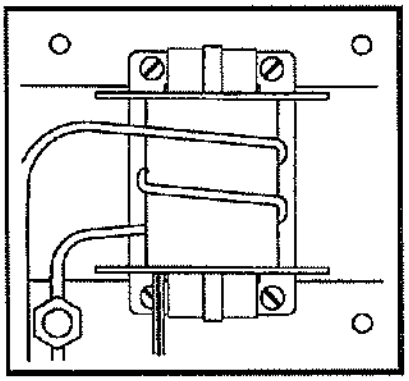
Referring to tables 14-16-19 mount parallel device as indicated.

Connect the power turns in series with phase.

The numbers of turns to be wound on the transformer will be indicated in the instruction accompanying the transformer itself.

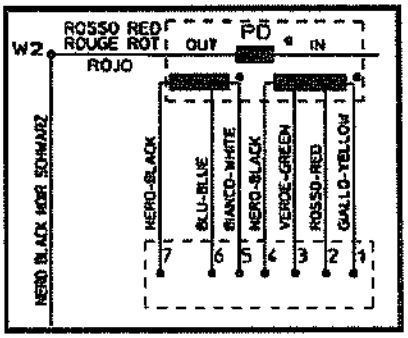
The secondary winding of the parallel transformer must be connected in series to the sensing of the electronic regulator as shown on tables 4 - 5 page 32.

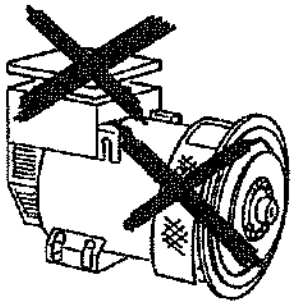
In order to activate the parallel device remove the bridge which shortcircuits the secondary winding of the device itself as shown in the above mentioned tables.



NOTE

When requesting a parallel device, it is necessary to indicate the nominal data of the alternator on which the device will be applied.



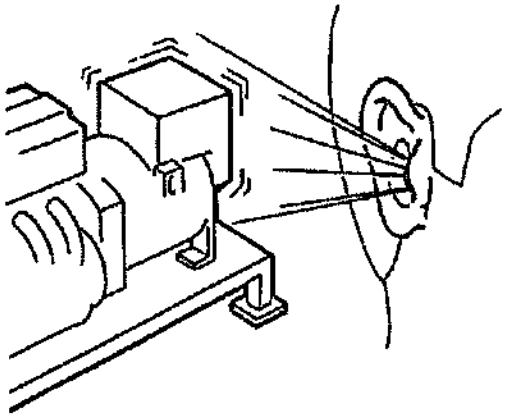


After all the electric connections have been made and only **after all the protections have been put in place**, can the system be started.

STARTING AND STOPPING THE OPERATIONS

All the instrumentation for starting, running and stopping the system shall be provided by the installer.

THE STARTING, RUNNING AND STOPPING OPERATIONS MUST BE CARRIED OUT BY SKILLED PERSONNEL WHO HAVE READ AND UNDERSTOOD THE SAFETY INSTRUCTIONS AT THE BEGINNING OF THIS MANUAL.

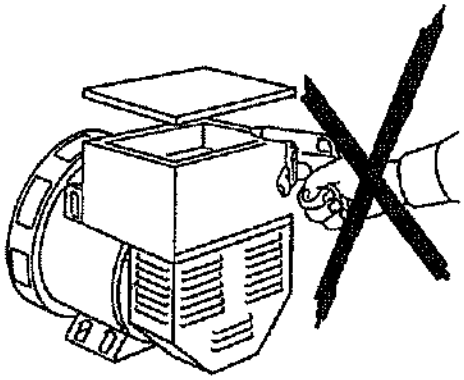


IMPORTANT :

When the system is set to work for the first time, which has to be done at a reduced speed, the operator shall check that no anomalous noises can be detected.
If an anomalous noise is detected, stop the system immediately and improve the mechanical coupling.

CLEANING AND LUBRIFICATION

Prior to approaching or touching the alternator, ensure that it is not live and it is at room temperature; at this stage it is possible to clean it on the outside using compressed air.



NEVER USE LIQUIDS OR WATER.

DO NOT CLEAN THE INSIDE ELECTRIC COMPONENTS WITH COMPRESSED AIR, BECAUSE THIS MAY CAUSE SHORT-CIRCUITS OR OTHER ANOMALIES.

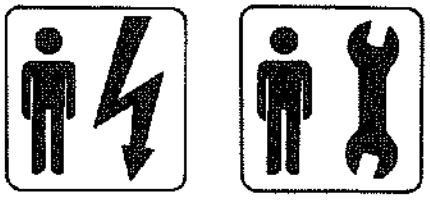
For the lubrication of bearings, see table 23 on page 42.

MAINTENANCE



The alternators series ECO-ECP are designed to give a long maintenance free working life.

BEFORE PERFORMING THIS OPERATION, READ THE SAFETY REQUIREMENTS AT THE BEGINNING OF THIS MANUAL CAREFULLY.



Maintenance operations on Mecc Alte generators can be divided into routine and extraordinary maintenance operations; in both cases, all operations must be authorised by the safety representative and they must be carried out when the machine is turned off and insulated from the electric installation or from the power mains.
High qualified mechanical or electrical technicians must carry out maintenance operations and any fault search since all operations described hereunder could put personnel in serious danger.
It is also highly recommended to take all the necessary precautions so as to prevent an inadvertent starting of the machine during maintenance and fault search operations..

Routine maintenance operations can be summed up as follows:

a) Assessment of windings conditions after long periods of storage or inactivity
b) Assessment, on a regular basis, of correct functioning (absence of anomalous noises or vibrations)
c) Mechanical inspections on all fastening bolts and, in particular, on electric connections
d) external cleaning of generator

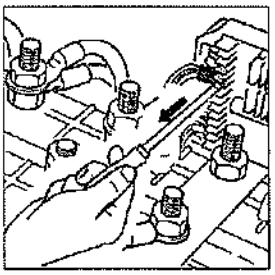


fig. a

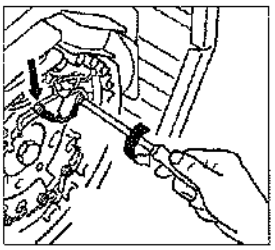


fig. b

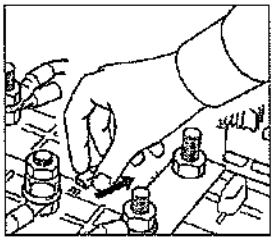


fig. c

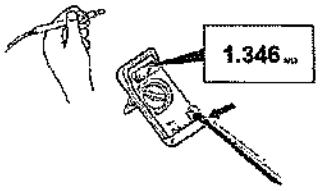
a) Assessment of windings conditions after long periods of storage or inactivity.

Measuring the insulating earth resistance can assess the condition of the windings. This measurement can be carried out with a "Megger" device, or similar, with a 500V direct-current voltage. It is very important to disconnect the voltage regulator (fig. a), the rotating diode bridge (fig. b) and the radio-interference filter (fig. c), as well as any other device connected to the windings to be checked, before carrying out the measurement.

The figure resulting from the measurement of the windings' earth resistance must be over 1MΩ.

Should the figure be smaller than the above mentioned one, the windings must be adequately dried up. This can be done by directing a jet of hot air of about 50-60°C into the generator's air inlets or outlets; alternatively, the stator's windings can be electrically connected and a voltage can be passed through them by means of a directcurrent power supply. The amount of current in the windings depends on the generator size, even though it must be fixed according to the nominal values stated on the plate.



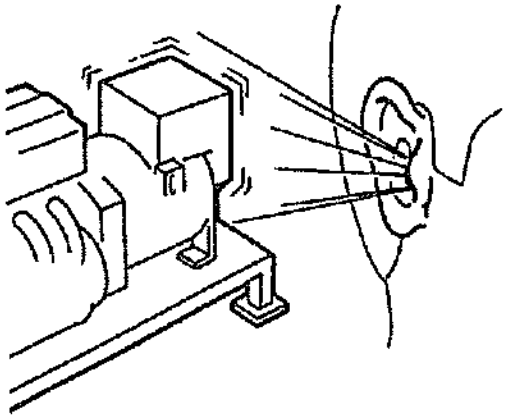


b) Assessment of current functioning (absence of anomalous noises or vibrations).

We recommend users to check regularly the correct functioning of the generator, and to verify that there are no anomalous noises or vibrations; their presence might indicate damage of bearings.

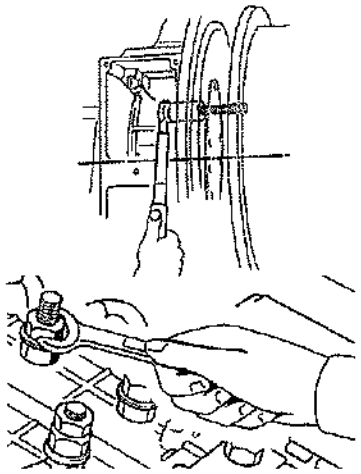
May we remind you that the alternator itself has no particular vibration since the rotating parts are perfectly balanced. Provided that the rotor balancing has not been altered and that the rotor's bearings have not been damaged, vibrations in the generator set may occur due to alignments of couplings, due to stress upon the combustion engine, or to vibration mounts.

We also recommend checking of performance data which must comply with the data on the generator's plate.



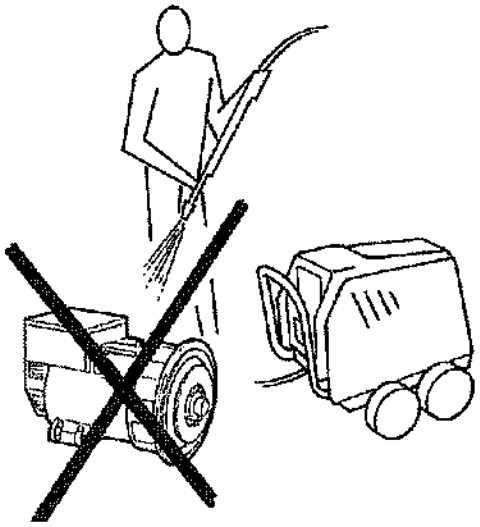
c) Mechanical checks of fastening bolts and, in particular, of electric connections.

We recommend a regular check of all fastening bolts, which must be perfectly tightened up. Special attention should be paid to all electric connections; this inspection must be carried out in the complete absence of voltage. To choose the correct tightening wrenches suitable for the different sizes of the bolts, see generator manual.



d) Internal and external cleaning of the generator.

For the external cleaning of the generator, you can use compressed air. The use of hydrocleaners and detergent fluids is strictly forbidden. The standard protection degree of the generator is IP21; therefore, use of fluids could cause anomalies or even short-circuits.

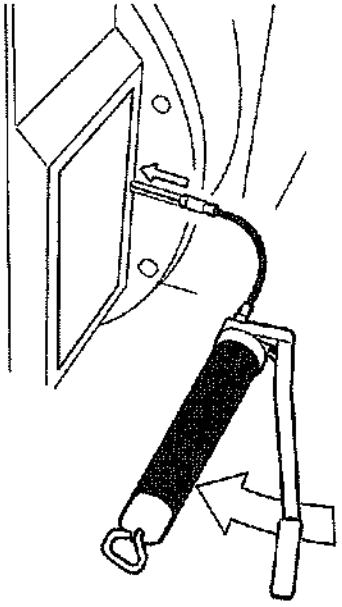


Extraordinary maintenance operations can be summed up as follows:

a) Maintenance and replacement (if necessary) of bearings
b) Cleaning of air filters (if available)
c) Cleaning of windings
d) Replacement of diode bridge
e) Replacement of exciter
f) Replacement of voltage regulator
g) Check of residual voltage

a) Maintenance and replacement (if necessary) of bearings.

During the assembling phase, all bearings are greased with SKF LGMT2 grease, or similar.



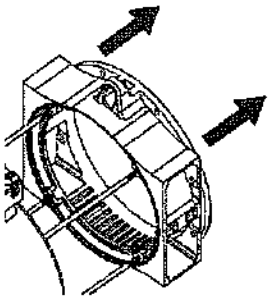
All generators, except the ECO40, the ECO43N and ECO46 versions, are equipped with sealed bearings; for this kind of bearing, no maintenance is required for the total operating time (estimated: 30.000 hours).

Bearings of alternator versions 40, 43 and 46 must be greased on a regular basis by means of a pressure grease cup (see bearings chart).

During the operating time, checks to detect presence of either overheating, or noises, must be carried out on a regular basis.

If the bearing is worn off, it can cause excessive vibrations. In such a case, the bearing must be removed, examined, and if necessary, replaced.

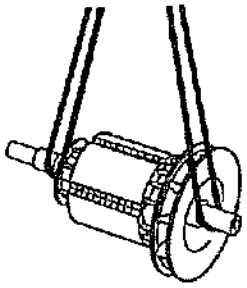
A description of the procedure for a bearing replacement.



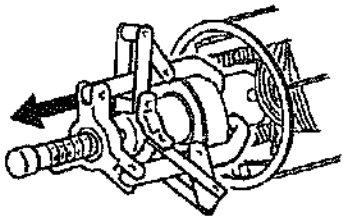
Generator versions: 28-31-32-34.

To disassemble alternator versions 28-31-32-34, follow these instructions:

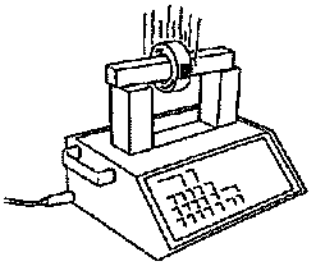
-) Remove front cover



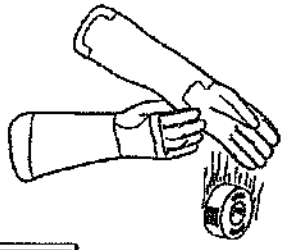
-) Use a lifting device equipped with soft ropes of an adequate lifting capacity to extract rotor. Make sure that the lifting devices are suitable for the weight of the parts to be shifted



-) To pull the bearing out, use a puller



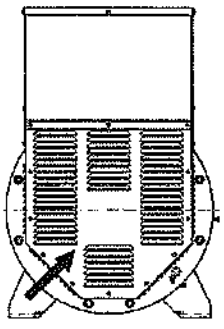
-) To insert new bearing, heat it with a suitable magnetic device



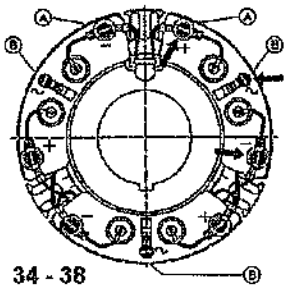
-) Put on safety gloves and insert bearing into its place

Generator versions: 38-40-43-46.

To disassemble alternator versions 38-40-43-46, remove exciter as follows:

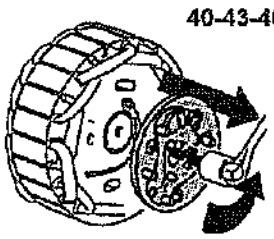


-) Remove rear seal

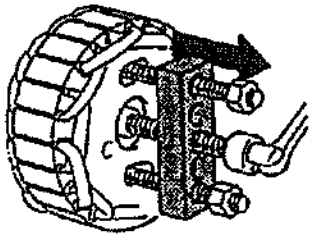


-) Disconnect the five wires of the rotating diode bridge "A" and "B".

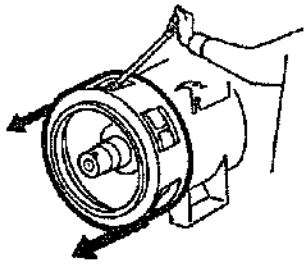
-) when dealing with versions 38, remove clamp screws from the diodes area of the rotating bridge, whilst when dealing with versions 40, 43 and 46, remove clamp bolt and, by pulling it gently, remove Diode Bridge



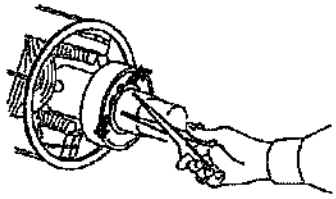
-) insert an adequate puller to pull out exciter rotor

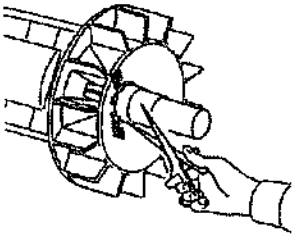


-) Pul out rotor from the drive end side; should the front lead diameter be smaller than the impeller's external diameter, remove lid to pull out rotor

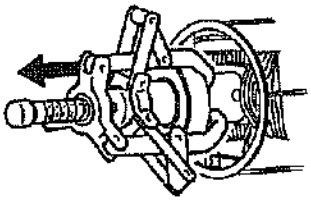


-) use a pair of suitable pliers to remove seeger rings

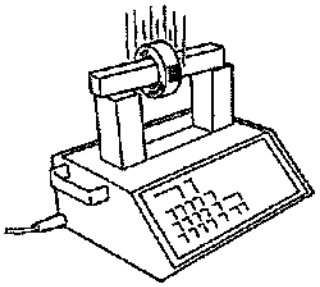




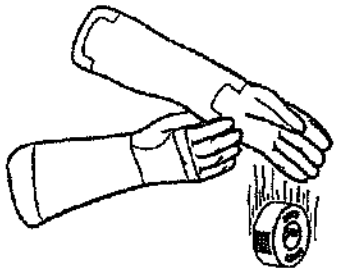
-) use a suitable puller to remove bearing



-) to insert new bearing, heat it with a suitable magnetic device

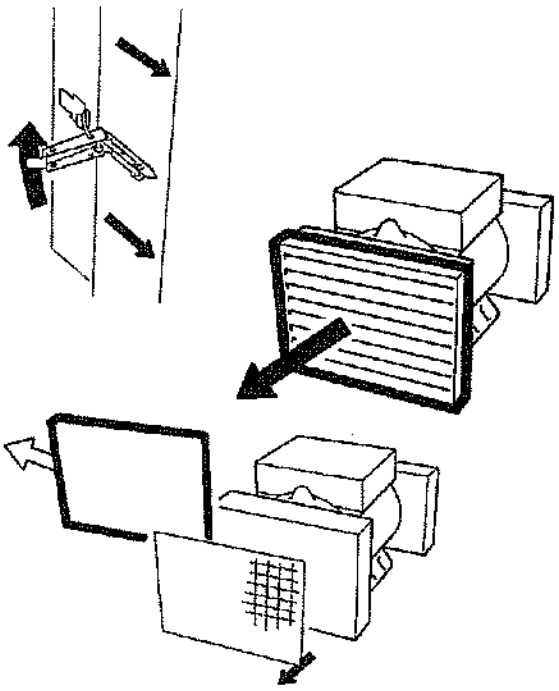


-) Put on safety gloves and insert bearing into its place



b) Cleaning of air filters (if available)

Air filters are optional parts that are supplied upon request; these devices must be cleaned on a regular basis; inside these filters there is a mesh net that has to be kept clean in order to ensure a good performance of the filter. The time interval between each cleaning operation depends on the conditions of the installation site. A frequent inspection of these parts will establish if any cleaning is required. Make sure you turn off the generator set when performing cleaning operations of such parts as their removal entails contact with live parts.



c) Cleaning of windings

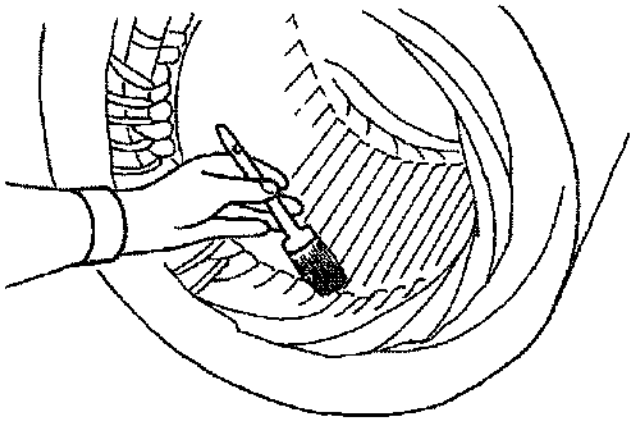
Both windings and generator will last longer with a correct maintenance and cleaning; an inspection and a maintenance schedule should be established by keeping in mind that the frequency of these inspections depends on the conditions of the site where the generator is being used.

If the generator is used in a dry and clean environment, an inspection a year is enough; in case of severe conditions, inspections must be carried out more frequently.

However, we recommend that a check should be done, regardless of the schedules, in the following cases:

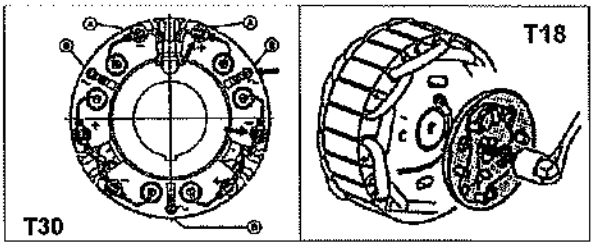
-) in case of rust
-) in case of corrosion
-) when the insulation is damaged
-) when there is dust on the surface of the windings

To clean windings, use solvents like oil of turpentine or "Solvesso" solvent. Cleaning with such substances, which contain a high evaporation level, will not damage the isolation level of the windings. When cleaning is over, please look out for any overheating or carbonisation signs.
We also recommend drying up of windings at 60-80°C and if you notice that the varnish of windings is not in good shape, then have them varnished again.

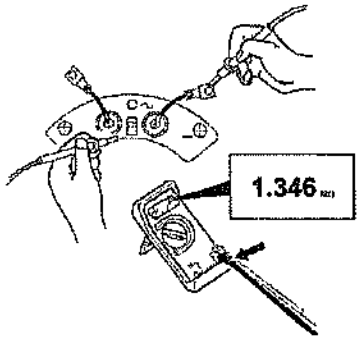


d) Replacement of diode bridge

The diode bridge varies according to the model of the generator. It can have three separate sectors with two diodes fixed on each sector (T30), or one circular body (T18) with 6 diodes. The first type (T30) is used in the alternator models 34-38, whereas the second one (T18) is used in the 40,43 and 46 versions.



Diodes can be easily inspected with a multimeter: simply disconnect the wire of the particular diode and check its resistance on both directions. A perfectly functioning diode will show a very high resistance in one direction and a very low resistance in the opposite direction. A faulty diode will show either a very low resistance, or an infinite resistance in both directions. Once the whole sector, or the whole bridge, is replaced, remember to tighten the screws with a suitable tightening wrench and to strictly comply with the polarities and the diagrams indicated by Mecc Alte.



Generator versions 28-31-32.
Procedure to check the diodes of the exciter rotor.

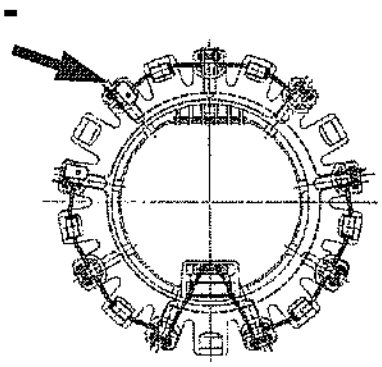
Necessary equipment :

- 12V battery
- 12V-21W lamp (or alternatively 6.8Ω-30W Resistance)
- Voltmeter (for instance, multimeter on scale VOLT d.c.)

IMPORTANTE

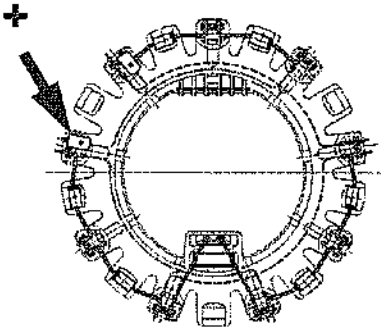
Warning: before performing the following actions, it is necessaty to disconnect the 2 cables connecting the main rotor to the diode bridge (+and-).

TEST OF THE DIODES ON THE "NEGATIVE"



- Connect the equipment, as it is pointed out in the picture A (table 26 page 45)
- Fix the cable connected to the lamp to the negative terminal of the bridge, as it is pointed out in the picture A (table 26 page 45)
- Connect the terminal "Probe" to the point A1 (it is checked the diode 1), then to the point A2 (it is checked the diode 2) and finally to the point A3 (it is checked the diode 3); check the readings on the voltmeter in relation with what is reported on the table (table 26 page 45).

TEST OF THE DIODES ON THE "POSITIVE"



- Connect the equipment, as it is pointed out in the picture B (table 26 page 45)
- Fix the cable connected to the negative terminal of the battery to the positive terminal of the bridge, as it is pointed out in the picture B (table 26 page 45)
- Connect the terminal "Probe" to the point A4 (it is checked the diode 4), then to the point A5 (it is checked the diode 5) and finally to the point A6 (it is checked the diode 6); check the readings on the voltmeter in relation with what is reported on the table (table 26 page 45).

INSTRUCTIONS TO REPLACE THE DIODE

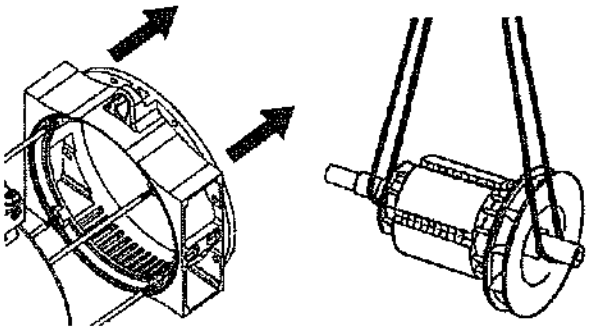
When the values measured point out a diode damaged, it is necessary to replace the component.
For this purpose it is recommended to not pull the rheophores out from their locations, but to cut them near to the body of the component; then fit in the new component respecting the polarity and soft solder accurately the rheophores with the pieces remained in their locations.

e) Replacement of exciter Generator versions 28-31-32-34.

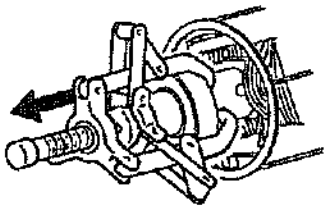
Follow these instructions to remove exciter of the 28-31-32-34 versions:

-) remove front lead

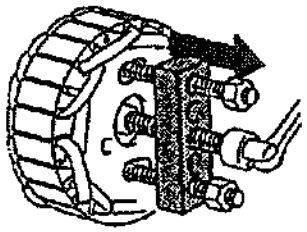
-) Use a lifting device equipped with soft ropes of an adequate lifting capacity to extract rotor. Make sure that the lifting devices are suitable for the weight of the parts to be shifted



-) Use a puller to pull out bearing

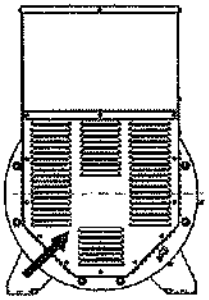


-) To remove the exciter rotor, use a suitable puller, which can be easily constructed or forwarded by the manufacturer upon request.



Generator versions 38-40-43-46.

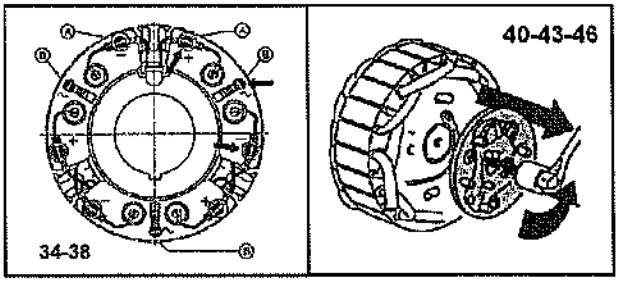
To remove exciter of the 38-40-43-46 versions, there is no need to disassemble the entire generator, however, you must follow the instructions below:



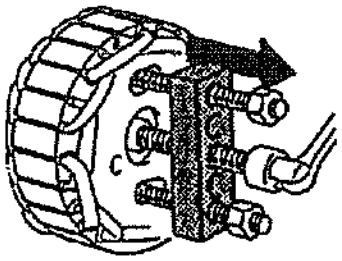
-) Remove real seal

-) Disconnect the five wires of the rotating diode bridge

-) When dealing with the 38 versions, remove clamp screws from sectors; whilst when dealing with the 40-43-46 versions, remove clamp bolt and, by pulling it gently, pull out diode bridge

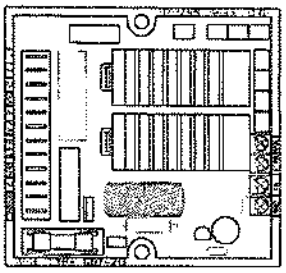


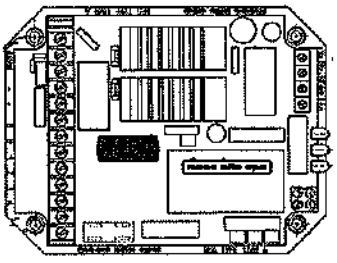
-) To insert exciter rotor, use a suitable puller, which can be easily constructed or forwarded by the manufacturer upon request.



f) Replacement of voltage regulator

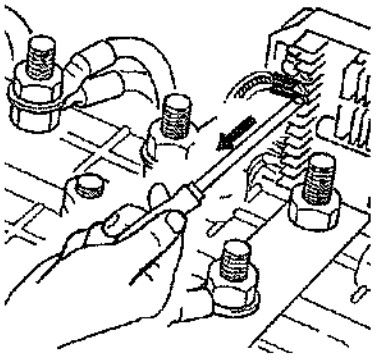
All generators are equipped with an automatic voltage regulator; depending on the alternator model, electronic regulators can be of two different types: SR7/2-G, UVR6/1-F.
The SR7/2-G is an integral part of the 28-31-32-34 generators; the UVR6/1-F is supplied with the 38-40-43 and 46 versions. Should some anomalous functioning be detected, please consult our technical manual or contact our technical assistance service.



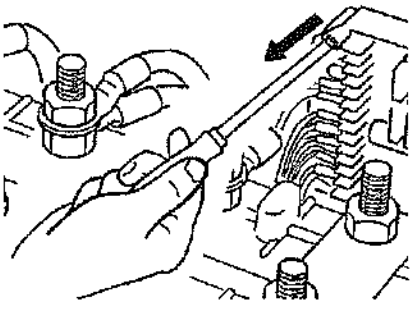


Once it has been ascertained that the regulator needs to be replaced, proceed as follows :

-) Disconnect all terminal board wires



-) Unscrew the 2/4 clamp screws of the regulator



-) Set new regulator in the usual position

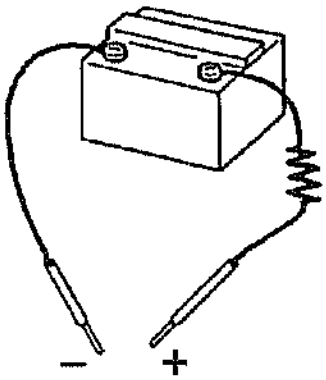
-) Tighten the new regulator with the previously unscrewed screws

-) Connect again all wires to the terminal board of the regulator.
Follow diagrams supplied by Mecc Alte, if necessary.

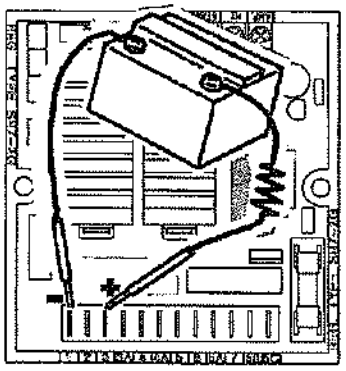
g) Check of residual voltage

For generators equipped with an electronic regulator, you must perform the following procedure. This must be applied to ensure that the generator is not over-excited (in such a condition, though it still rotates at nominal velocity, no voltage is present in the generator's main terminal board):

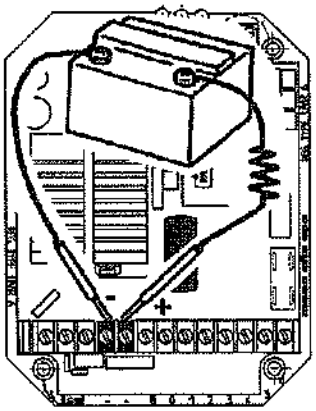
-) When the generator is switched off, remove lid from the terminals case



-) Connect two connecting wires to a 12 Vdc battery with a 30Ω in-series resistance

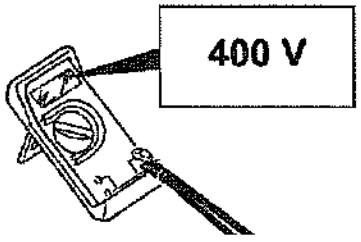


-) Follow the electrical diagrams supplied by Mecc Alte, to locate positive and negative terminals of electronic regulator



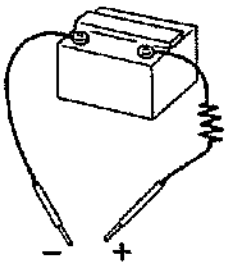
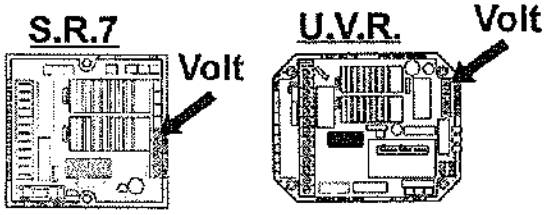
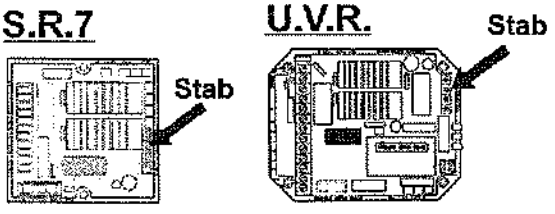
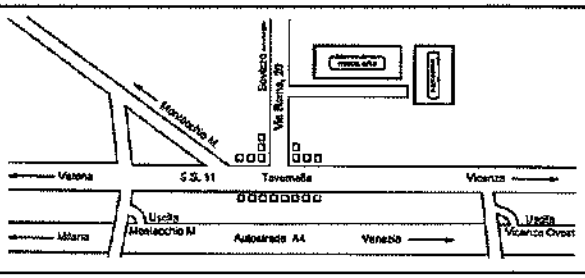
-) Start generator

-) Connect, only for a moment, the two connecting wires to the previously located terminals. Make sure to match polarities (positive terminal of regulator with positive terminal of battery, negative terminal of regulator with negative terminal of battery)



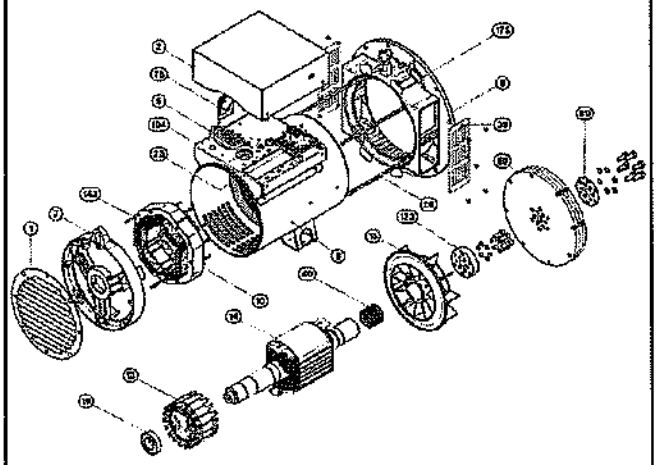
-) Use a voltmeter or the right instrument panel, to check whether the generator is producing the nominal voltage indicated on the plate.

DEFECTS AND REMEDIES

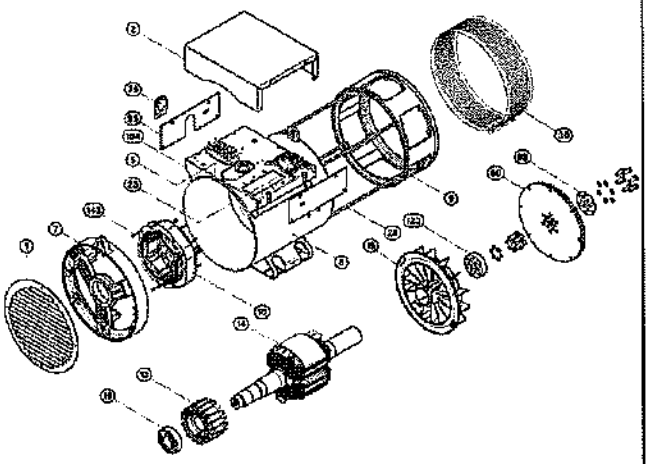
ALTERNATOR DOES NOT EXCITE - Substitute fuse. - Increase speed by 15%. - For an instant apply on "+" and " -" of the electronic regulator a 12 V battery voltage with a 30 Ω resistor in series, respecting the polarities.	
AFTER BEING EXCITED ALTERNATOR DOES NOT EXCITE - Check connection cables as per attached drawings.	
LOW VOLTAGE AT NO LOAD - Reset voltage potentiometer. - Check speed. - Check windings.	
HIGH VOLTAGE AT NO LOAD - Reset voltage potentiometer. - Substitute regulator.	
AT LOAD CONDITIONS, VOLTAGE LOWER THAN RATED VALUE - Reset voltage potentiometer. - Current too high, power factor lower than 0.8, speed lower than 4% of rated speed. - Substitute regulator. - Check diodes, disconnect cables	
AT LOAD CONDITIONS, VOLTAGE HIGHER THAN RATED VOLTAGE - Ritarare la tensione. - Sostituire il regolatore.	
UNSTABLE VOLTAGE - Check uniformity of rotation. - Regulate stability of regulator by acting on "STAB" potentiometer.	
For any other defect, please contact the seller, the after sales service or Mecc Alte directly.	

Exploded view and terminology

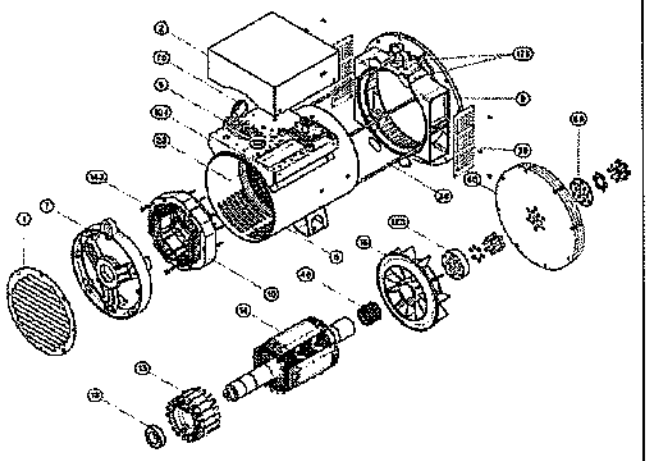
ECP 28/2



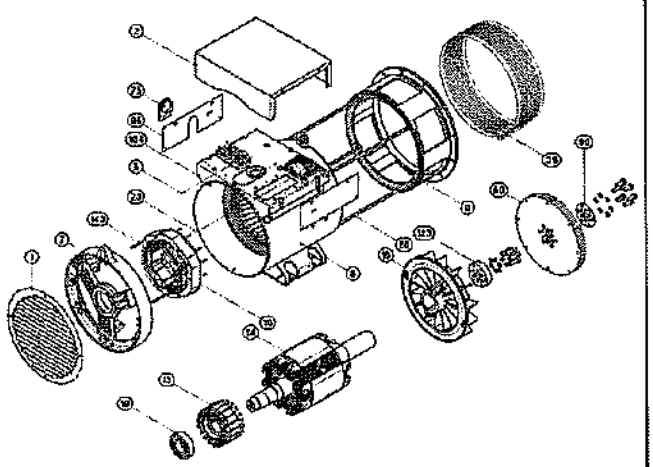
ECO 31N/2



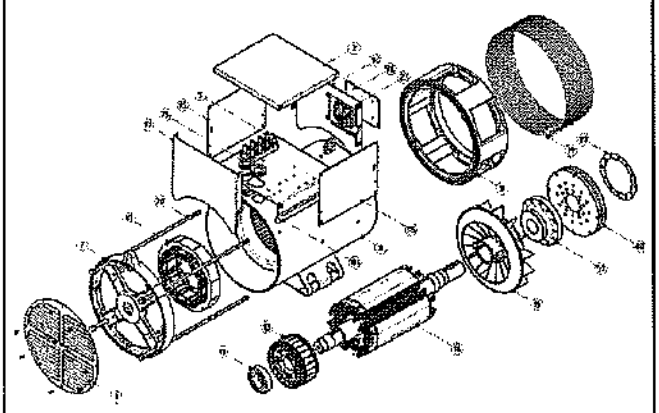
ECP 28/4



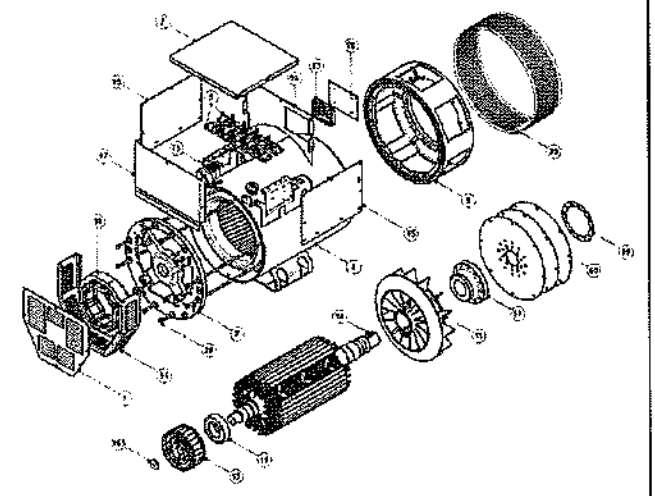
ECO 32/4



ECP 34

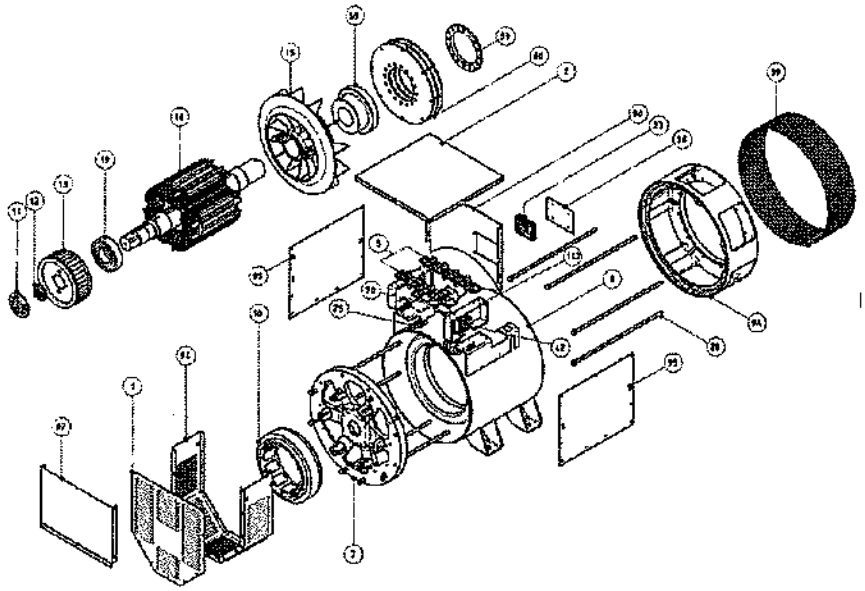


ECP 38N

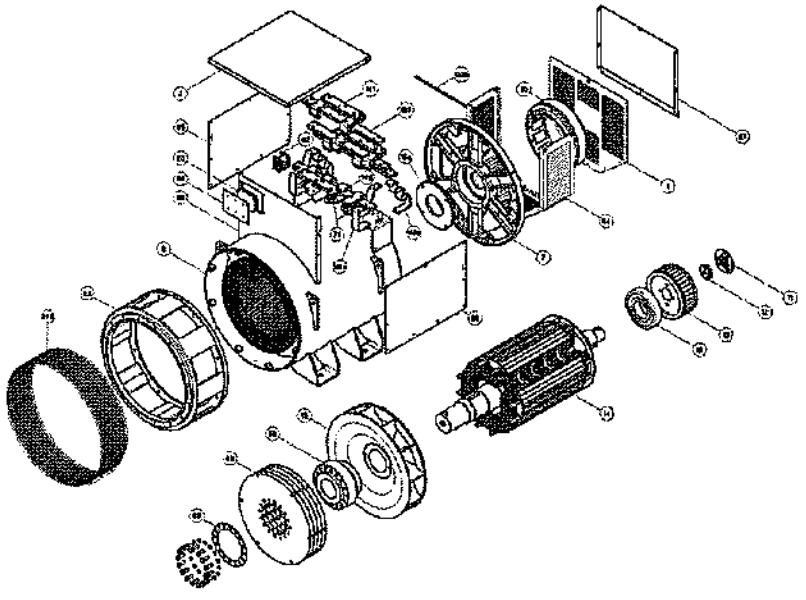


Exploded view and terminology

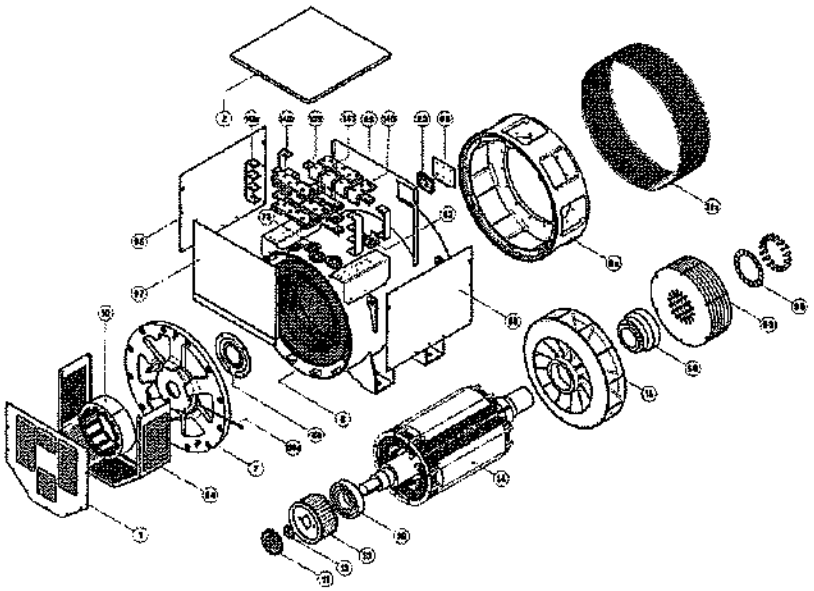
ECO 40



ECO 43N



ECO 46



N.	NAME
1	real seal
2	casing
3	grid
5	users terminal board
7	rear cover
8	frame with stator
9	front cover
9A	front cover MD 35
10	exciting stator
11	rotating diode bridge
12	hub
13	exciting armature
14	rotor
15	fan
16	exterior flange bearing cover
17	drive end bearing
18	interior flange bearing cover
19	rear bearing
20	terminal box
22	diode holder washer
23	electronic regulator
24	auxiliary terminal board
28	cover stay bolt
39	protection screen
40	fixing ring
42	parallel device
59	coupling hub
60	disc plates
75	cable grommet
94	rear case
95	termin.brd.side panel
96	termin.brd.front panel
97	termin.brd.rear panel
98	regulator carrying panel
99	disc blocking ring-spacer
104	component-carryng panel
123	ring spacer
138a	front gresing pipe
138b	rear greasing pipe
139a	rear terminal strip
139b	front terminal strip
140	copper terminal
141	copper bridge
142	stirrups support
143	exciter stay bolt

Table 1

WINDING RESISTENCES AT 20 °C AMBIENT

4 POLE GENERATORS

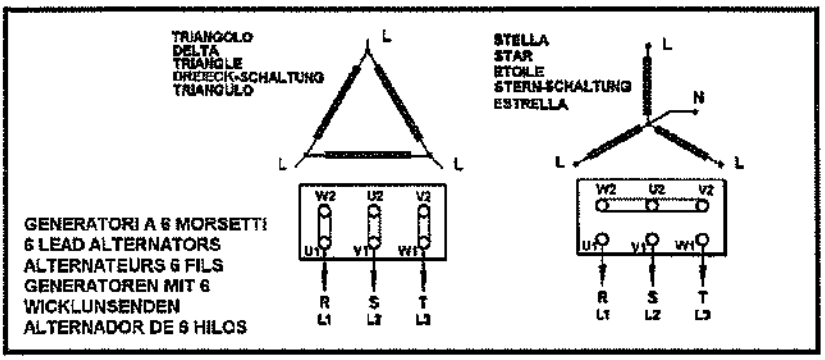
TYPE	V / Hz	GENERATORS			EXCITER	
		STATOR 1-2 Ω	ROTOR Ω	AUXILIARY WINDING Ω	STATOR Ω	ROTOR PHASE-PHASE Ω
ECP 28 1VS	115/200/230/400-50	0,951	0,911	3,753	10,60	0,417
ECP 28 2VS	115/200/230/400-50	0,582	1,032	3,225	10,60	0,417
ECP 28 0S	115/200/230/400-50	0,430	1,13	2,957	10,60	0,417
ECP 28 S	115/200/230/400-50	0,283	1,260	4,060	10,60	0,417
ECP 28 1L	115/200/230/400-50	0,198	1,396	2,250	10,60	0,417
ECP 28 2L	115/200/230/400-50	0,128	1,670	2,150	10,60	0,417
ECP 28 VL	115/200/230/400-50	0,106	1,860	2,170	10,60	0,417
ECO 32 2S	115/200/230/400-50	0,097	2,010	1,098	10,60	0,417
ECO 32 3S	115/200/230/400-50	0,078	2,163	0,929	10,60	0,417
ECO 32 1L	115/200/230/400-50	0,061	2,473	0,993	11,35	0,442
ECO 32 2L	115/200/230/400-50	0,041	2,861	0,909	11,35	0,442
ECO 32 3L	115/200/230/400-50	0,035	3,171	0,790	11,35	0,442
ECP 34 1.5VS	115/200/230/400-50	0,045	2,248	1,04	15,28	0,410
ECP 34 1S	115/200/230/400-50	0,030	2,477	1,43	15,28	0,410
ECP 34 2S	115/200/230/400-50	0,020	2,951	1,35	15,28	0,410
ECP 34 1L	115/200/230/400-50	0,018	3,165	1,18	15,28	0,410
ECP 34 2L	115/200/230/400-50	0,015	3,577	1,05	15,28	0,410
ECP 34 3L	115/200/230/400-50	0,015	4,35	0,855	15,28	0,410
ECO 38 1SN	115/200/230/400-50	0,0130	3,905	0,854	15,28	0,685
ECO 38 2SN	115/200/230/400-50	0,0105	4,133	0,845	15,28	0,685
ECO 38 3SN	115/200/230/400-50	0,0085	4,449	0,778	15,28	0,685
ECO 38 1LN	115/200/230/400-50	0,0065	4,887	0,796	15,28	0,685
ECO 38 2LN	115/200/230/400-50	0,0055	5,604	0,751	15,28	0,685
ECO 38 3LN	115/200/230/400-50	0,0042	6,780	0,700	15,28	0,685
ECO 40 1S	230/400/460/800-50	0,0180	4,488	0,558	8,85	0,317
ECO 40 2S	230/400/460/800-50	0,0130	4,881	0,521	8,85	0,317
ECO 40 3S	230/400/460/800-50	0,0106	5,176	0,540	8,85	0,317
ECO 40 1L	230/400/460/800-50	0,0100	6,025	0,476	8,85	0,317
ECO 40 1.5L	230/400/460/800-50	0,0087	1,376	0,550	8,85	0,050
ECO 40 2L	230/400/460/800-50	0,0130	1,500	0,481	8,85	0,050
ECO 40 VL	230/400/460/800-50	0,0104	1,592	0,300	8,85	0,050
ECO 43 1SN	230/400/460/800-50	0,0109	2,100	0,440	10,63	0,130
ECO 43 2SN	230/400/460/800-50	0,0086	2,300	0,413	10,63	0,130
ECO 43 1LN	230/400/460/800-50	0,0078	2,500	0,713	10,63	0,130
ECO 43 2LN	230/400/460/800-50	0,0058	2,800	0,677	10,63	0,130
ECO 43 VL	230/400/460/800-50	0,0046	2,886	0,40	10,63	0,130
ECO 46 1S	230/400/460/800-50	0,0057	3,050	0,414	12,90	0,120
ECO 46 1.5S	230/400/460/800-50	0,0034	3,319	0,35	12,90	0,120
ECO 46 2S	230/400/460/800-50	0,0039	3,500	0,330	12,90	0,120
ECO 46 1L	230/400/460/800-50	0,0032	3,977	0,360	12,90	0,120
ECO 46 1.5L	230/400/460/800-50	0,0027	4,27	0,40	12,90	0,120
ECO 46 2L	230/400/460/800-50	0,0024	4,500	0,390	12,90	0,120

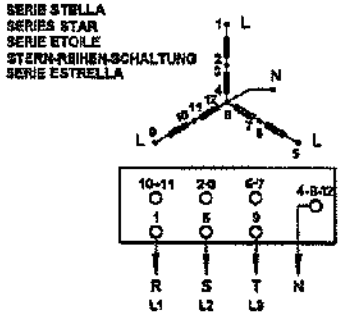
2 POLE GENERATORS

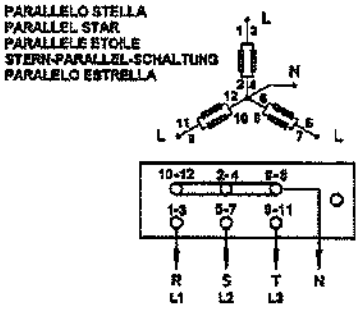
ECP 28 1L	115/200/230/400-50	0,1480	4,877	2,706	10,60	0,417
ECP 28 2L	115/200/230/400-50	0,0863	5,523	1,173	10,60	0,417
ECP 28 3L	115/200/230/400-50	0,0860	5,848	1,087	10,60	0,417
ECP 28 VL	115/200/230/400-50	0,056	6,500	0,690	10,60	0,417
ECO 31 2SN	115/200/230/400-50	0,110	3,650	1,553	10,60	0,417
ECO 31 3SN	115/200/230/400-50	0,046	4,071	1,403	10,60	0,417
ECO 31 1LN	115/200/230/400-50	0,043	4,301	1,358	11,35	0,475
ECO 31 2LN	115/200/230/400-50	0,034	4,680	1,141	11,35	0,475

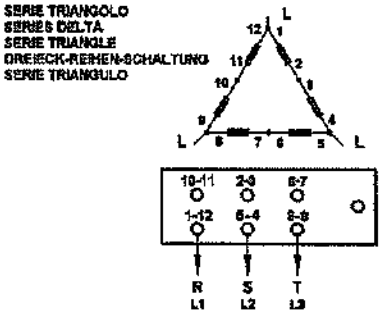
Table 2

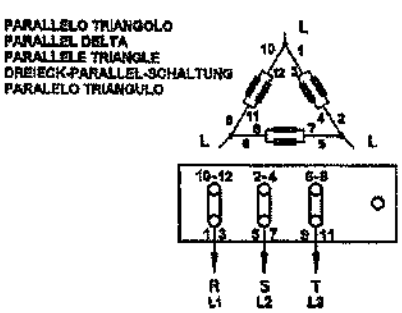
CONNECTIONS ALTERNATORS

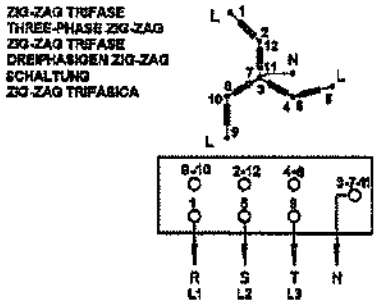


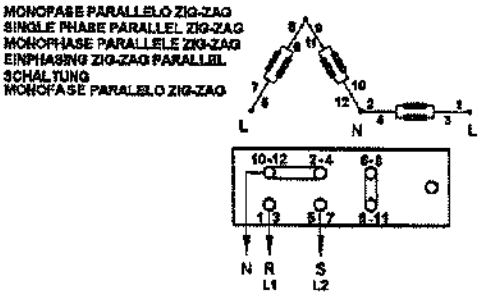












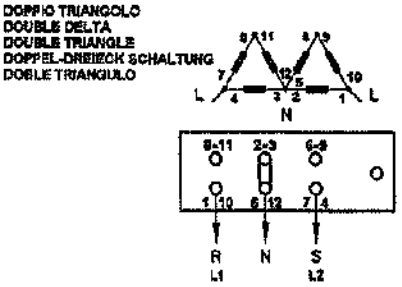
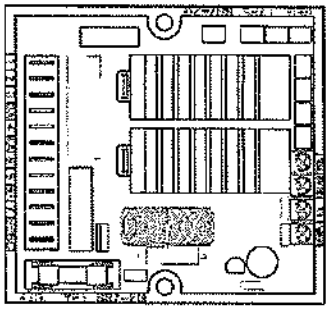
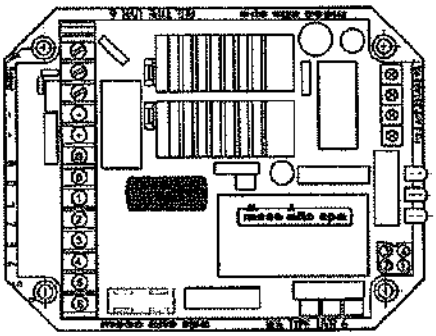


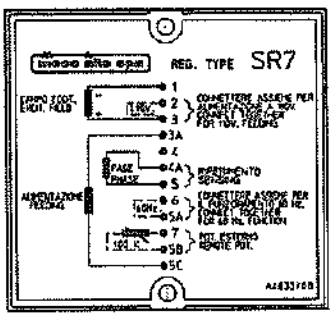
Table 3

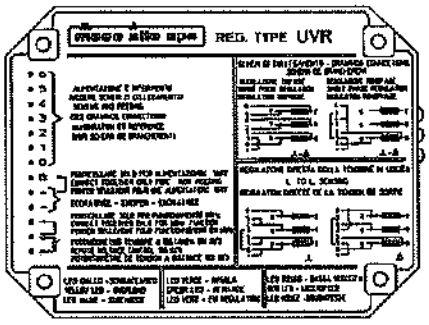
S.R.7/2-G

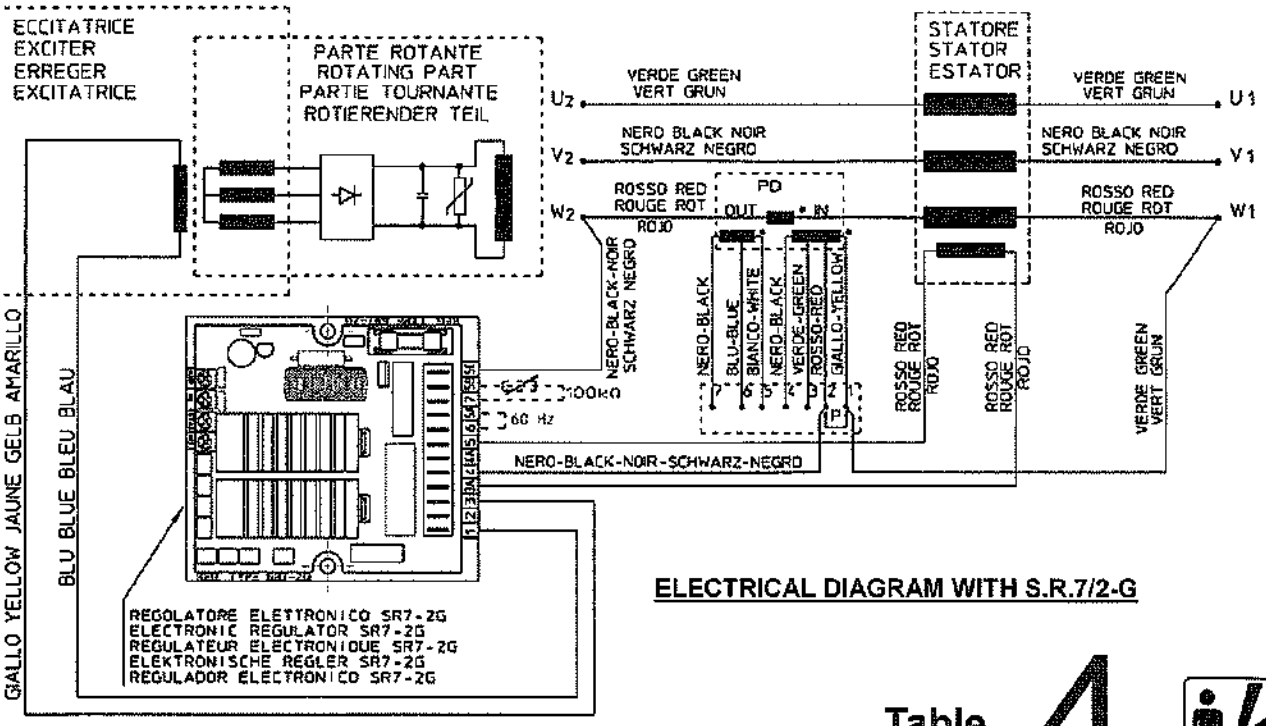


U.V.R.6/1-F



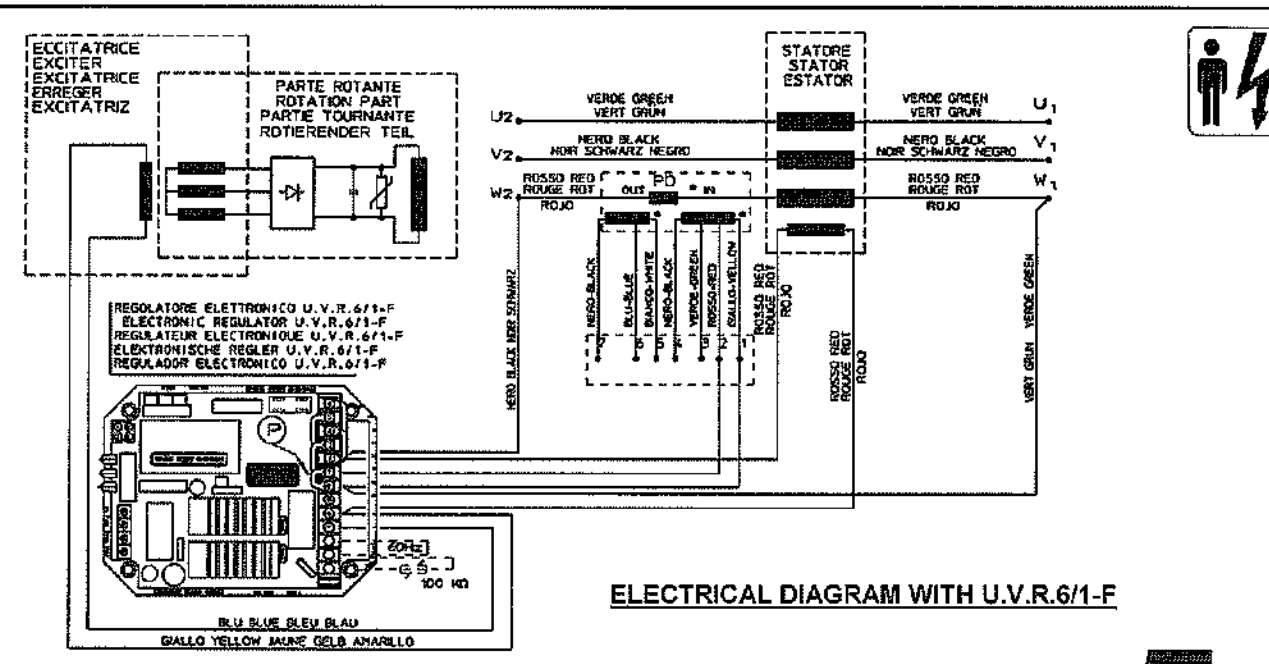






ELECTRICAL DIAGRAM WITH S.R.7/2-G

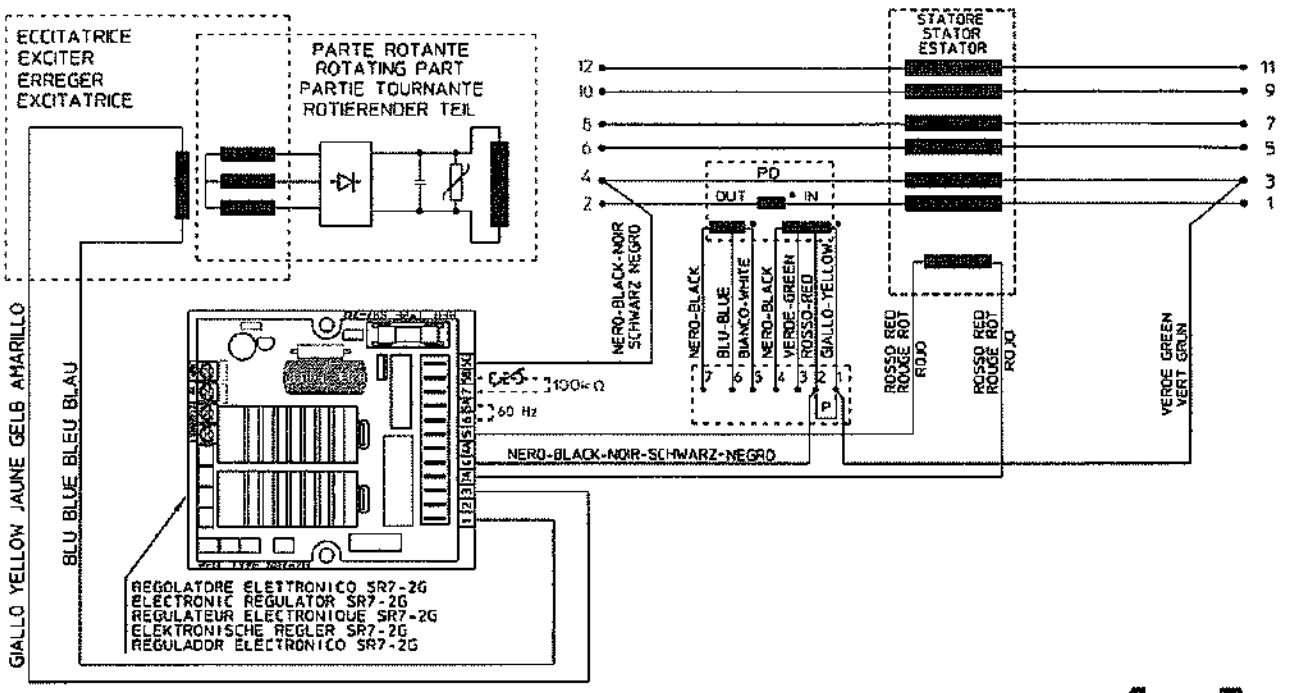
Table 4



ELECTRICAL DIAGRAM WITH U.V.R.6/1-F

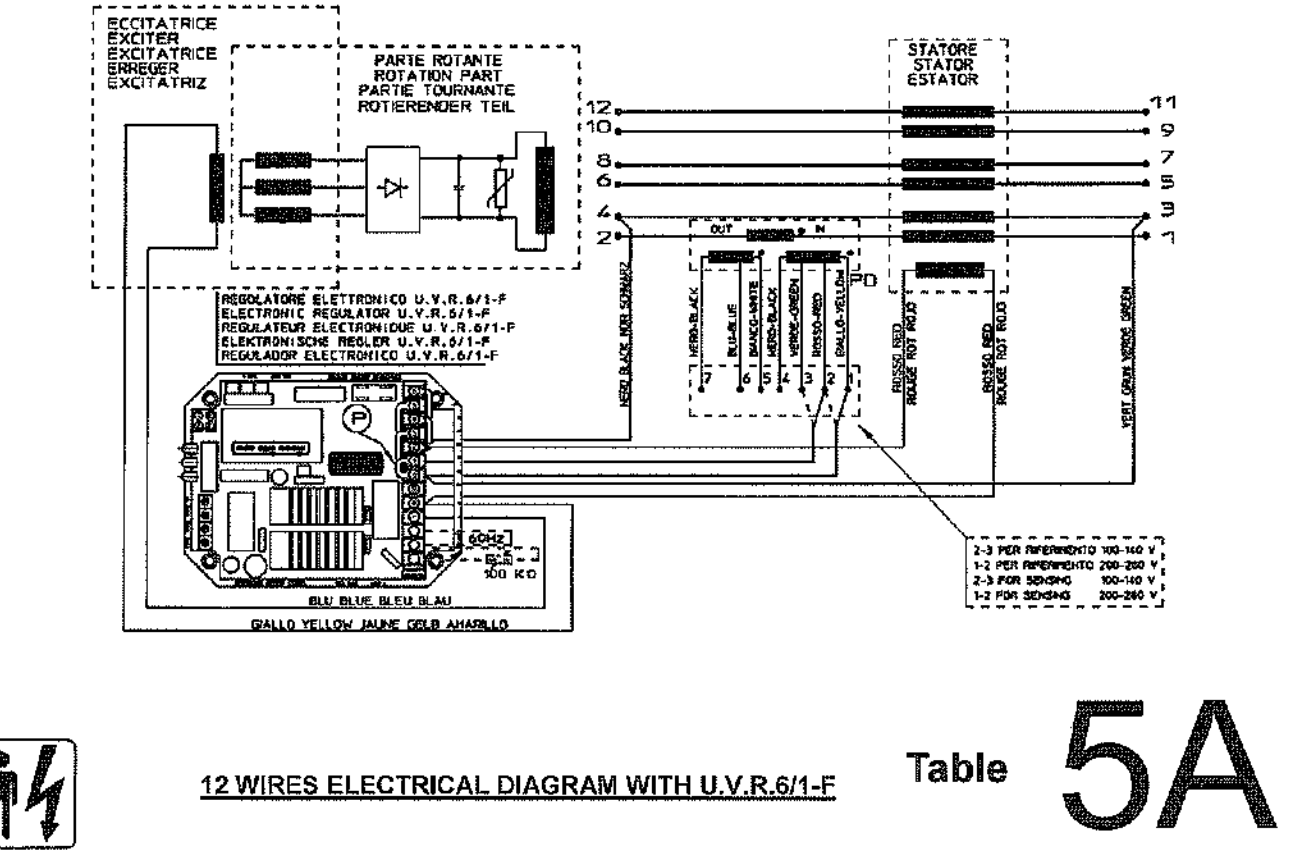
Table 5

Note: The parallel device PD is optional up to 350 kVA.
The link P activates or deactivates the parallel device, if it is present.



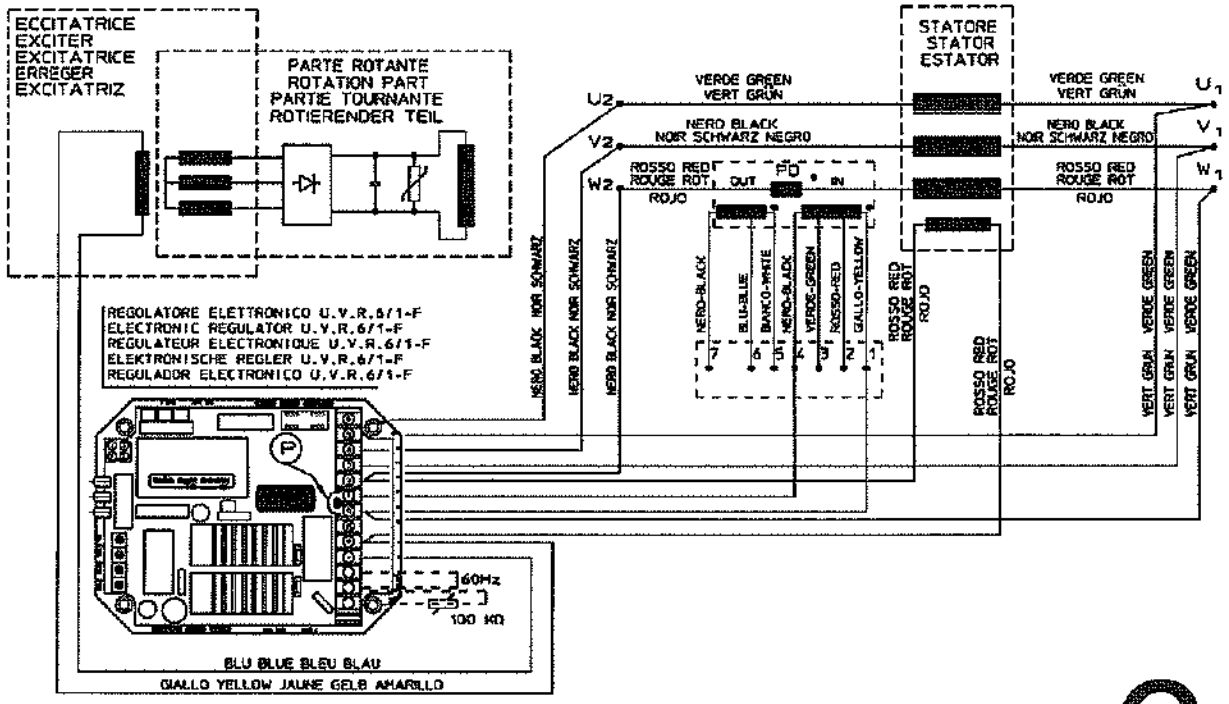
12 WIRES ELECTRICAL DIAGRAM WITH S.R.7/2-G

Table 4A

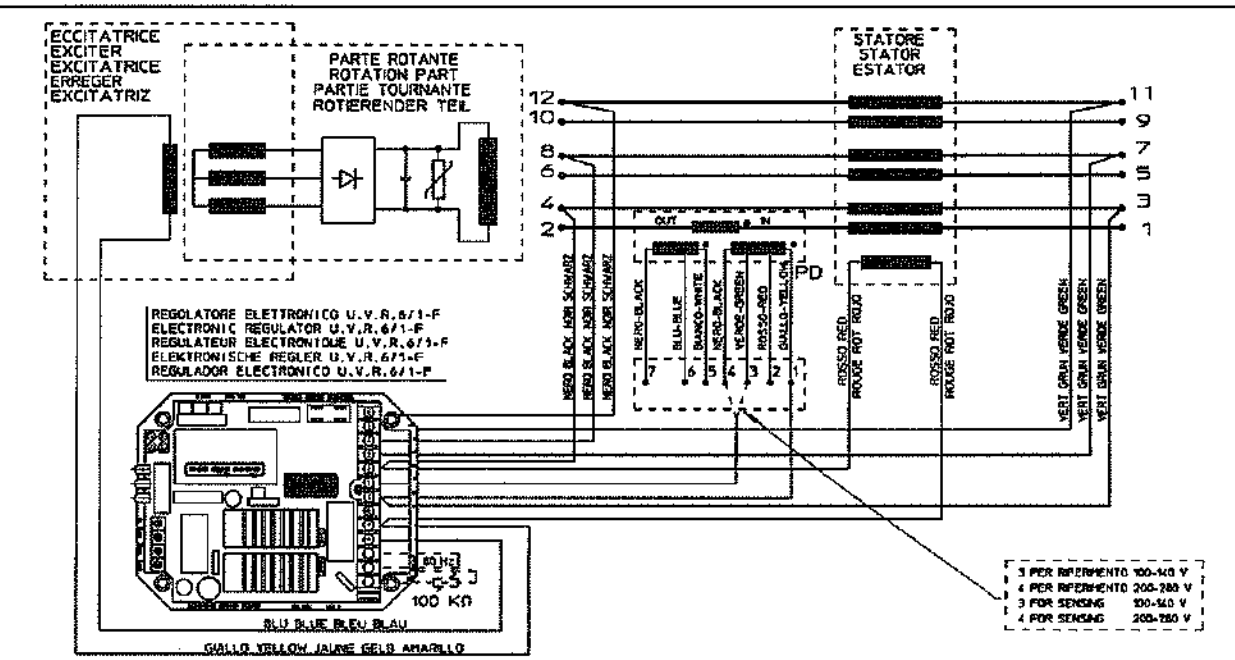


12 WIRES ELECTRICAL DIAGRAM WITH U.V.R.6/1-F

Table 5A

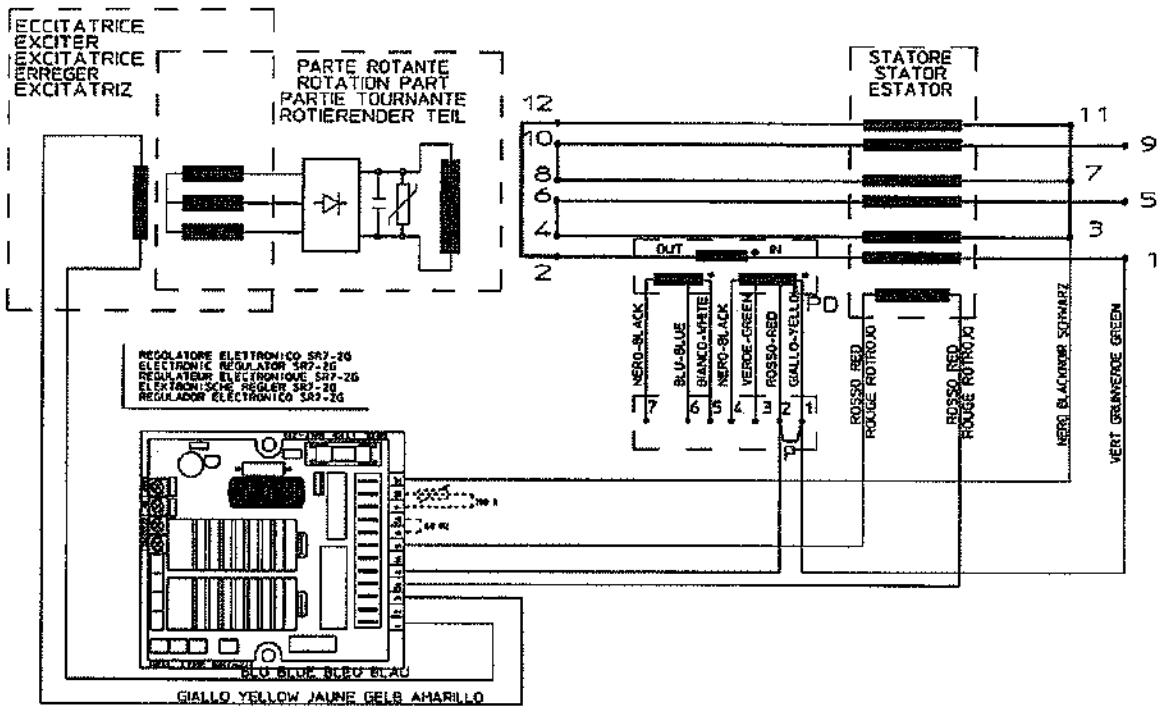


ELECTRICAL DIAGRAM WITH THREEPHASE SENSING Table 6



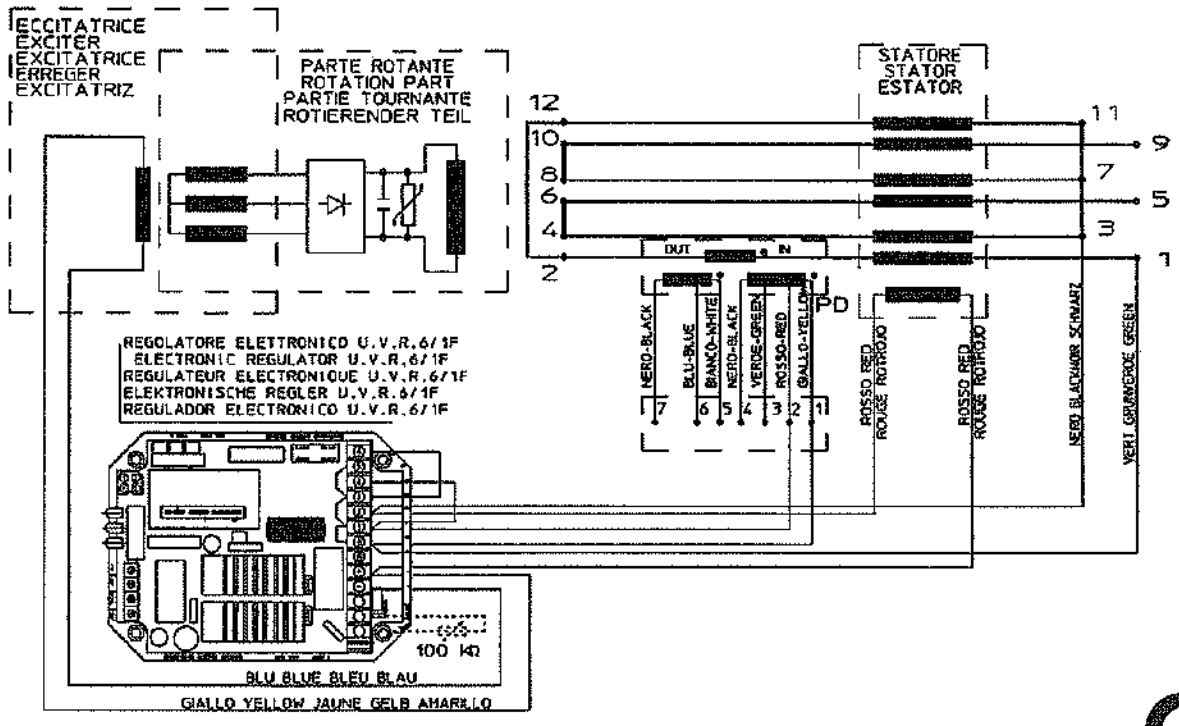
12 WIRES ELECTRICAL DIAGRAM WITH THREEPHASE SENSING Table 7

Note: The parallel device PD is optional up to 350 kVA.
The link P activates or deactivates the parallel device, if it is present.



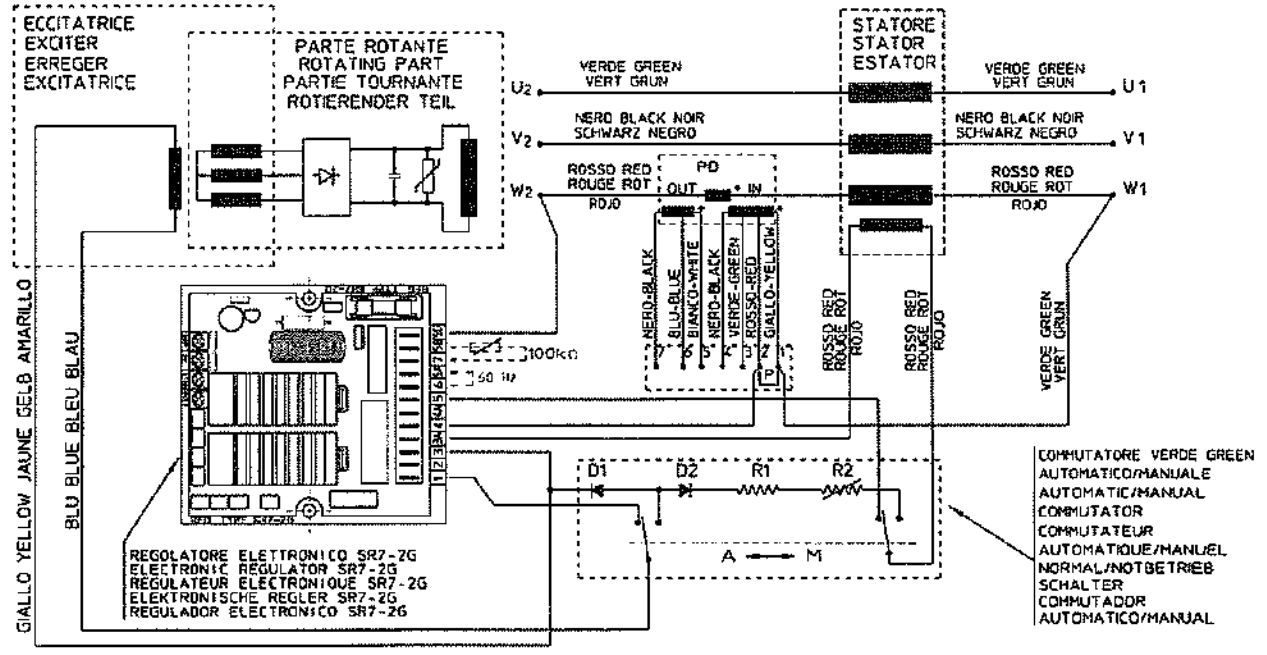
12 WIRES ELECTRICAL DIAGRAM WITH S.R.7/2-G (ZIG-ZAG)

Table 8



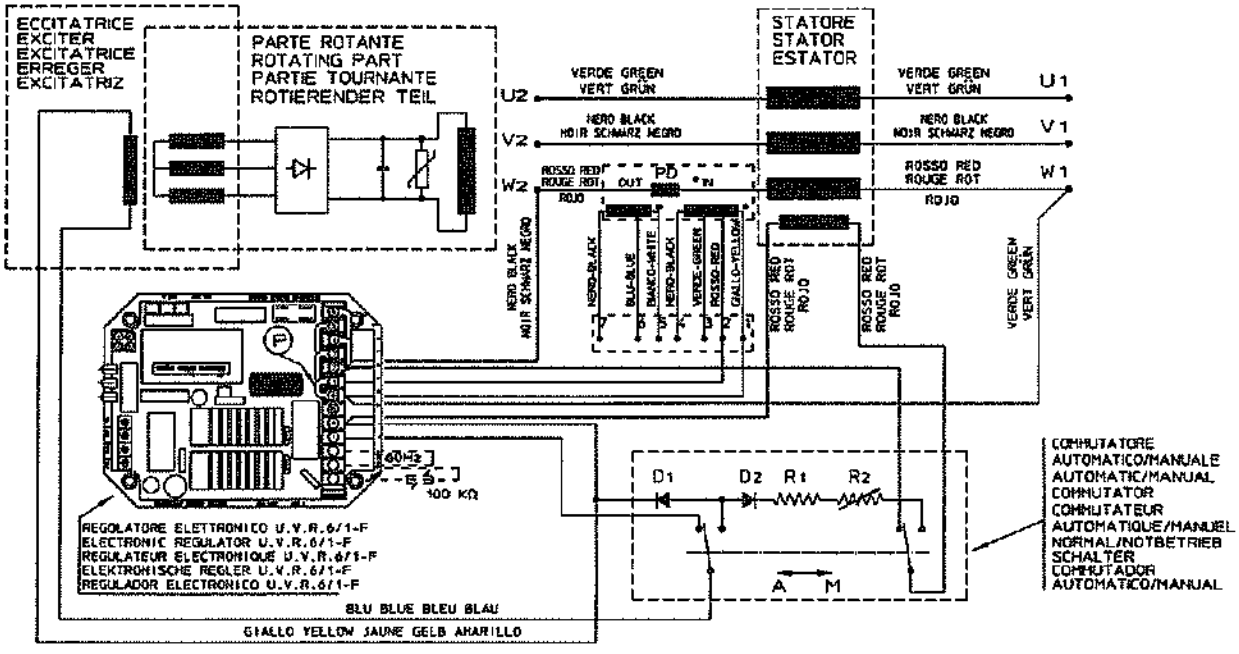
12 WIRES ELECTRICAL DIAGRAM WITH U.V.R.6/1-F (ZIG-ZAG)

Table 9



AUTOMATIC/MANUAL COMMAND WITH S.R.7/2-G REGULATOR

Table 10



AUTOMATIC/MANUAL COMMAND WITH U.V.R.6/1-F REGULATOR

Table 11

Note: The parallel device PD is optional up to 350 kVA.
The link P activates or deactivates the parallel device, if it is present.

Table 12

USER CABLES CONNECTION 28-31-32-34

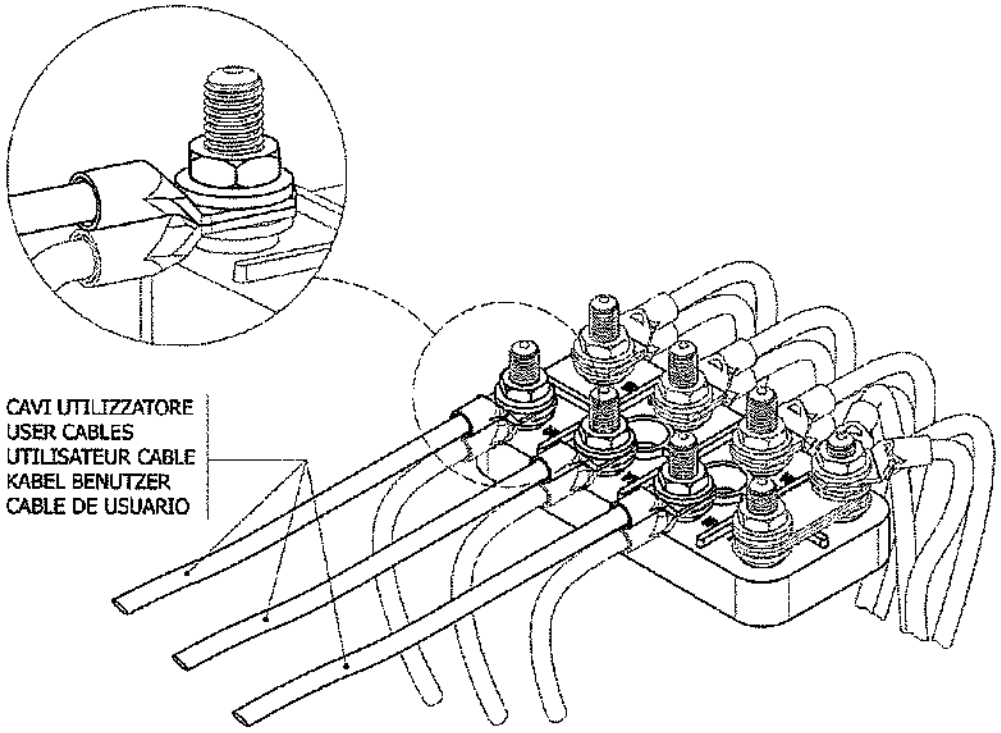
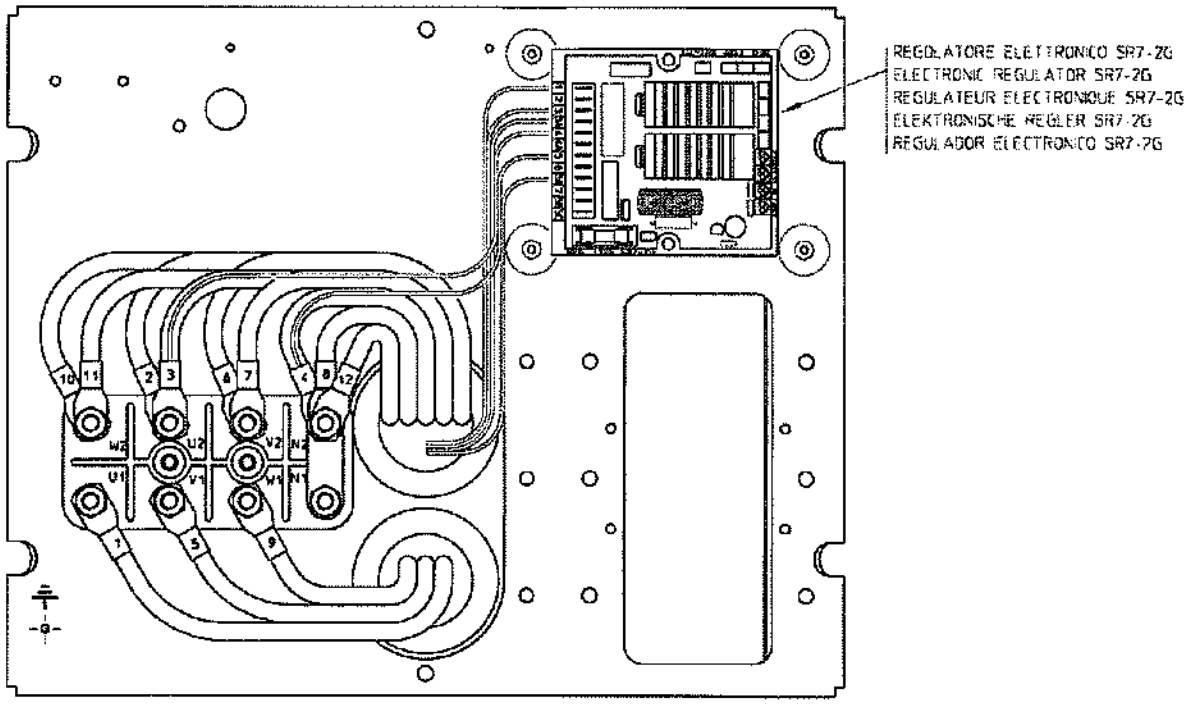


Table 13

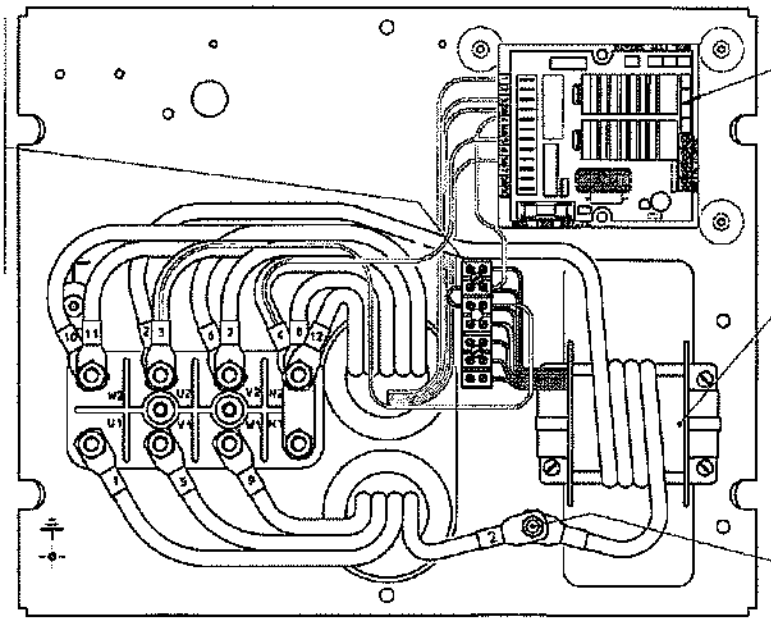
TERMINAL BOX 28-31-32



Series star connection

Table 14

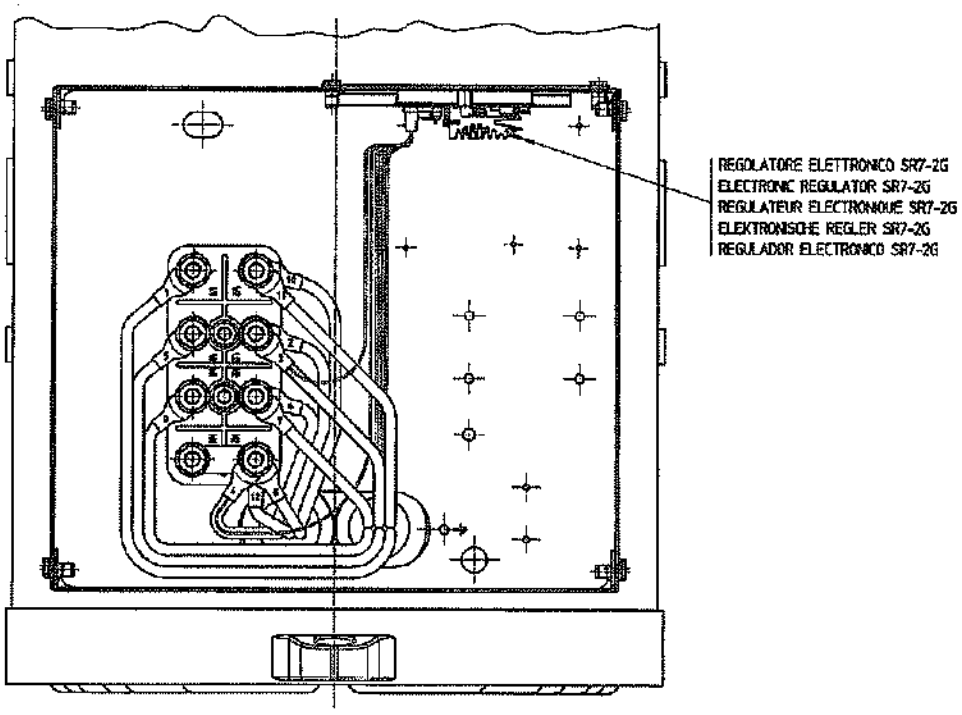
TERMINAL BOX 28-31-32 WITH PARALLEL DEVICE



Series star connection

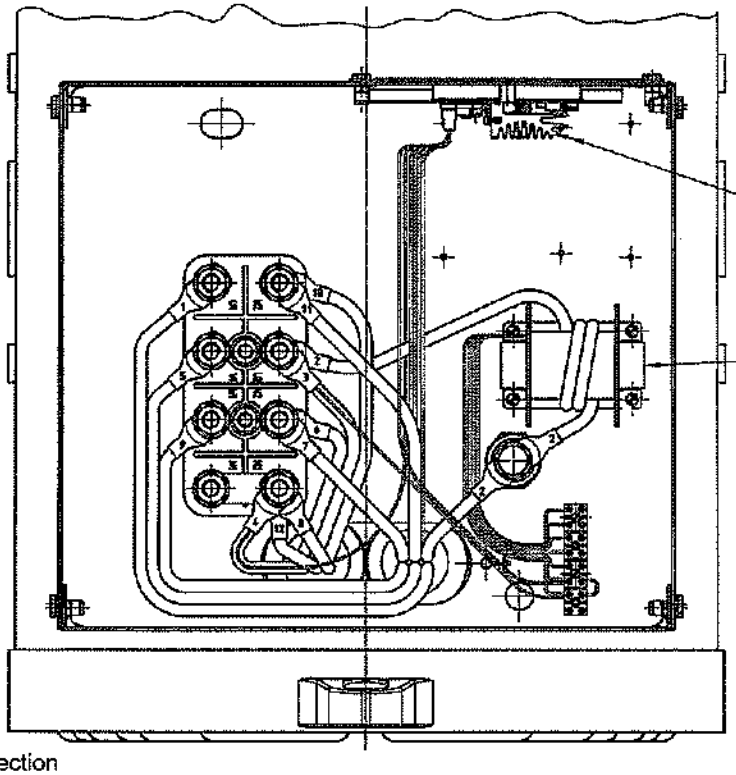
Table 15

TERMINAL BOX 34



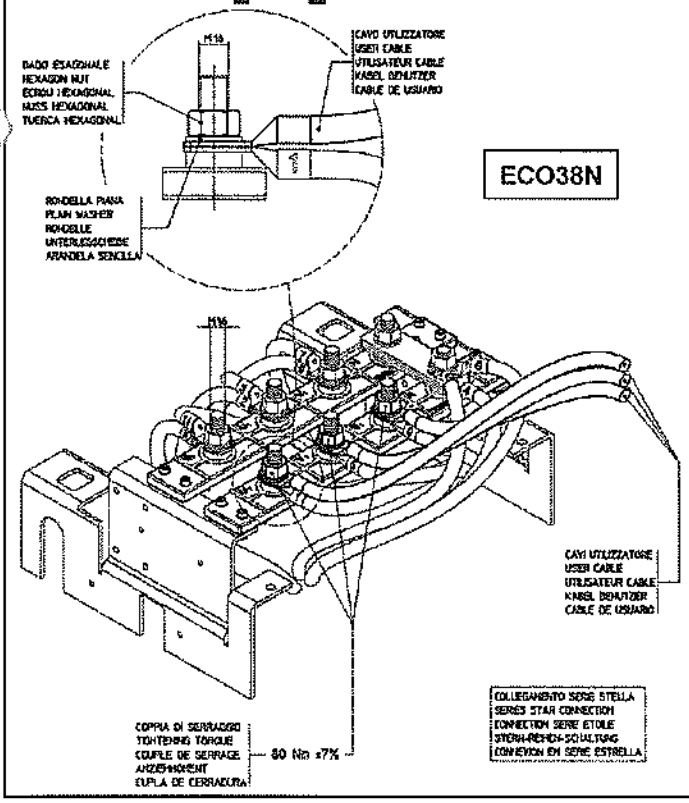
Series star connection

Table 16 TERMINAL BOX 34 WITH PARALLEL DEVICE



Series star connection

Table 17 USER CABLES CONNECTION 38-40



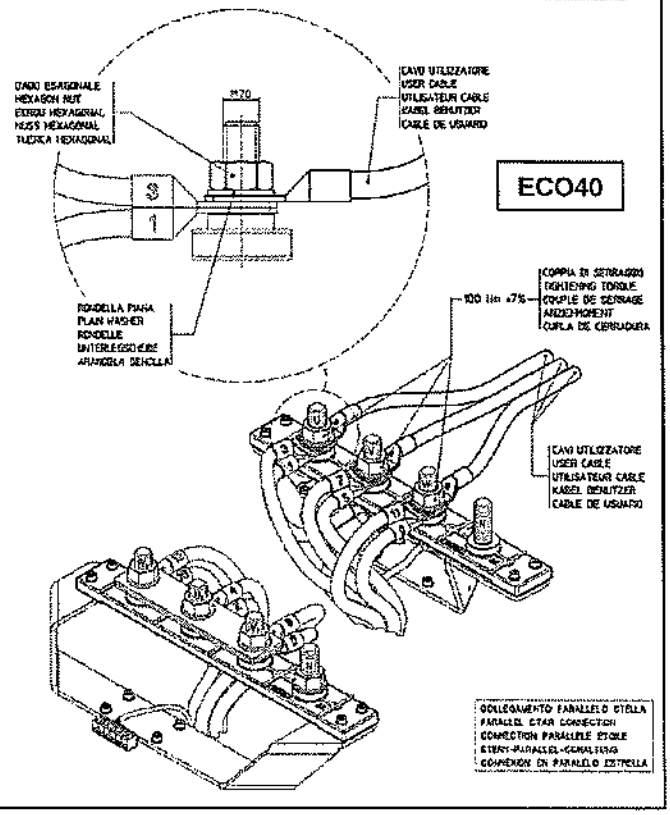
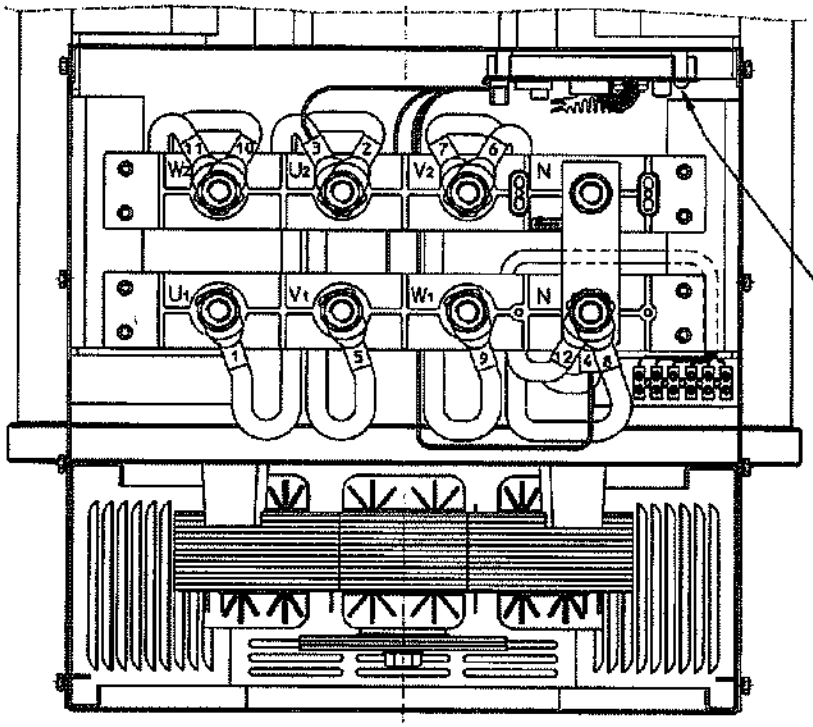


Table 18

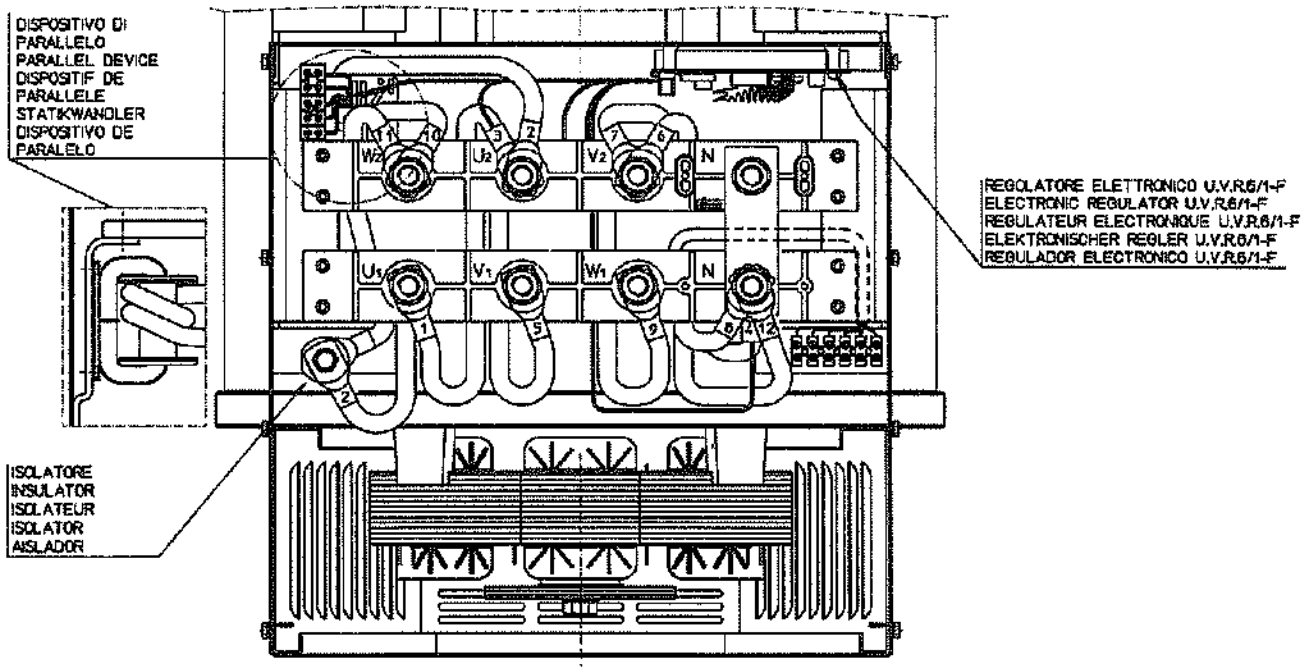
TERMINAL BOX 38



Series star connection

Table 19

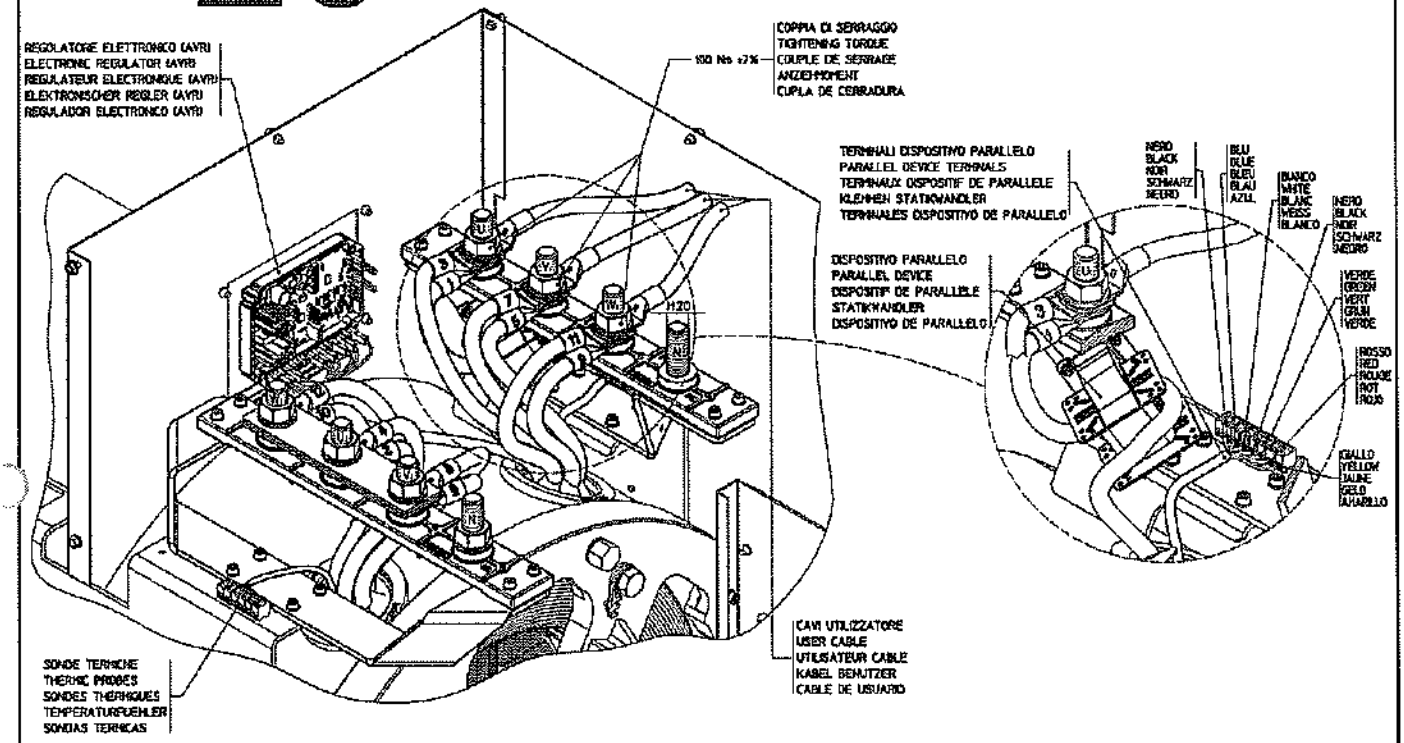
TERMINAL BOX 38 WITH PARALLEL DEVICE



Series star connection

Table 20

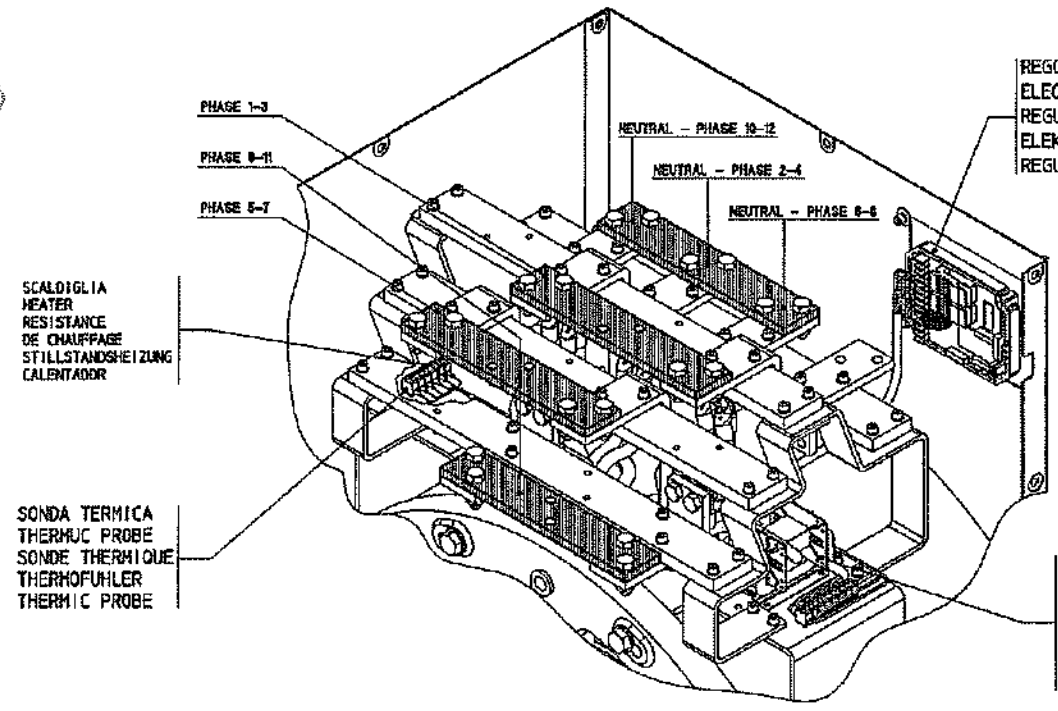
TERMINAL BOX 40



Parallel star connection

Table 21

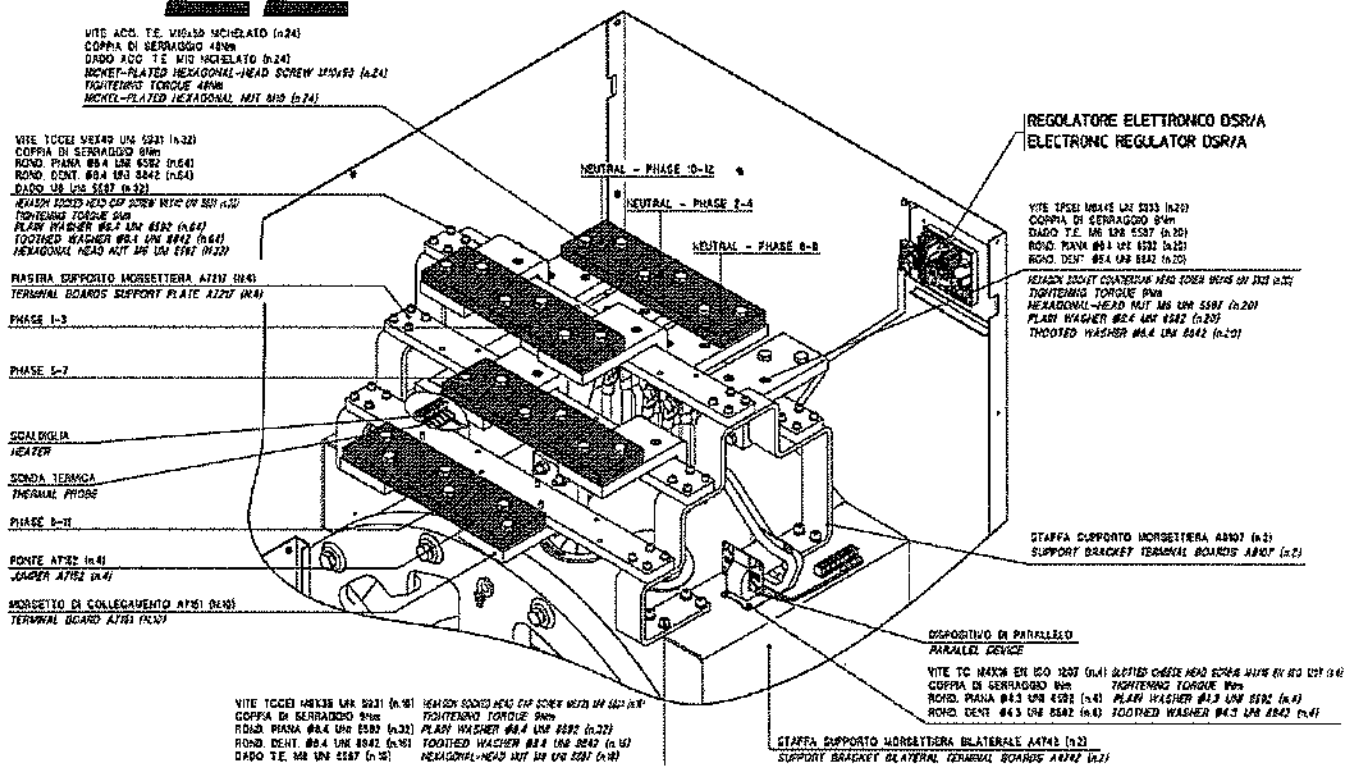
TERMINAL BOX 43



Parallel star connection

Table 22

TERMINAL BOX 46



Parallel star connection

Table 23

PERIODIC MAINTENANCE AND BEARING TABLE

All bearings are greased during assembly.

Use SKF LGMT2 or equivalent grease for normal operation.

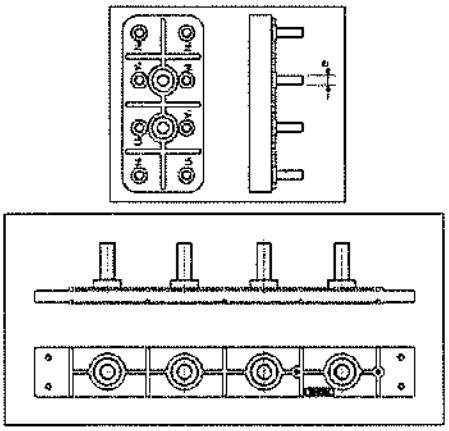
Alternator type	Bearing type		Lubrication		Quantity	
	L.A. D.E. R.A.R.	L.O.A. N.D.E. R.A.V.	L.A. D.E. R.A.R.	L.O.A. O.D.E. R.A.V.	L.A. D.E. R.A.R.	L.O.A. O.D.E. R.A.V.
ECP 28	6309.2RS	6207.2RS	(*)	(*)	-	-
ECO 31N	6312.2Z	6309.2RS	(*)	(*)	-	-
ECO 32	6312.2RS	6309.2RS	(*)	(*)	-	-
ECP 34	6314.2RS	6311.2RS	(*)	(*)	-	-
ECO 38N	6318.2RS	6314.2RS	(*)	(*)	-	-
ECO 40	6322	6318.2RS	4.000	(*)	60	-
ECO 43N	6324	6322	4.000	4.000	70	60
ECO 46	6330	6324	4.000	4.000	90	70

(*) Sealed bearings:

no maintenance is necessary for their entire working life (approximately 30.000 hours).

Table 24

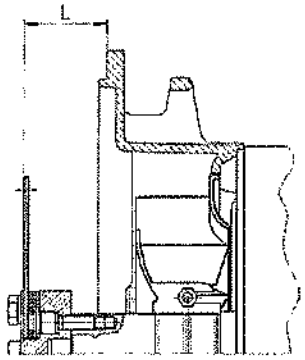
TERMINAL BOARD TIGHTENING TORQUE TABLE



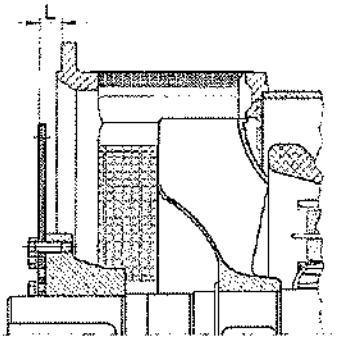
THREAD DIAMETER Df	TYPE	TIGHTENING TORQUE (Nm)
M6	ECP 28	8 ± 7%
M8	ECO 32	18 ± 7%
M10 (Steel)	ECO43-ECO46	30 ± 7%
M12	ECP34	42 ± 7%
M14	ECO32-34 special	54 ± 7%
M16	ECO38	80 ± 7%
M20	ECO40	100 ± 7%

COUPLING DISCS TIGHTENING TORQUE TABLE

TYPE 28 - 31 - 32



TYPE 34 - 38 - 40 - 43 - 46



TYPE	SAE	L	SCREWS DIMENSIONS		TIGHTENING TORQUE (Nm)	
			TE	TCCEI	CL. 8.8	CL. 12.9
ECP28	6 ½	30,2	M10x30-8.8	/	48	/
	7 ½	30,2	M10x30-8.8	/	48	/
	8	62	M12x30-8.8	M10x30-8.8	80-48	/
	10	53,8	M12x30-8.8	M10x30-8.8	80-48	/
	11 ½	39,6	M10x40-8.8	/	48	/
ECO31-32	6 ½	30,2	/	M12x40-12.9	/	140
	7 ½	30,2	/	M12x40-12.9	/	140
	8	62	M12x30-8.8	M12x40-12.9	80	140
	10	53,8	M12x30-8.8	M12x40-12.9	80	140
	11 ½	39,6	/	M12x40-12.9	/	140
ECP34	10	53,8	M10x30-8.8	M10x40-8.8	48	/
	11 ½	39,6	M10x45-8.8	/	48	/
	14	25,4	M10x30-8.8	/	48	/
ECO38-N	11 ½	39,6	M12x45-8.8	/	80	/
	14	25,4	M12x30-8.8	/	80	/
ECO40	14	25,4	M16x45-8.8	/	200	/
	18	15,7	M16x40-8.8	/	200	/
ECO43-N	14	25,4	M16x55-8.8	/	200	/
	18	15,7	M16x40-8.8	/	200	/
	21	0	M16x40-8.8	/	200	/
ECO46	18	15,7	M16x40-8.8	/	200	/
	21	0	M16x40-8.8	/	200	/

STAY BOLT TIGHTENING TORQUE TABLE



THREAD DIAMETER Df	TYPE	TIGHTENING TORQUE (Nm)
M8	ECP 28	17 ± 7%
M10	ECO 32	48 ± 7%
M14	ECP34	120 ± 7%
M12	ECO38	100 ± 7%
M16	ECO40	180 ± 7%
M14	ECO43-46	120 ± 7%

Table 25 AIR FLOW, NOISE AND WEIGHT

4 POLE GENERATOR

TYPE	Air flow m³/min 50 Hz	Air flow m³/min 60 Hz	Noise dB(A) 50 Hz 1m	Noise dB(A) 50 Hz 7m	Noise dB(A) 60 Hz 1m	Noise dB(A) 60 Hz 7m	Weight Kg
ECP 28 1VS	5,3	5,8	68	57	71	61	82
ECP 28 2VS							89
ECP 28 0S							99
ECP 28 S							107
ECP 28 1L							122
ECP 28 2L							139
ECP 28VL							165
ECO 32 2S	11,8	14,5	75	60	79	64	199
ECO 32 3S							214
ECO 32 1L							248
ECO 32 2L							282
ECO 32 3L							298
ECP 34 1.5VS	19,3	23	79	65	83	69	310
ECP 34 1S							341
ECP 34 2S							419
ECP 34 1L							445
ECP 34 2L							491
ECP 34 3L							495
ECO 38 1SN	32	39	82	69	86	73	510
ECO 38 2SN							560
ECO 38 3SN							590
ECO 38 1LN							680
ECO 38 2LN							765
ECO 38 3LN							905
ECO 40 1S	54	64,8	94	82	98	88	1040
ECO 40 2S							1118
ECO 40 3S							1171
ECO 40 1L							1324
ECO 40 1.5L							1380
ECO 40 2L							1586
ECO 40 VL							1693
ECO 43 1SN	90	108	95	84	99	89	1870
ECO 43 2SN							2090
ECO 43 1LN							2395
ECO 43 2LN							2660
ECO 43 VL							2950
ECO 46 1S	135	162	97	86	100	91	2770
ECO 46 1.5S							3380
ECO 46 2S							3440
ECO 46 1L							3720
ECO 46 1.5L							4260
ECO 46 2L							4250

2 POLE GENERATOR

TYPE	Air flow m³/min 50 Hz	Air flow m³/min 60 Hz	Noise dB(A) 50 Hz 1m	Noise dB(A) 50 Hz 7m	Noise dB(A) 60 Hz 1m	Noise dB(A) 60 Hz 7m	Weight Kg
ECP 28 1L	9,7	11	86	74	90,5	78	129
ECP 28 2L							136
ECP 28 3L							141
ECP 28 VL							156
ECO 31 2SN	22,4	27	88	77	93	80	178
ECO 31 3SN							204
ECO 31 1LN							217
ECO 31 2LN							236

Table 26 PROCEDURE TO CHECK THE DIODES OF THE EXCITER ROTOR

ALTERNATOR TYPE : 28-31-32

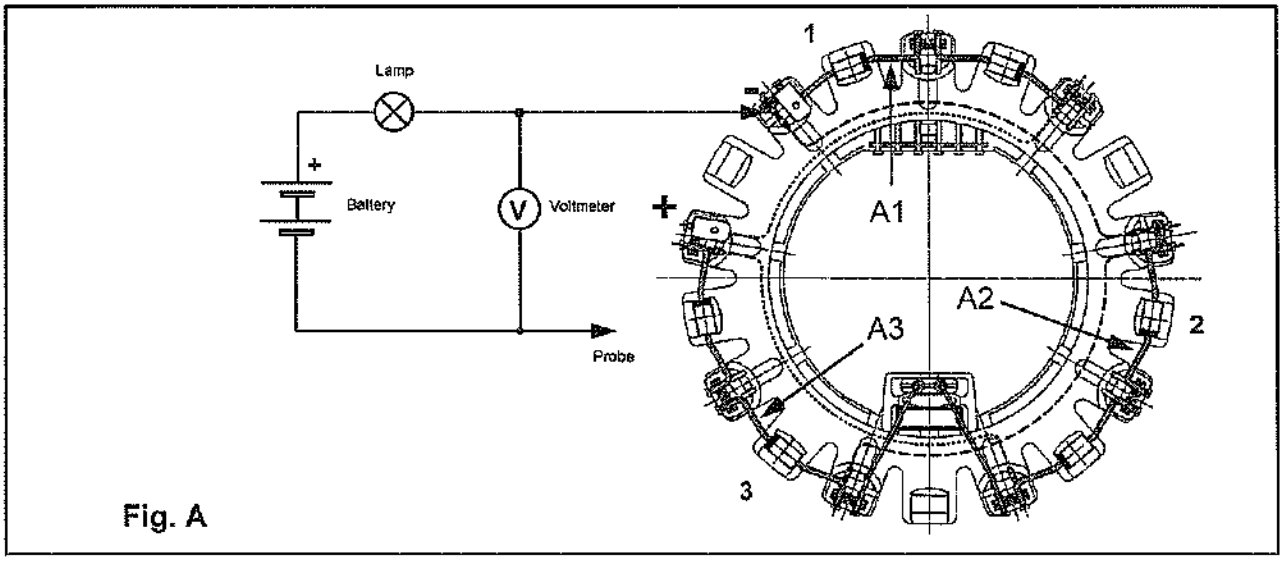
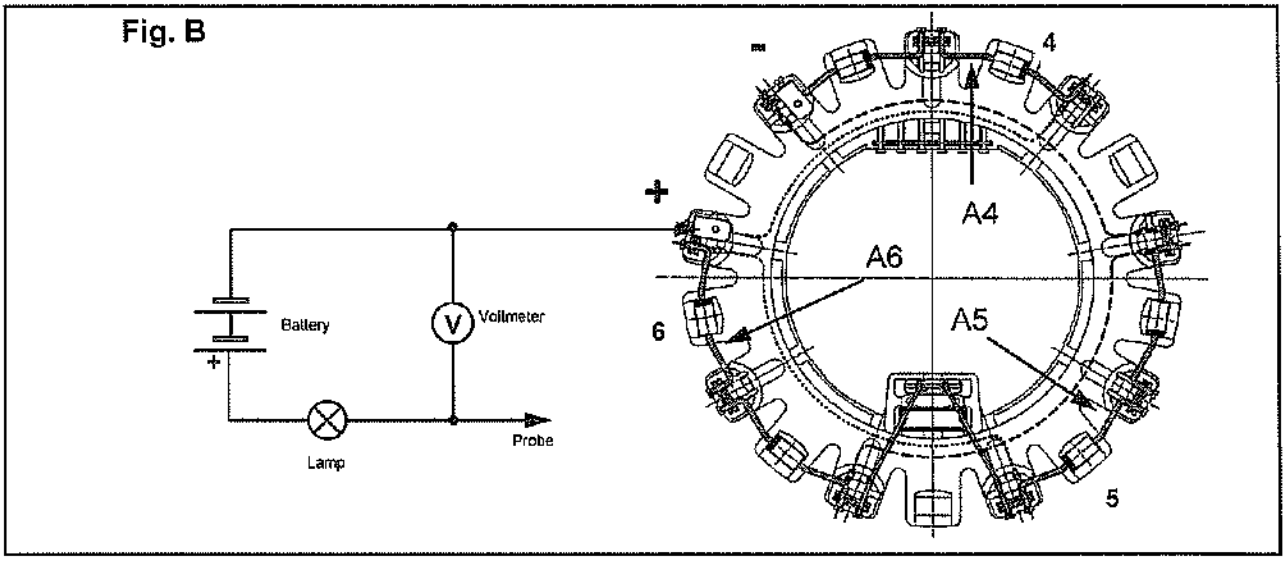


Fig. A

Fig. B

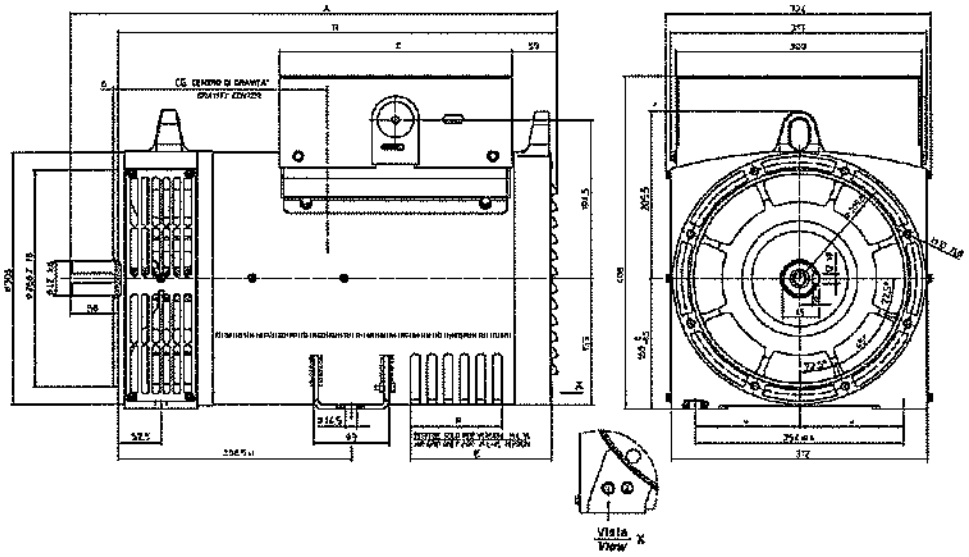


2 and 4 pole ALTERNATOR TYPE	VOLTAGE MEASURED (fig. A-B)		
	Good diode	Diode in short	Diode open
ECP28, ECO31-2SN, ECO31-3SN, ECO32-2S, ECO32-3S	from 0,8V to 1,2V	Lower than 0,6V	More than 1,3V
ECO31-1LN, ECO31-2LN, ECO32-1L, ECO32-2L, ECO32-3L	from 0,8V to 1,2V	Lower than 0,6V	More than 1,4V

ECP 28

FORM B3/B14

dimensions in mm



TYPE	A	B	C	E	F
28 1VS/4 - 2VS/4	477	419	225	/	/
28 0S/4 - S/4	517	459	285	/	/
28 M/4 - M/2	552	494	285	131,5	71
28 2L/4 - 2L/2 28 3L/2	597	539	285	171,5	111
28 VL	627	569	285	171,5	111

TYPE	CG*
28-1VS/4	230
28-2VS/4	230
28-0S/4	235
28-S/4	237
28-M/4	250
28-2L/4	275
28-VL/4	286

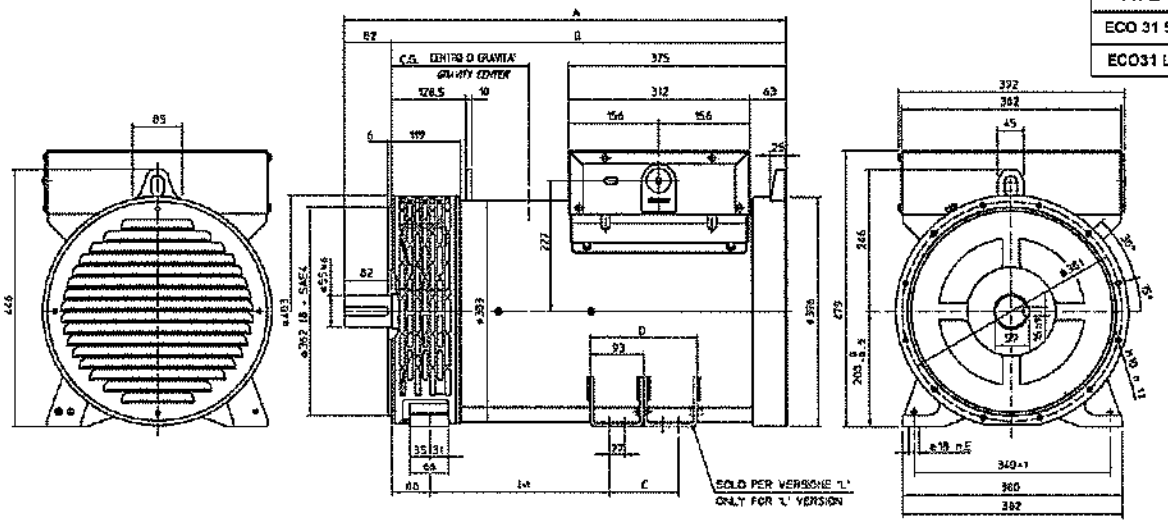
TYPE	CG*
28-M/2	245
28-2L/2	271
28-3L/2	275
28-VL/2	291

* Center of Gravity

ECO 31N

FORM B3/B14

dimensions in mm



TYPE	A	B	l	C	D	E
ECO 31 S	658	576	204	-	-	6
ECO31 L	763	681	309	120	186	10

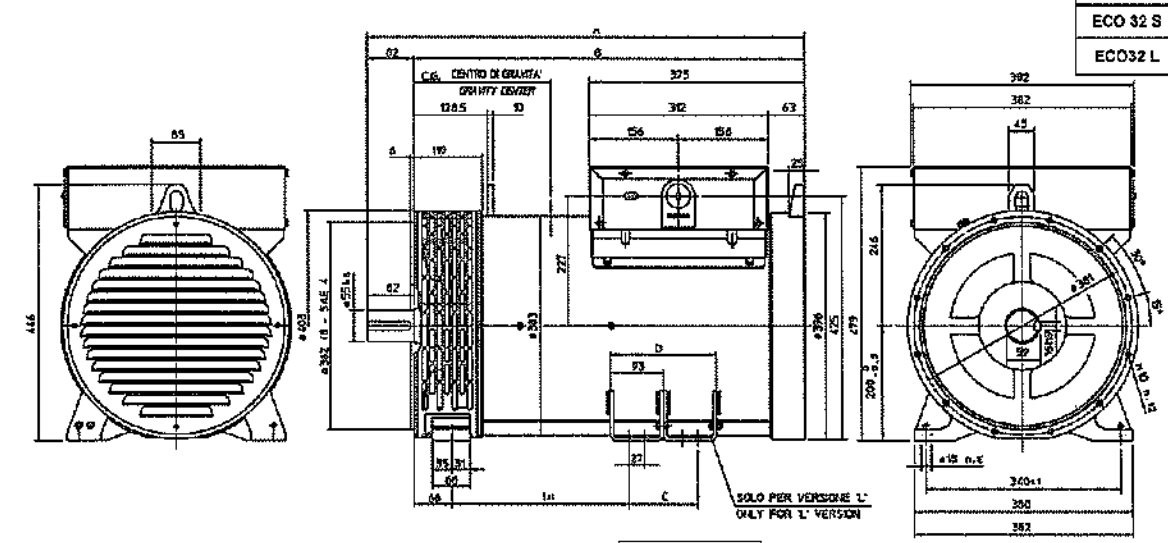
TYPE	CG*
31-2S/2	272
31-3S/2	285
31-1L/2	311
31-2L/2	336

* Center of Gravity

ECO 32

FORM B3/B14

dimensions in mm



TYPE	A	B	l	C	D	E
ECO 32 S	638	555	186	-	-	6
ECO32 L	763	681	310	120	186	10

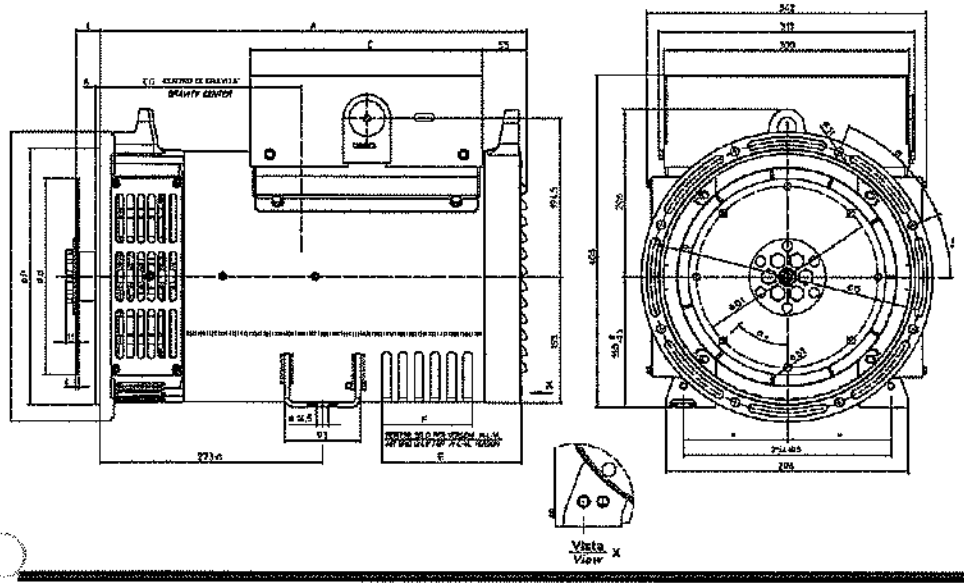
TYPE	CG*
32-2S/4	269
32-3S/4	274
32-1L/4	316
32-2L/4	330
32-3L/4	351

* Center of Gravity

ECP 28

FORM MD35

dimensions in mm



SAE N°	Disc coupling				
	L	d	Q1	S1	α1
6 ½	30,2	215,9	200	9	60°
7 ½	30,2	241,3	222,25	9	45°
8	62	263,52	244,47	11	60°
10	53,8	314,32	295,27	11	45°
11 ½	39,6	352,42	333,37	11	45°

TYPE	A	C	E	F
28 1VS - 2VS	405	225	/	/
28 0S - S	445	285	/	/
28 M/4 - M/2	460	285	131,5	71
28 2L/2 - 3L/2 28 2L/4	525	285	171,5	111
28 VL	555	285	171,5	111

SAE N°	Flange			
	O	P	Q	α
5	356	314,3	333,4	45°
4	403	362	381	30°
3	451	409,6	428,6	30°
2	490	447,7	466,7	30°

TYPE	CG*
28-1VS	200
28-2VS	200
28-0S	214
28-S/4	217
28-M/4	239
28-2L/4	254
28-VL/4	274

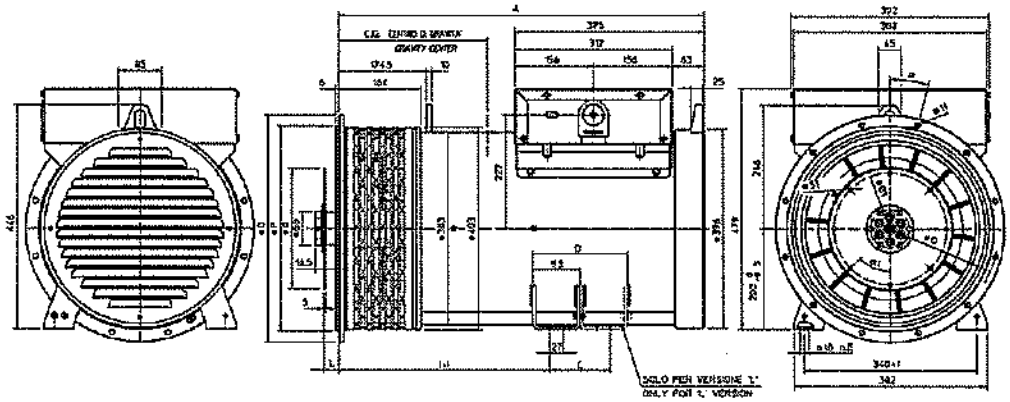
TYPE	CG*
28-M/2	233
28-2L/2	248
28-3L/2	254
28-VL/2	273

* Center of Gravity

ECO 31N

FORM MD35

dimensions in mm



SAE N°	Disc coupling				
	L	d	Q1	S1	α1
6 ½	30,2	215,9	200	9	60°
7 ½	30,2	241,3	222,25	9	45°
8	62	263,52	244,47	11	60°
10	53,8	314,32	295,27	11	45°
11 ½	39,6	352,42	333,37	11	45°

TYPE	A	I	C	D	E
ECO 31 S	621	315	-	-	4
ECO 31 L	726	420	120	186	8

SAE N°	Flange			
	O	P	Q	α
5	356	314,3	333,4	45°
4	403	362	381	30°
3	451	409,6	428,6	30°
2	490	447,7	466,7	30°
1	552	511,2	530,2	30°

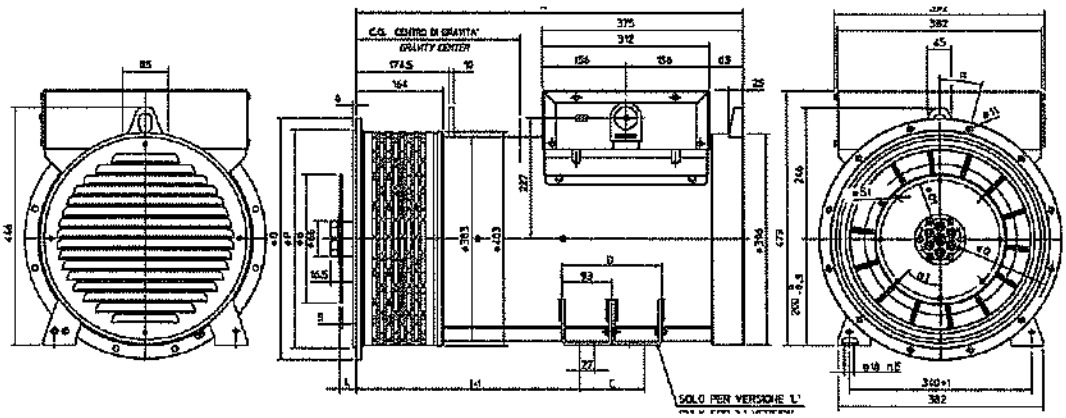
TYPE	CG*
31-2SN/2	296
31-3SN/2	310
31-1LN/2	335
31-2LN/2	380

* Center of Gravity

ECO 32

FORM MD35

dimensions in mm



SAE N°	Disc coupling				
	L	d	Q1	S1	α1
6 ½	30,2	215,9	200	9	60°
7 ½	30,2	241,3	222,25	9	45°
8	62	263,52	244,47	11	60°
10	53,8	314,32	295,27	11	45°
11 ½	39,6	352,42	333,37	11	45°

SAE N°	Flange			
	O	P	Q	α
5	356	314,3	333,4	45°
4	403	362	381	30°
3	451	409,6	428,6	30°
2	490	447,7	466,7	30°
1	552	511,2	530,2	30°

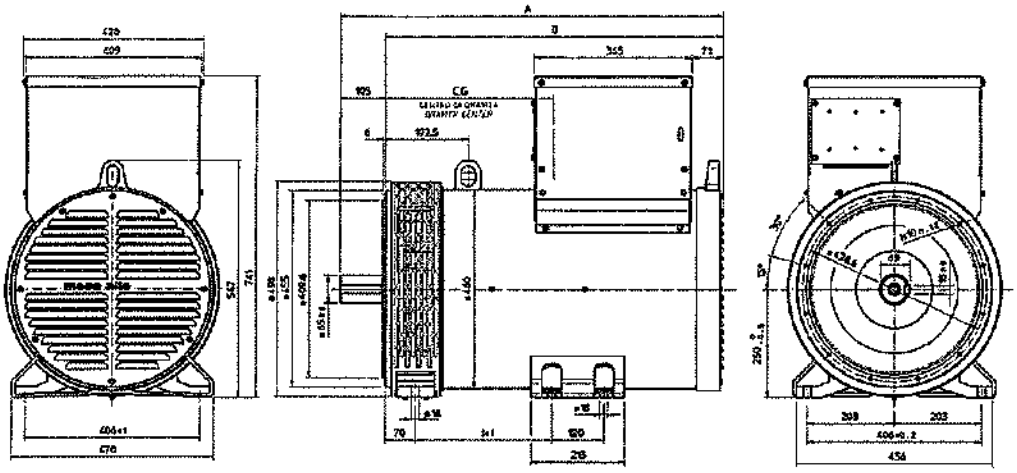
TYPE	A	I	C	D	E
ECO 32 S	601	295	-	-	4
ECO 32 L	726	420	120	186	8

TYPE	CG*
32-2S/4	312
32-3S/4	316
32-1L/4	356
32-2L/4	377
32-3L/4	388

* Center of Gravity

ECP 34

FORM B3/B14



dimensions in mm

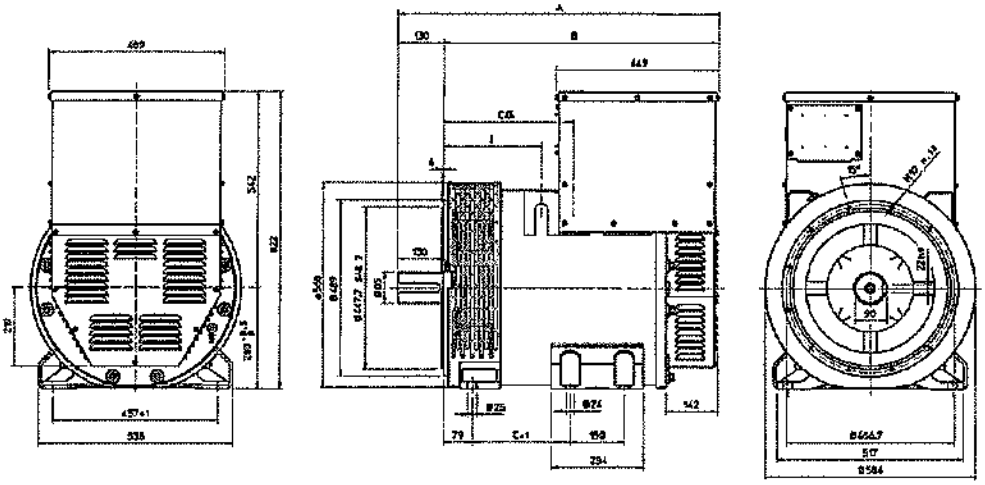
TYPE	A	B	I
34 VS	702	597	227
34 S	806,5	701,5	227
34 L	886,5	781,5	317

TYPE	CG*
34-1.5VS/4	287
34-1S/4	310
34-2S/4	350
34-1L/4	365
34-2L/4	390
34-3L/4	390

* Center of Gravity

ECO 38N

FORM B3/B14



dimensions in mm

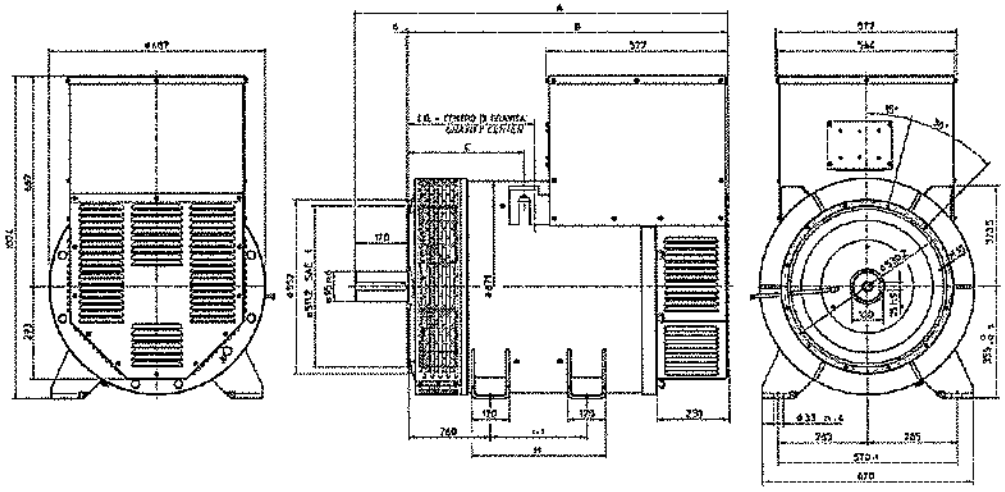
TYPE	A	B	C	I
38 SN	866	758	270	269
38 LN	1098	968	430	479

TYPE	CG*
38-1SN/4	358
38-2SN/4	371
38-3SN/4	385
38-1LN/4	400
38-2LN/4	437
38-3LN/4	476

* Center of Gravity

ECO 40

FORM B3/B14



dimensions in mm

TYPE	A	B	C	I	H
40 S	1187	1017	369,5	305	425
40 L	1352	1182	534,5	470	590
40 VL	1452	1282	634,5	470	590

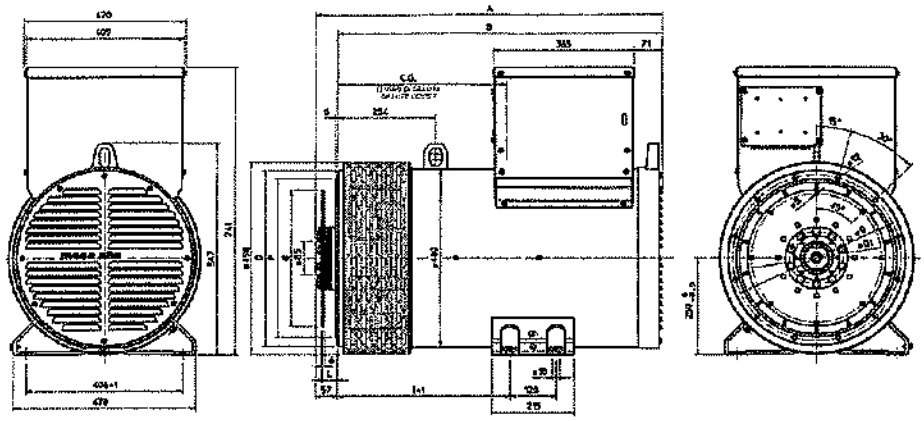
TYPE	CG*
40-1S/4	362
40-2S/4	372
40-3S/4	442
40-1L/4	537
40-1.5L/4	542
40-2L/4	547
40-VL/4	594

* Center of Gravity

ECP 34

FORM MD35

dimensions in mm



TYPE	CG*
34-1.5VS/4	347
34-1S/4	358
34-2S/4	398
34-1L/4	415
34-2L/4	440
34-3L/4	440

SAE N°	Flange		
	O	P	Q
3	451	409,6	428,6
2	489	447,7	466,7
1	552	511,2	530,2

* Center of Gravity

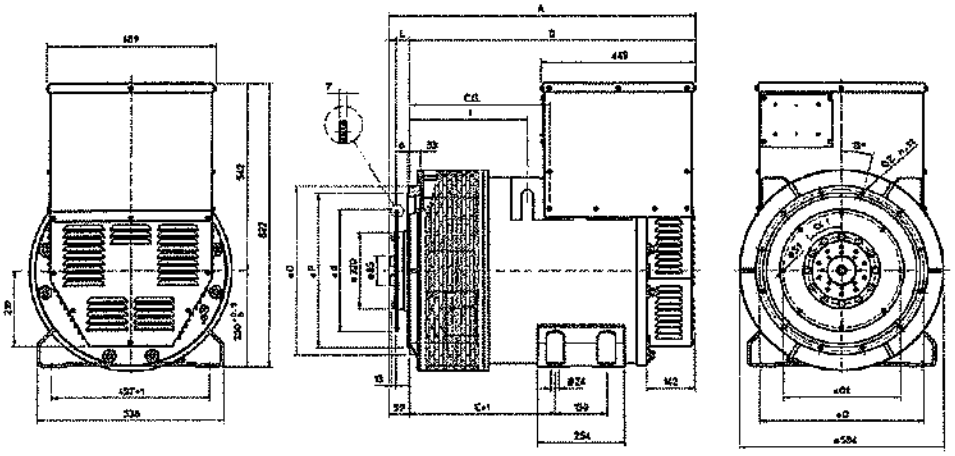
SAE N°	Disc coupling			
	L	d	Q1	S
10	59,8	314,32	295,27	11
11½	39,6	352,42	333,37	11
14	25,4	466,72	438,15	14

TYPE	A	B	I
34 VS	712,5	655,5	356
34 S	817,5	760,5	356
34 L	897,5	840,5	446

ECO 38N

FORM MD35

dimensions in mm



TYPE	A	B	C	I
38 SN	888	829	420	340
38 LN	1098	1039	580	550

SAE N°	Disc coupling					
	L	d	Q1	N° holes	S1	α1
11 ½	39,6	352,42	333,37	8	11	45°
14	25,4	466,72	438,15	8	14	45°

TYPE	CG*
38-1SN/4	405
38-2SN/4	420
38-3SN/4	436
38-1LN/4	455
38-2LN/4	495
38-3LN/4	540

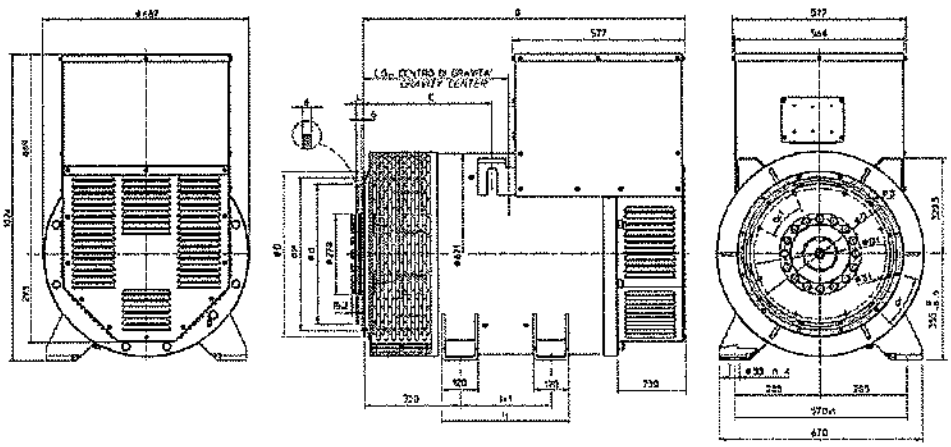
* Center of Gravity

SAE N°	Flange		
	O	P	Q
3	451	409,6	428,6
2	489	447,7	466,7
1	552	511,2	530,2
½	648	584,2	619,1

ECO 40

FORM MD35

dimensions in mm



SAE N°	Flange					
	O	P	Q	N° fori	S	α
1	552	511,2	530,2	12	11	30°
½	648	584,2	619,1	12	14	30°
0	711	647,7	679,5	16	14	22,5°
00	883	787,4	850,9	16	14	22,5°

SAE N°	Disc coupling					
	L	d	Q1	N° holes	S1	α1
14	25,4	466,72	438,15	8	14	45°
18	15,7	571,5	542,92	6	17	60°

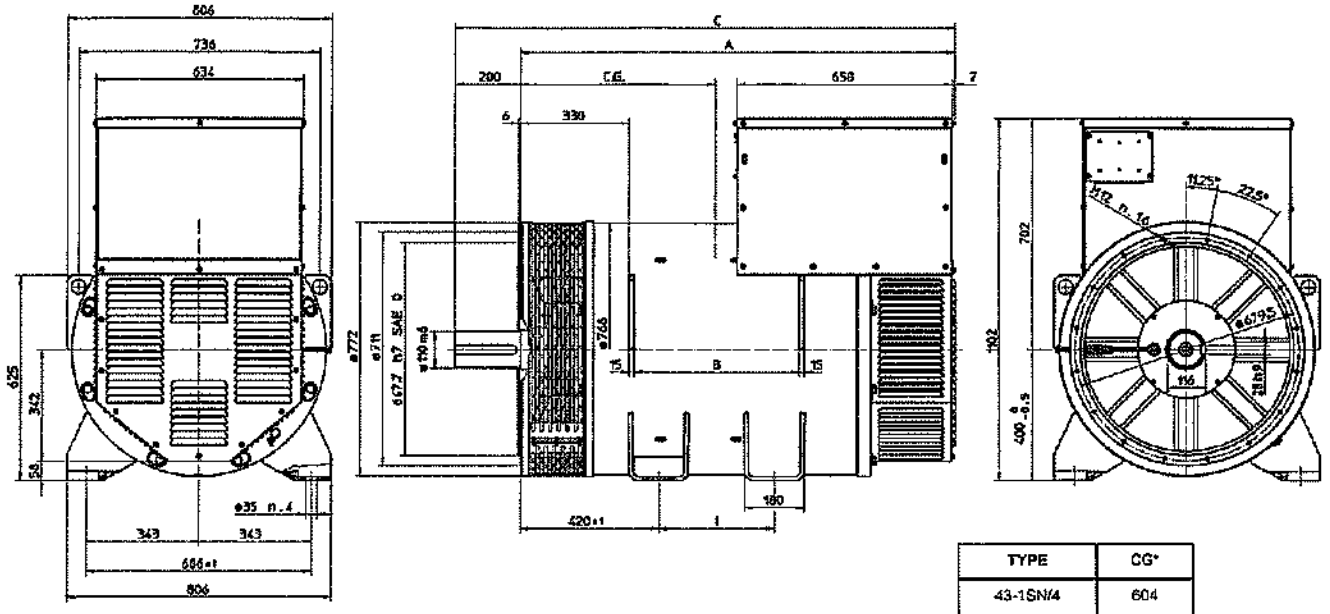
TYPE	CG*
40-1S/4	422
40-2S/4	432
40-3S/4	442
40-1L/4	597
40-1.5L/4	600
40-2L/4	607
40-VL/4	650

TYPE	B	C	I	H
40 S	1077	429,5	305	425
40 L	1242	594,5	470	590
40 VL	1342	604,5	470	590

* Center of Gravity

dimensions in mm

ECO 43N FORM B3/B14



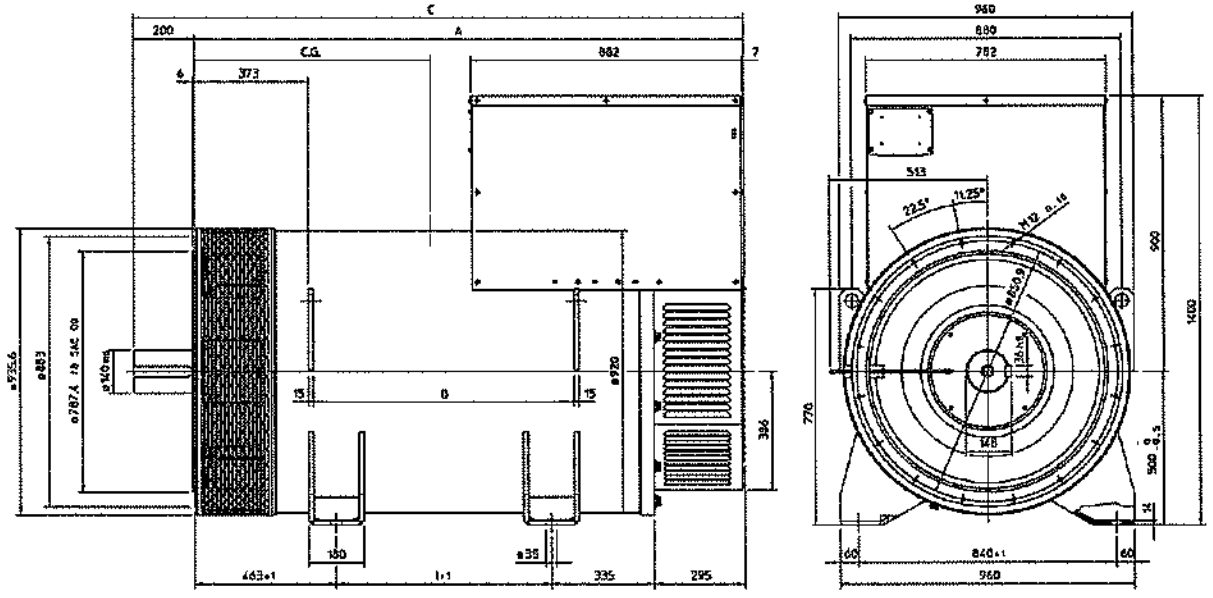
TYPE	A	B	C	I
43 SN	1320	500	1520	350
43 LN	1520	700	1720	550
43 VL	1600	780	1800	550

TYPE	CG*
43-1SN/4	604
43-2SN/4	614
43-1LN/4	670
43-2LN/4	714
43-VL/4	756

* Center of Gravity

dimensions in mm

ECO 46 FORM B3/B14



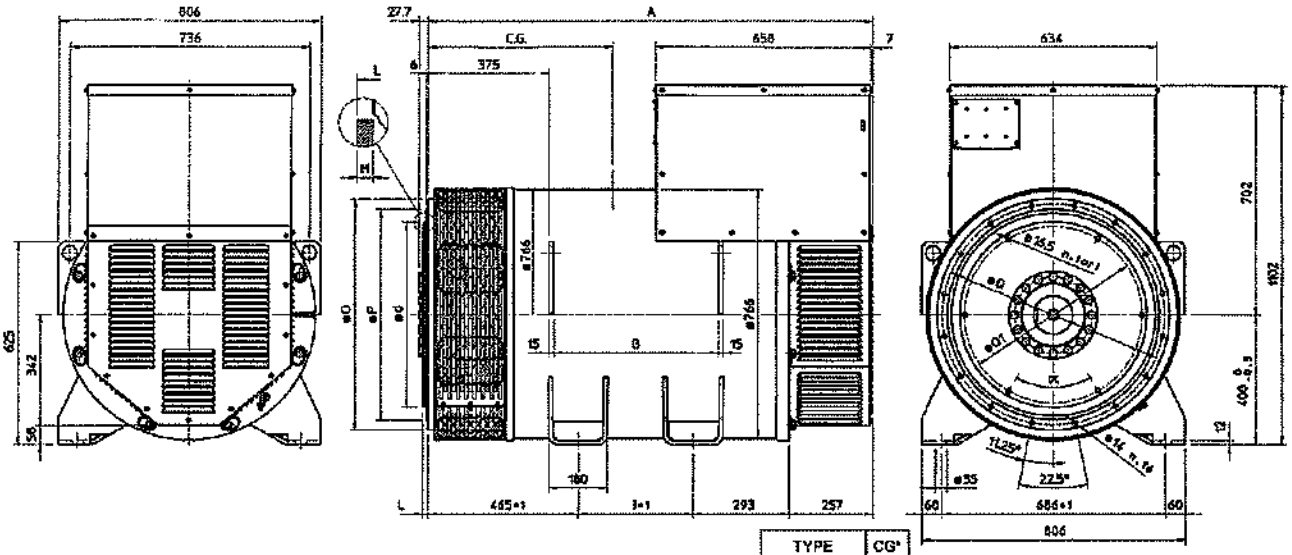
TYPE	A	B	C	I
46 S	1563	620	1763	470
46 L	1793	850	1993	700

TYPE	CG*
46-1S/4	627
46-1.5S/4	689
46-2S/4	701
46-1L/4	772
46-1.5L/4	800
46-2L/4	817

* Center of Gravity

ECO 43N FORM MD35

dimensions in mm



SAE N°	Disc coupling					
	d	L	M	Q1	N° holes	α1
18	571,5	15,7	10	542,92	6	60°
21	673,1	0	12	641,35	12	30°

SAE N°	Flange		
	O	P	Q
0	711	647,7	679,5
00	883	787,4	850,9

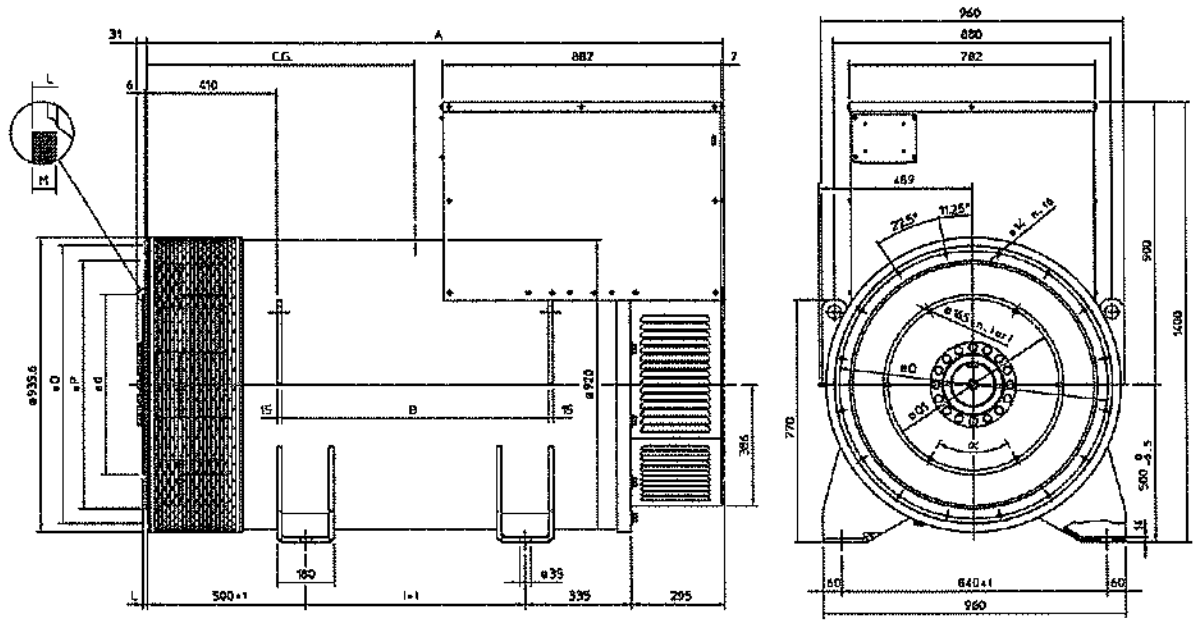
TYPE	CG*
43-1SN/4	630
43-2SN/4	654
43-1LN/4	720
43-2LN/4	760
43-VU/4	796

* Center of Gravity

TYPE	A	B	I
43 SN	1365	500	350
43 LN	1665	700	550
43 VL	1645	780	550

dimensions in mm

ECO 46 FORM MD35



SAE N°	Disc coupling					
	d	L	M	Q1	N° holes	α
18	571,5	15,7	15	542,92	6	60°
21	673,1	0	17	641,35	12	30°

SAE N°	Flange		
	O	P	Q
0	711	647,7	679,5
00	883	787,4	850,9

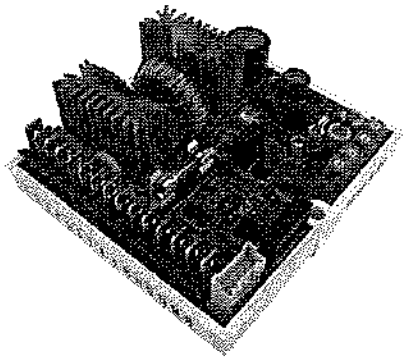
TYPE	A	B	I
46 S	1600	620	470
46 L	1830	850	700

TYPE	CG*
46-1S/4	664
46-1.5S/4	728
46-2S/4	741
46-1L/4	812
46-1.5L/4	839
46-2L/4	856

* Center of Gravity

DSR APPENDIX

DSR DIGITAL REGULATOR



Further information about DSR regulator are available in the web site download area at following address :

www.meccalte.com

INSTALLATION

Upon receipt of the digital regulator, perform a visual inspection to ensure that no damage has been sustained during transportation and movement of the equipment. In the event of damage, advise the shipper, the insurance company, the seller or Mecc Alte immediately. If the regulator is not installed immediately, store it in its original packaging in a dust and humidity-free environment. The regulator is normally installed in the generator terminal box. It is fixed with two M4x20 or M4x25 screws and must be installed in a location where the temperature does not exceed the environmental conditions foreseen.

CONNECTIONS

The digital regulator connections depend on the application and excitation system. **An error in connection may have serious consequences for the unit.** Carefully check to make sure that all connections are precise and in accordance with the attached drawings, before turning on the power.

TERMINALS

The connections must be made using cables having a minimum diameter :

- **1,5 mm²** for power cables on terminals 1, 2, 3 and 9 (Exc-, Aux/exc+, Aux)
- **0,5 mm²** for signal cables

INPUTS AND OUTPUTS : TECHNICAL SPECIFICATIONS

TABELLA 1 : CONNETTORE CN1			
Terminal [1]	**Name**	**Function**	**Specifications**
1	Exc-	Excitation	Continuous Rating : 4Adc max Transitory Rating : 12Adc peak
2	Aux/Exc+		
3	Aux/Exc+	Power	Frequency : from 12Hz to 72Hz Range: 40Vac - 270Vac
9	Aux/Neutral		
4	F_phase	Sensing	Range: 140Vac - 280Vac Burden : <1VA
5	F_Phase		
6	H_phase	Sensing	Range: 70Vac - 140Vac Burden : <1VA
7	H_phase		
8	Aux/Neutral		
10	Vext/Pext	Input for remote voltage control	Type: Not isolated Range: 0 - 2,5 Vdc or Potentiometer 10K Adjustment: from -14% to +14% [3] Burden: 0 - 2 mA (sink) Max length: 30m[2]
11	Common		
12	50/60Hz	Jumper Input 50/60Hz	Type: Not isolated Max length: 3m
13	Common		
14	A.P.O.	Active protections output	Type: Open collector not isolated Current : 100mA Voltage: 30V Max length: 30m[2]
15	Common		

Note 1) The terminals are connected to each other on the board: 2 with 3, 4 with 5, 6 with 7, 8 with 9, 11 with 13 and 15.
Note 2) with external EMI SDR 128/K filter (3m without EMI filter)
Note 3) starting from revision 10 of the Firmware. It is convenient do not exceed ±10%

DSR regulator, on board of new generators, is already calibrated; in case of loose regulators (ie spare parts) or in case of wiring modifications or adjusting, to guarantee its correct working, it must be accurately set .

Basic settings can be done directly on the regulator by its four trimmers (VOLT - STAB - Hz - AMP), the jumper 50/60 and the Vext input. More detailed settings or measures can be done exclusively by software using for example the MeccAlte communication interface DI1 and the program DSR_Terminal or DSR_Reader.

Vext Input

The Vext input (connector CN1 – terminals 10 and 11) permits analogical remote control of output voltage through a 10Kohm potentiometer with a programmable variation range through parameter 16 with respect to the value set (by default the setting is ±14% starting from revision 10 of the Firmware); if you want to use continuous voltage, it will be effective if it is in the range between 0V and +2,5V. The input tolerates voltages from -5V to +5V, but for values exceeding the limits of 0V / +2,5V (or in the event of disconnection), two options are possible: not to take the set point of external input (default configuration) and return to regulation to the voltage value set with the trimmer (if enabled) or with parameter 19, or keep the minimum (or maximum) value of voltage that can be reached. The two options can be set with the **RAM Voltage CTRL** flag in the **Configuration** menu corresponding to the bit B7 of the configuration word P[10].

NOTE : The DC voltage generator must be able to sink al least 2mA. In making adjustments it is reccomended not to exceed the nominal value of voltage of the alternator beyond ± 10%

50/60 Signal

A jumper is located on the 50/60 input (connector CN1, terminals 12 and 13); it provokes the commutation of the underspeed protection threshold from 50·(100%-αHz%) to 60·(100%-αHz%), where αHz% represents the position relative to the Hz trimmer.

APO Contact

The acronym APO stands for Active Protection Output: (connector CN1 – terminals 14 and 15) 30V-100mA non-insulated open collector transistor, normally opened, is closed (with a delay that can be programmed by software from 1 to 15 seconds) when, among all the alarms, one or more of the active ones can be selected separately by software.

The **VOLT trimmer** allows adjustment from about 70V to about 140V when using for sensing terminals 4 and 5, or from about 140V to about 280V when using terminals 6 and 7.

The **STAB trimmer** adjusts the dynamic response (statism) of the alternator under transient conditions.

The **AMP trimmer** adjusts the excitation overcurrent protection intervention threshold.

Use the following procedure in order to calibrate the overload protection:

1) Rotate the Hz trimmer entirely in the counter clockwise direction
2) Apply the nominal load to the alternator.
3) Decrease the speed by 10%
4) Rotate the AMP trimmer completely in the counter clockwise direction.
5) After a few seconds, there should be a decrease in the voltage value of the generator and alarm 5 should come on (visible due to a change in the flashing indicator light) .
6) Under these conditions, rotate the AMP trimmer slowly in the clockwise direction, until the output voltage value is 97% of the nominal value: alarm 5 is still activated.
7) Return to the nominal speed; alarm 5 should disappear in a few seconds and the generator voltage should increase to the nominal value.
8) Re-adjust the trimmer as indicated in the following paragraph.

The **Hz trimmer** allows to calibrate the threshold of the intervention of the under frequency protection up to -20% with respect to the nominal speed value set by jumper 50/60 (at 50 Hz the threshold can be calibrated from 40 Hz to 50 Hz, at 60 Hz the threshold can be calibrated from 48 Hz to 60 Hz).

The intervention of this protection reduce the output generator voltage and, to calibrate it, use the following procedure :

1) Rotate the Hz trimmer entirely in the counter clockwise direction.
2) If the machine has to operate at 60 Hz, ensure that the bridge is inserted between terminals 12 and 13 of the CN1 connector.
3) Bring the generator to 90% of the nominal speed.
4) Slowly turn the "Hz" trimmer, rotating it clockwise until the generator voltage begins to drop and ascertain that the indicator light simultaneously begins flashing rapidly.
5) By increasing speed, the generator voltage will normalise and the alarm will disappear.
6) Set the speed to the nominal value.

During normal operation and a duty cycle of 50% an indicator light mounted on the board flashes every 2 seconds; it flashes differently in the event of intervention or alarm, as indicated in figure 1.

NOTE: Notwithstanding DSR maintains the voltage regulation, it goes in shutdown mode if the frequency decreases under 20Hz. The reset needs the Gen-Set switching off.

N.	Description of event	Action
1	Checksum EEprom	Reset default, Blockage
2	Overvoltage	APO
3	Undervoltage	APO
4	Short circuit	APO, Maximum current, Blockage
5	Excitation overcurrent	APO, Reduction of excitation current
6	Underspeed	APO, Ramp V/F
7	Overspeed	APO

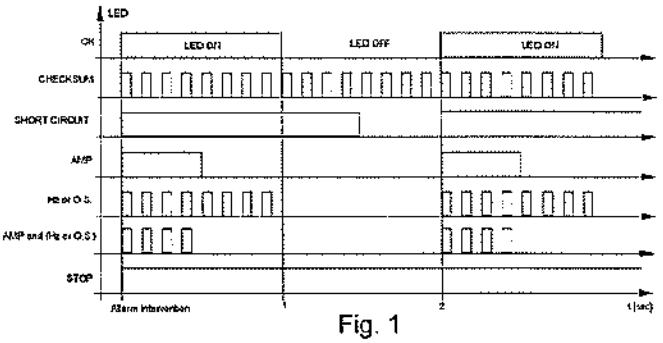
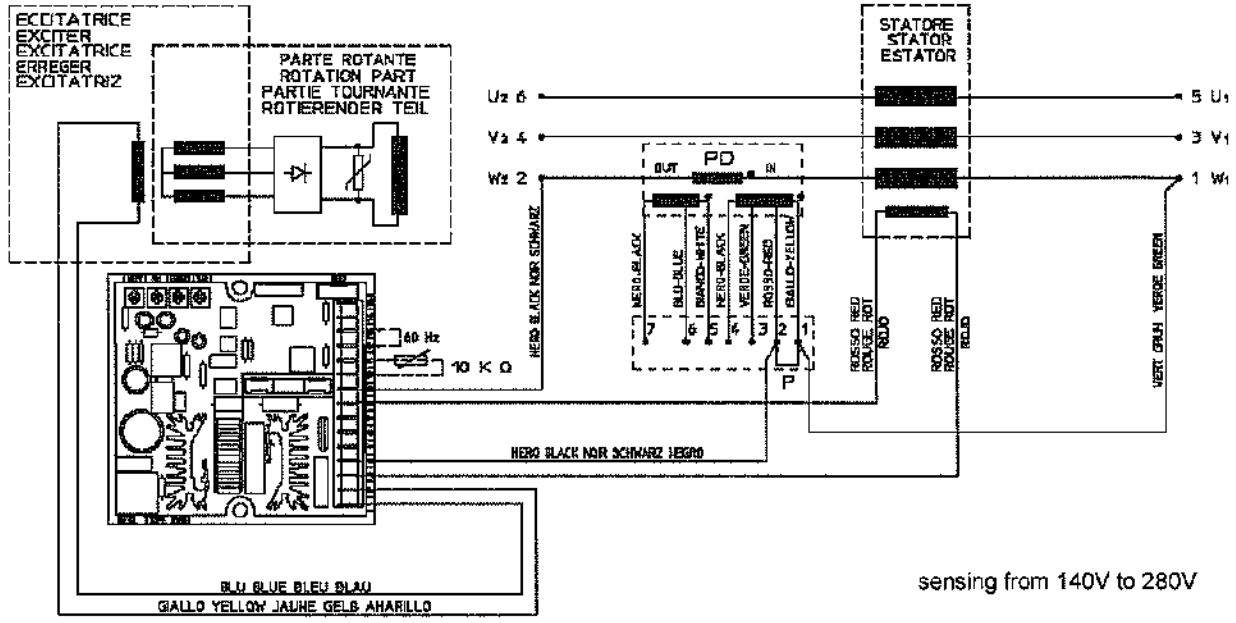


Fig. 1

6 terminal alternators

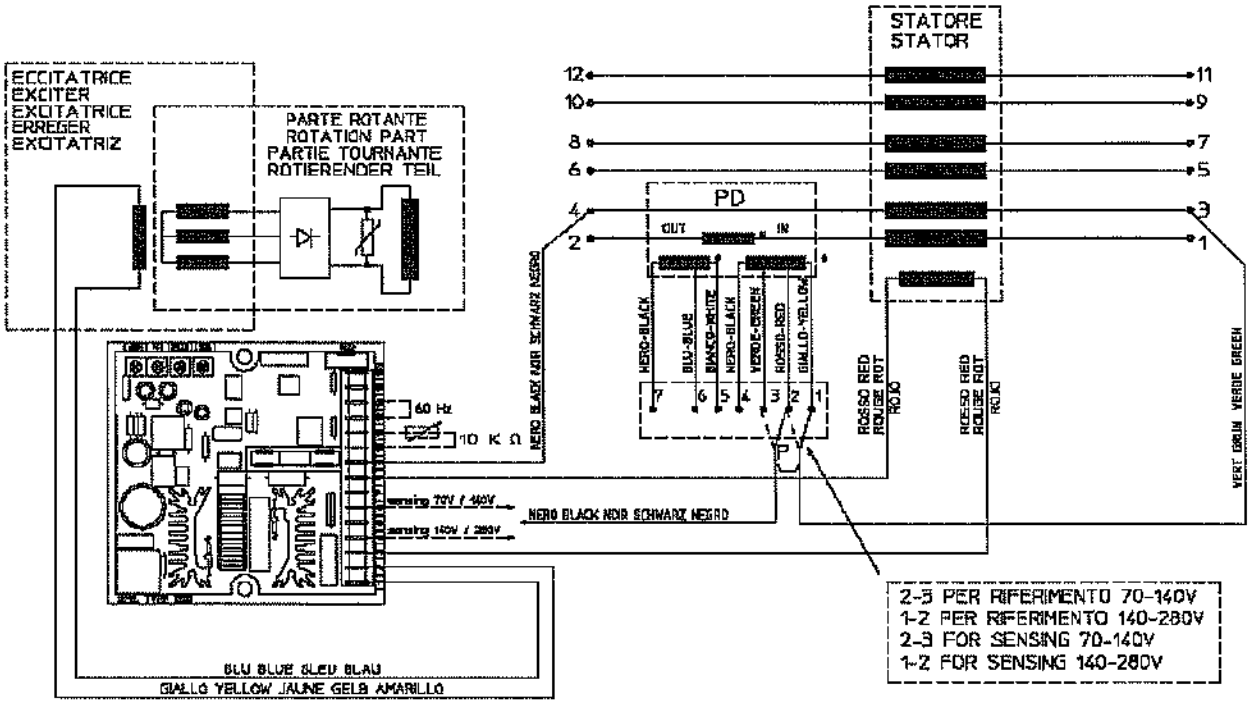
SCC0061/02



sensing from 140V to 280V

12 terminal alternators

SCC0100/00

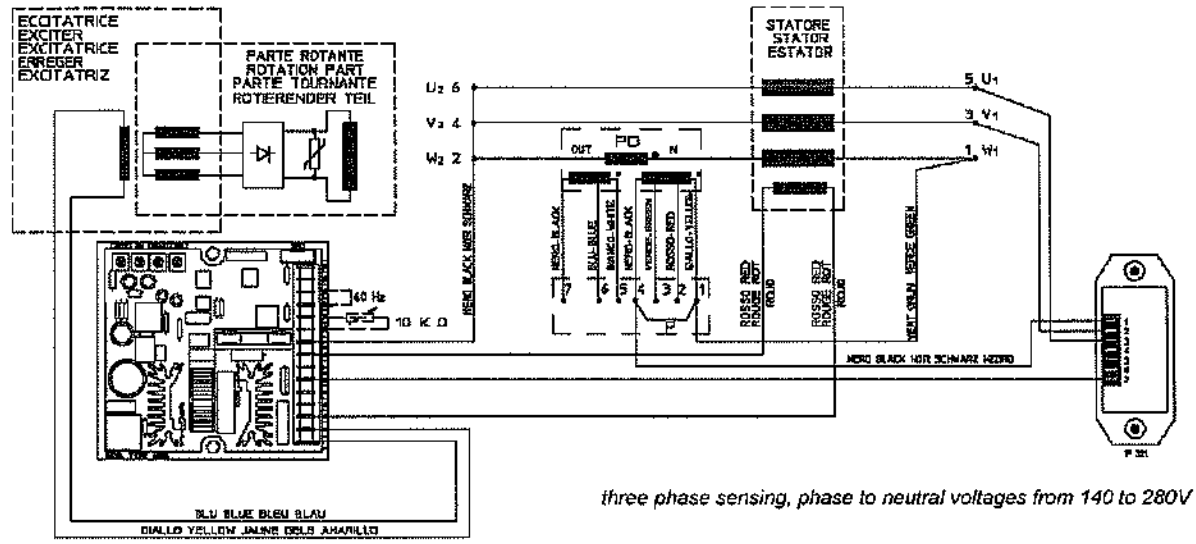


terminal 4 : sensing 140V / 280V

terminal 6 : sensing 70V / 140V

6 terminal alternators, three-phase sensing

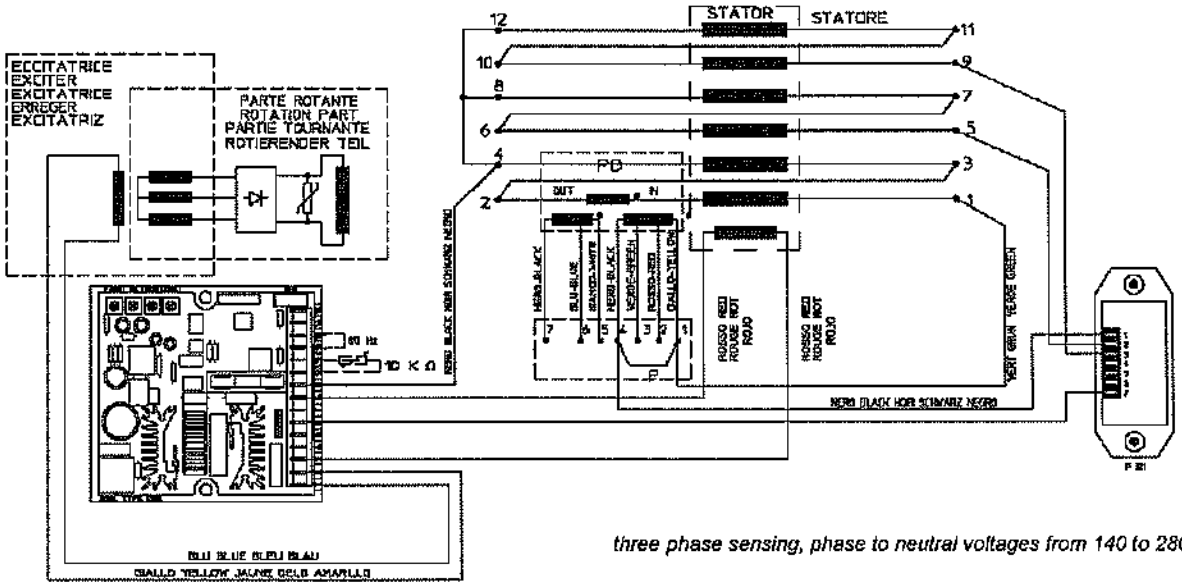
SCC0104/00



three phase sensing, phase to neutral voltages from 140 to 280V

12 terminal alternators, three-phase sensing

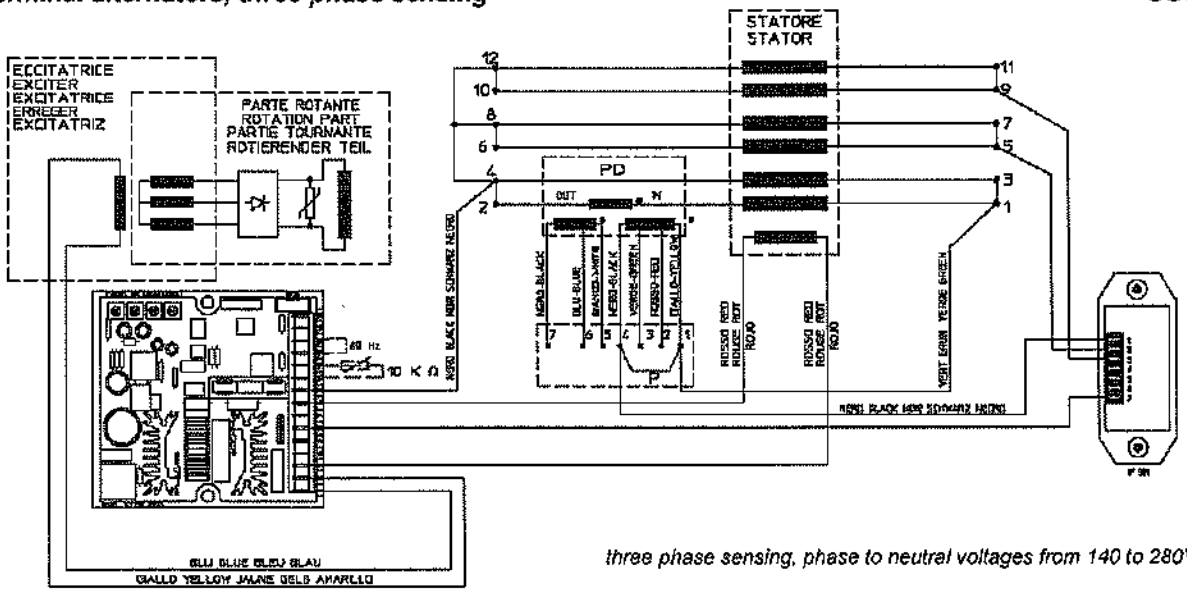
SCC0106/00



three phase sensing, phase to neutral voltages from 140 to 280V

12 terminal alternators, three-phase sensing

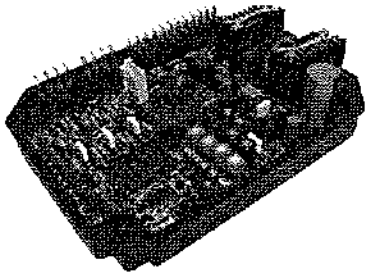
SCC0105/00



three phase sensing, phase to neutral voltages from 140 to 280V

DER1 APPENDIX

DER1 DIGITAL REGULATOR



Further information about DER1 regulator are available in the web site download area at following address :

www.meccalte.com

INSTALLATION

Upon receipt of the digital regulator, perform a visual inspection to ensure that no damage has been sustained during transportation and movement of the equipment. In the event of damage, advise the shipper, the insurance company, the seller or Mecc Alte immediately. If the regulator is not installed immediately, store it in its original packaging in a dust and humidity-free environment. The regulator is normally installed in the generator terminal box. It is fixed with two or M4x25 screws and must be installed in a location where the temperature does not exceed the environmental conditions foreseen.

CONNECTIONS

The digital regulator connections depend on the application and excitation system. **An error in connection may have serious consequences for the unit.** Carefully check to make sure that all connections are precise and in accordance with the attached drawings, before turning on the power.

TERMINALS

The connections must be made using cables having a minimum diameter :

- **1,5 mm²** for power cables on terminals from 1 to 22
- **0,5 mm²** for signal cables on terminals from 23 to 32

INPUTS AND OUTPUTS : TECHNICAL SPECIFICATIONS

TABLE 1 : CONNECTOR CN1

Terminal[1]	Name	Function	Specification	Notes
1	Exc-	Excitation	Continuous rating: 4Adc Transitory rating: 12Adc at peak	
2	Aux/Exc+			
3	Aux/Exc+	Power	40÷270 Vac, Frequency: 12÷72Hz [2]	(1)
4	UFG	Sensing range 2	Range 2: 150÷300 Vac Burden: <1VA	U channel
5	UFG			
6	UHG	Sensing range 1	Range 1: 75÷150 Vac Burden: <1VA	
7	UHG			
8	UHB	Jumper range 1		Short for sensing 75÷150 Vac
9	UFB			
10	UFB		Board reference	Star point (12YY or 6Y leads generators) is hard connected to AVR power supply input [1]
11	UFB			
12	UFB			
13	-		Not present	
14	VFG	Sensing	Range 1: 75÷150 Vac Burden: <1VA	V channel, to be connected in parallel to U channel in case of single phase sensing.
15	VHG	Sensing range 1		
16	VHB		Range 2: 150÷300 Vac Burden: <1VA	
17	VFB	range 2		
18	-		Not present	
19	WFG	Sensing	Range 1: 75÷150 Vac Burden: <1VA	W channel, unused (with shorted inputs) in case of single phase sensing.
20	WHG	Sensing range 1		
21	WHB		Range 2: 150÷300 Vac Burden: <1VA	
22	WFB	range 2		

Note 1) The terminals are connected to each other on the board: 2 with 3, 74 with 5, 6 with 7, 9 with 10, 11 and 12.

Note 2) Minimum power voltage 40Vac at 15Hz, 100V at 50Hz, 115V at 60Hz.

TABLE 2 : CONNECTOR CN3				
Terminal	Name	Function	Specifications	Notes
23	Common	Active protections output	Type: Not insulated open collector Current: 100mA Voltage: 30V Max lenght: 30m (3)	Both activating alarm and delay time are programmable.
24	A.P.O.			
25	Common	Jumper 50/60Hz	Type: Not insulated Max lenght: 3m	Selection of underspeed (4)
26	50/60Hz			
27	0EXT	Jumper for remote voltage control 0÷2,5Vdc	Type: Not insulated Max lenght: 3m	Short for 0÷2,5Vdc input or potentiometer
28	JP1			
29	0EXT	Jumper for remote	Type: Not insulated Max lenght: 3m (3)	Regulation: ±10 % (5)
30	PEXT	Input remote voltage control 0÷2,5Vdc or Pext	Input : 0÷2,5Vdc or Potentiometer 100K	Burden: 0÷1mA (sink)
31	JP2	Pext Jumper	Type: Not insulated Max lenght: 3m	Short for 0÷2,5Vdc input or potentiometer
32	±10V	control±10 Vdc	Input: ±10Vdc	Burden: ±1mA (source/sink)

Nota 3) With external EMI filter (3m without EMI filter)
Nota 4) 50-(100%-αHz%) o 60-(100%-αHz%) where αHz% is the position relative to the Hz trimmer or the percentage value of parameter P[21]
Nota 5) Value not to be exceeded. The effective range depends on parameter P[16]

DER1 regulator, on board of new generators, is already calibrated; in case of loose regulators (ie spare parts) or in case of wiring modifications or adjusting, to guarantee its correct working, it must be accurately set .

Basic settings can be done directly on the regulator by its four trimmers (VOLT - STAB - Hz - AMP), the jumper 50/60, JP1, JP2 and the Pext input. More detailed settings or measures can be done exclusively by software using for example the MeccAlte communication interface DI1 and the programs DSR_Terminal or DSR_Reader.

Remote control of voltage

The Pext input (terminal 30) and ±10V (terminal 32) allow to obtain remote control of the output voltage by means of a DC signal or an external potentiometer. The output voltage can be controlled by software as well with the P[19]. The excursion range and gain of the remote control can be set independently by software despite the output voltage control device system used (potentiometer, VDC signal or P[19]). If DC voltage is used, it will take effect if it is within the range 0Vdc/2,5Vdc or -10Vdc/+10Vdc, when connected between terminals 30 and 29 and subjected by jumpers JP1 and JP2; for values exceeding the aforementioned limits (or in the event of disconnection), two options are possible: not to take the set point of external input and return to regulation to the voltage value set with the trimmer (if enabled) or with parameter P[19], or keep the minimum (or maximum) value of voltage that can be reached (see figures 3a and 3b). The second option can be set only with the **RAM Voltage CTRL** flag in the configuration menu corresponding to the bit B7 of the configuration word P[10]The setting relative to the Vext input are summarised in table 3.

NOTE: the source of DC voltage must be capable of absorbing at least 2 mA.

In making adjustments it is reccomended not to exceed the nominal value of voltage of the alternator beyond ± 10%

Relationship between analogical input and output voltage

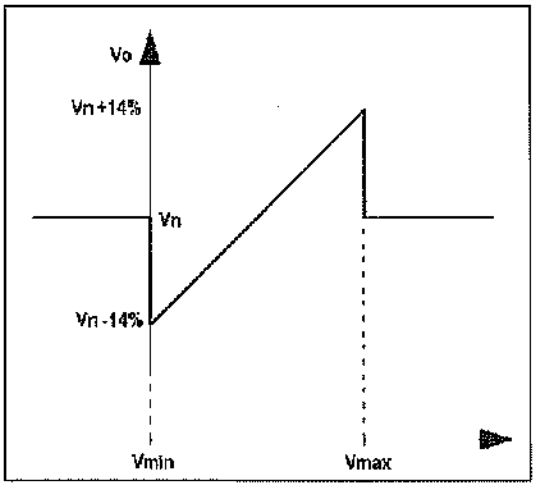


Figure 3a: without saturation of the output voltage upon reaching the input voltage limits

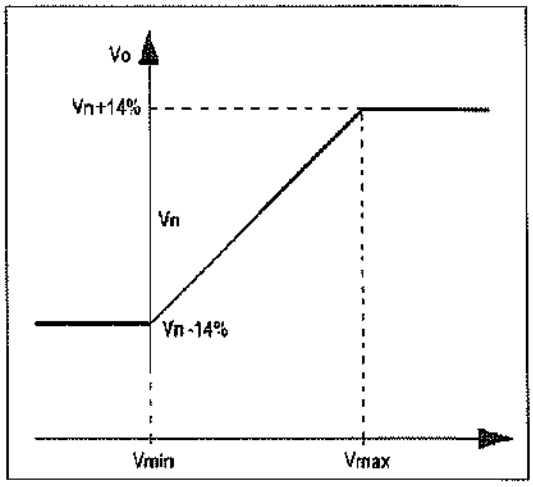


Figure 3b: with saturation of the output voltage upon reaching the input voltage limits

TABLE 3 : HARDWARE AND SOFTWARE CONFIGURATION OF VOLTAGE REMOTE CONTROL					
Type	Input	Jumpers		Flags (Menu configuration) or Parameter P[10]	
		JP1 (27-28)	JP2 (31-32)	RAM Voltage CTRL	Ext. Input
Potentiometer	0Ext - Pext (29-30)	Close	Close	Disabled (Bit B7=0)	Enabled (Bit B12=1)
0V/2,5V without saturation	0Ext - Pext (29-30)	Close	Close	Disabled (Bit B7=0)	Enabled (Bit B12=1)
0V/2,5V with saturation	0Ext - Pext (29-30)	Close	Close	Enabled (Bit B7=1)	Enabled (Bit B12=1)
-10V/+10V without saturation	0Ext - ±10V (29-32)	Open	Open	Disabled (Bit B7=0)	Enabled (Bit B12=1)
-10V/+10V with saturation	0Ext - ±10V (29-32)	Open	Open	Enabled (Bit B7=1)	Enabled (Bit B12=1)
Parameter P[15]	EEPROM	Close	Close	Disabled (Bit B7=0)	Disabled (Bit B12=0)
Location L[49]	RAM	Close	Close	Enabled (Bit B7=1)	Disabled (Bit B12=0)

With a 100Kohm linear potentiometer connected as shown in figure 4a, you have the full excursion set with parameter P[16] (with the default value P[16]=4608 there is an excursion of ± 14%); with a 25Kohm linear potentiometer in series with a 3.9Kohm resistor, connected as shown in figure 4b, the effect of the external potentiometer is cut in half (with the default value P[16]=4608 there is an excursion of approximately ± 7%).

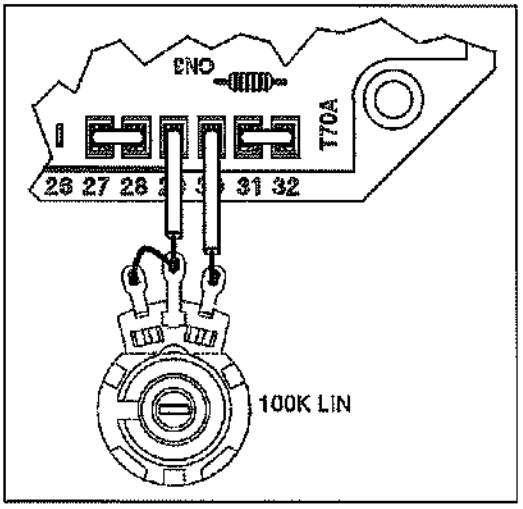


Figure 4a: 100K external potentiometer connection

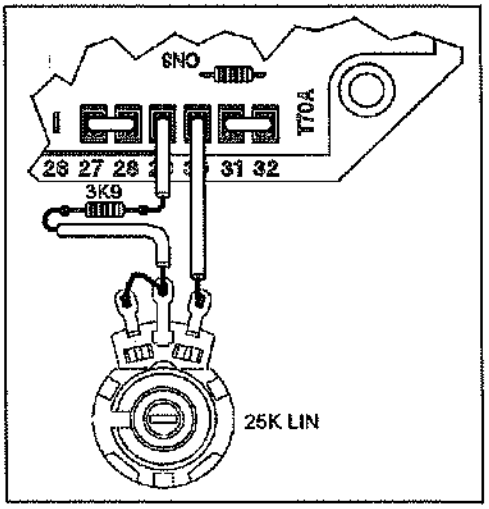


Figure 4b: 25K external potentiometer connection

50/60 Signal

A jumper is located on the 50/60 input (terminals 25 and 26); it provokes the commutation of the underspeed protection threshold from 50·(100%-αHz%) to 60·(100%-αHz%), where αHz% represents the position relative to the Hz trimmer.

APO Contact

The acronym APO stands for Active Protection Output: terminals 23 (common) and 24 (collector) 30V-100mA non-insulated open collector transistor, normally opened, is closed (with a delay that can be programmed only by software from 1 to 15 seconds) when, among all the alarms, one or more of the active ones can be selected separately by software.

The **VOLT** trimmer allows adjustment from about 75V to about 150V when using for sensing terminals 6/7 - 10/11/12 (with brdge 8-9), 15-16 and 20-21, or from about 150V to about 300V when using terminals 4/5 - 9/10/11/12, 14-17 and 19-22.

The **STAB** trimmer adjusts the dynamic response (statism) of the alternator under transient conditions. Do not set this trimmer in a position lower than two notches counted counterclockwise.

The **AMP** trimmer adjusts the excitation overcurrent protection intervention threshold.
Use the following procedure in order to calibrate the overload protection:
1) Rotate the Hz trimmer entirely in the counter clockwise direction
2) Apply the nominal load to the alternator.
3) Decrease the speed by 10%
4) Two minutes later slowly rotate the AMP trimmer in the counter clockwise direction until there should be a decrease in the voltage value of the generator and alarm 5 should come on (visible due to a change in the flashing indicator light) .
5) Under these conditions, adjust the AMP trimmer, until the output voltage value is 97% of the nominal value: alarm 5 is still activated.
6) Return to the nominal speed; alarm 5 should disappear in a few seconds and the generator voltage should increase to the nominal value.
7) Adjust the trimmer as indicated in the following paragraph.

The **Hz** trimmer allows to calibrate the threshold of the intervention of the under frequency protection up to -20% with respect to the nominal speed value set by jumper 50/60 (at 50 Hz the threshold can be calibrated from 40 Hz to 50 Hz, at 60 Hz the threshold can be calibrated from 48 Hz to 60 Hz).
The intervention of this protection reduce the output generator voltage and, to calibrate it, use the following procedure :
1) Rotate the **Hz** trimmer entirely in the counter clockwise direction.
2) If the machine has to operate at 60 Hz, ensure that the bridge is inserted between terminals 25 and 26.
3) Bring the generator to 90% of the nominal speed.
4) Slowly turn the "Hz" trimmer, rotating it clockwise until the generator voltage begins to drop and ascertain that the indicator light simultaneously begins flashing rapidly.
5) By increasing speed, the generator voltage will normalise and the alarm will disappear.
6) Set the speed to the nominal value

During normal operation and a duty cycle of 50% (OK in fig. 5) an indicator light mounted on the board flashes every 2 seconds; it flashes differently in the event of intervention or alarm, as indicated in fig. 5.

NOTE: Notwithstanding DER1 maintains the voltage regulation, it goes in shutdown mode if the frequency decreases under 20Hz.The reset needs the Gen-Set switching off

N.	Description of event	Action
1	Checksum EEprom	Reset default, Blockage
2	Overvoltage	APO
3	Under voltage	APO
4	Short circuit	APO, Maximum current, Blockage
5	Excitation Overcurrent	APO, Reduction of excitation current
6	Underspeed	APO, Ramp V/F
7	Overspeed	APO

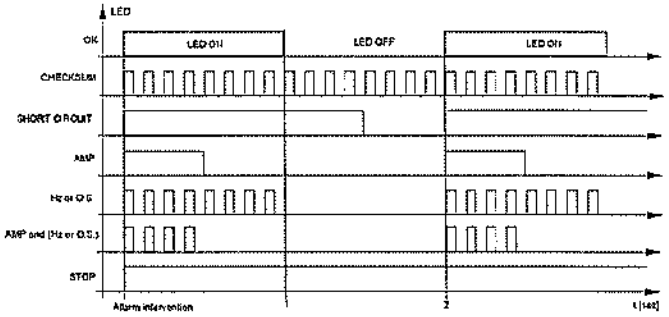
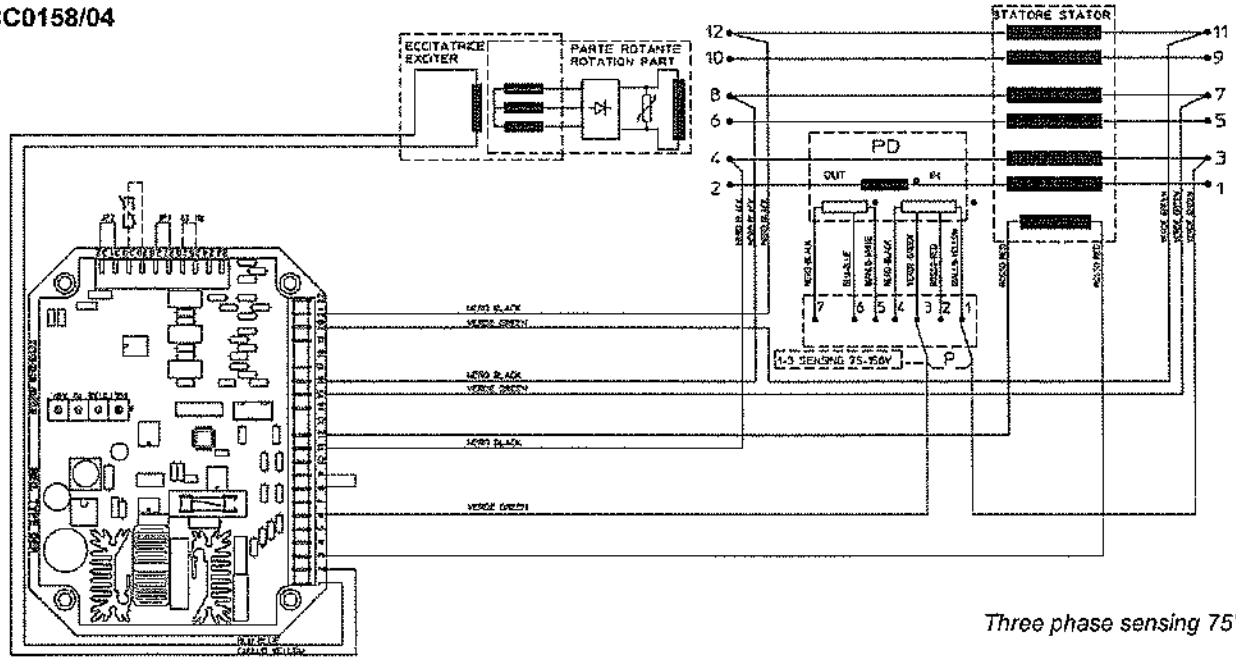


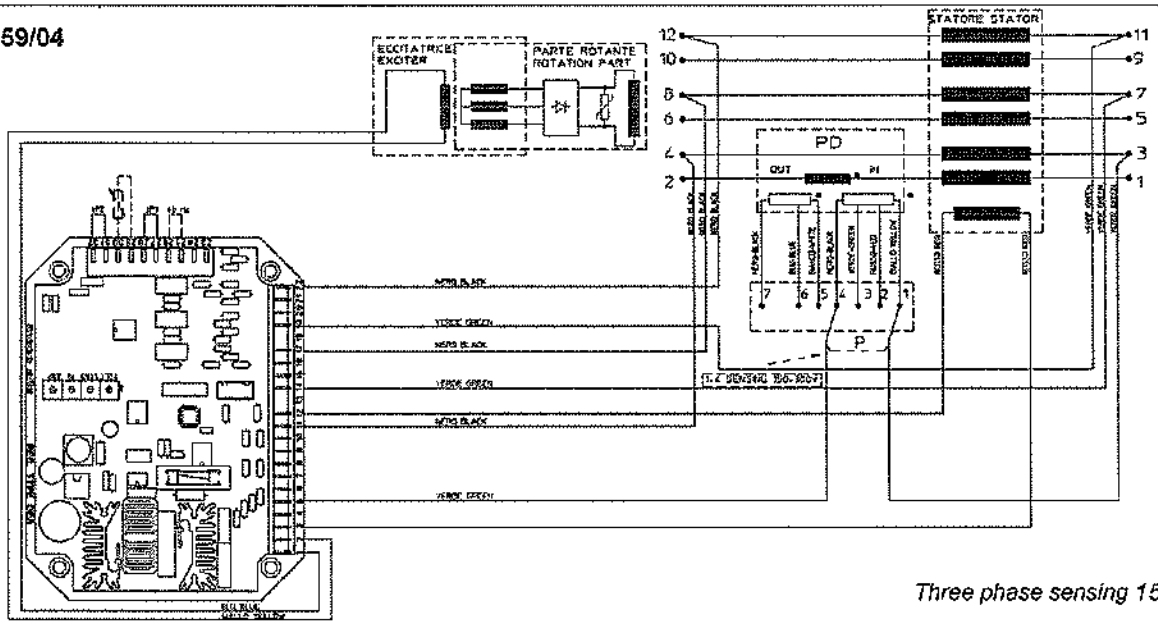
Fig. 5

SCC0158/04



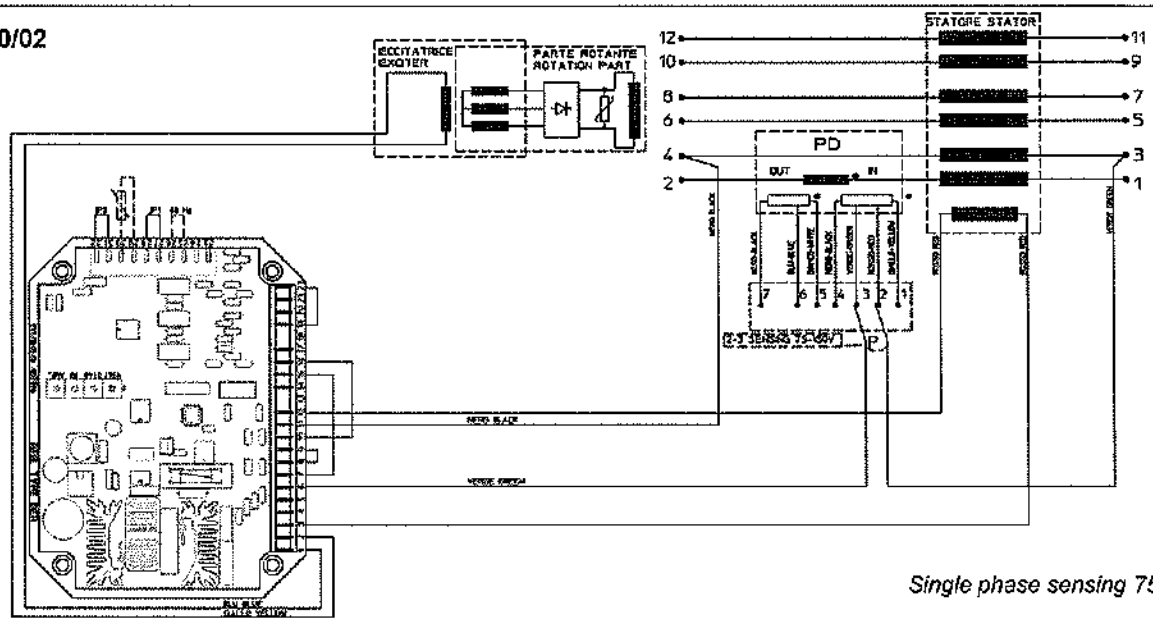
Three phase sensing 75V-150V

SCC0159/04



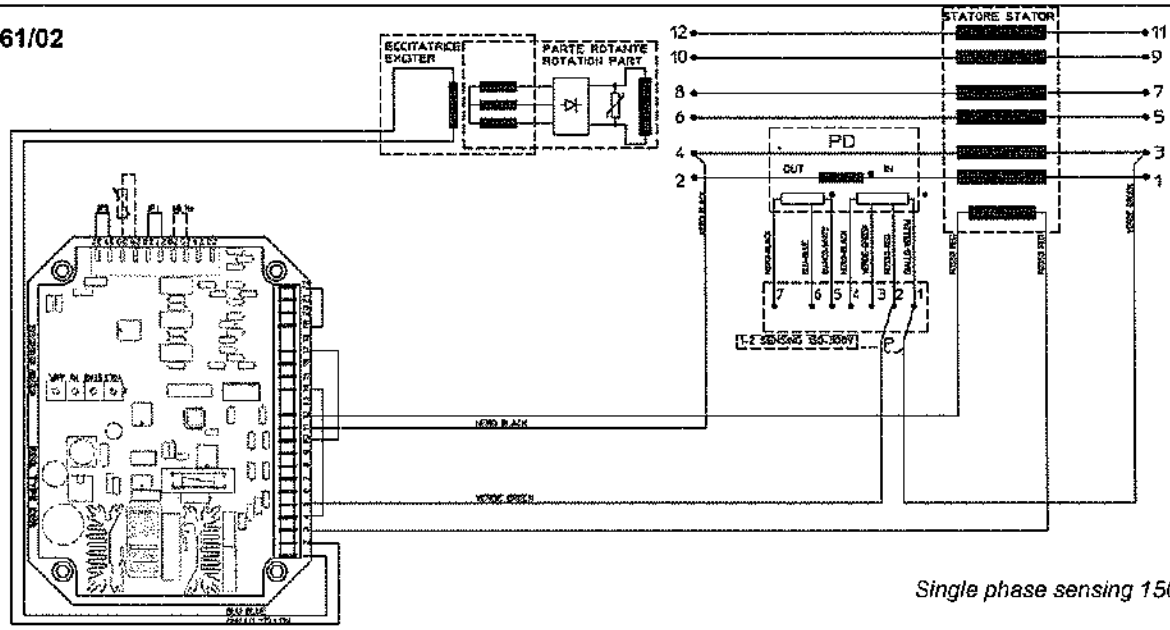
Three phase sensing 150V-300V

SCC0160/02



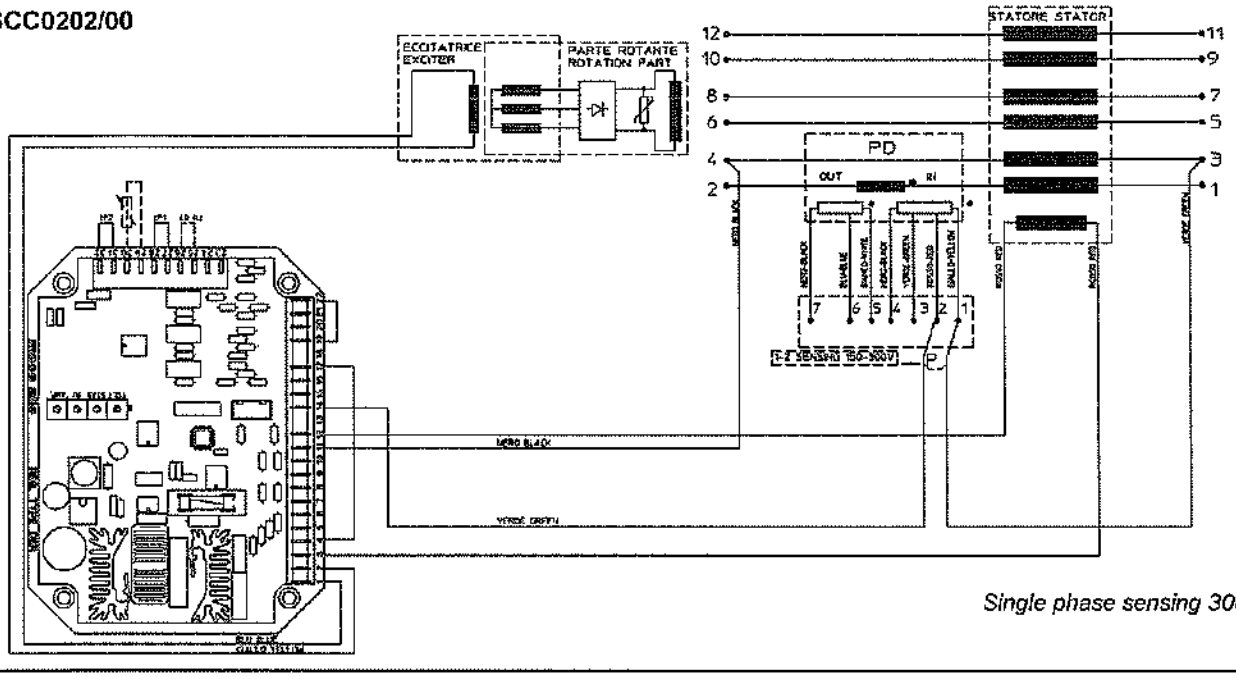
Single phase sensing 75V-150V

SCC0161/02



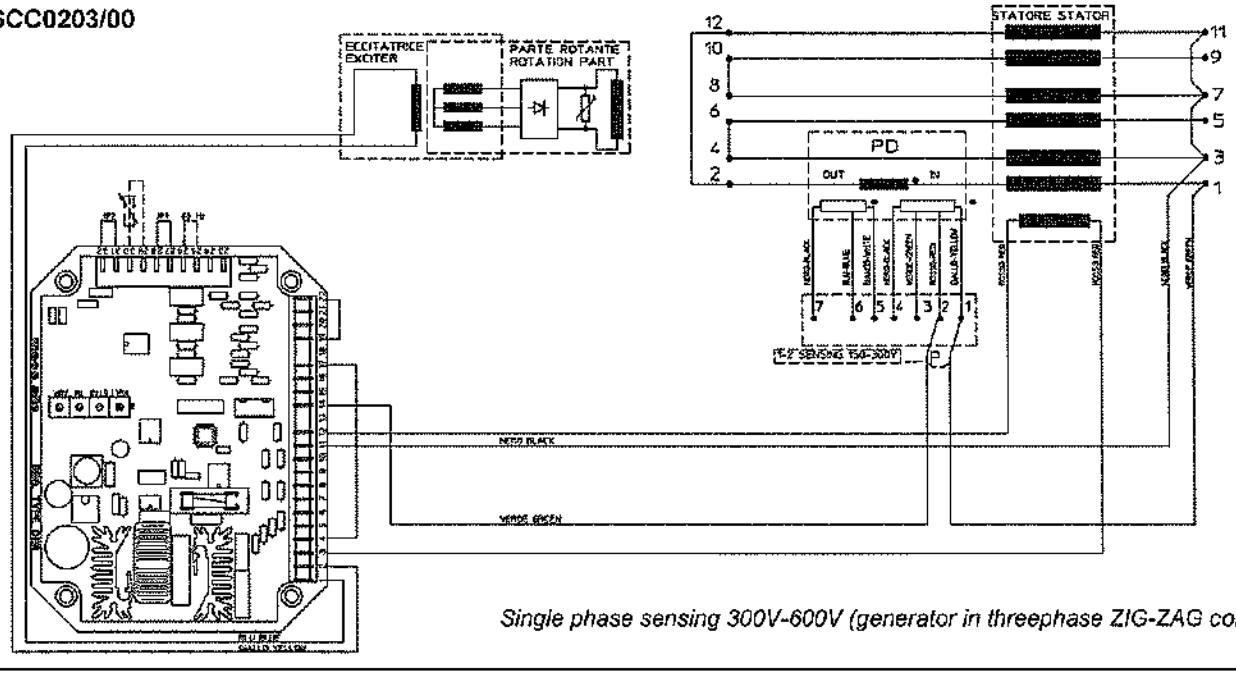
Single phase sensing 150V-300V

SCC0202/00



Single phase sensing 300V-600V

SCC0203/00



Single phase sensing 300V-600V (generator in threephase ZIG-ZAG connection)

DER1 connections

The DER1 regulator has 3 differential inputs, with 2 selectable scales for each of them :
scale "H" for voltages between 75V and 150V
scale "F" for voltages between 150V and 300V

Connections based on main alternator voltage

Based on the machine connections, and the desired voltage[1] you can use the three phase or single phase sensing used in one range or the other. Table summarises the connections for the most common voltages

Connection	Phase-to-phase Voltage [V]	Sensing - Phase	Range	Drawing	Notes
Series star	380-400-415-440-460-480- 500 (from 260 to 500)	Single phase on half phase	H	SCC0160	
		Three phase on half phase	H	SCC0158	
		Single phase on full phase	F	N.D.	
		Three phase on full phase	F	N.D.	
	530-550-575-600-690-760- 800-920 960(from 520 to 1000)	Single phase on half phase	F	SCC0161	
		Three phase on half phase	F	SCC0159	
	1200 (from 1100 to 2000)	Single phase on half phase	F	SCC0202	2 channels in series
Parallel star	190-200-208-220-230-240- 250 (from 130 to 250)	Single phase	H	SCC0160	
		Three phase	H	SCC0158	
	380-400-415-440-460-480- 500 (from 260 to 500)	Single phase	F	SCC0161	
		Three phase	F	SCC0159	
Series delta	220-230-240-254-265-277- 290 (from 150 to 300)	Single phase on half phase	H	SCC0160	
		Three phase on half phase	H	SCC0158	
	305-320-330-440-460-530- 555 (from 300 to 600)	Single phase on half phase	F	SCC0161	
		Three phase on half phase	F	SCC0159	
	220-230-240-254-265-277- 290 (from 150 to 300)	Single phase on full phase	F	N.D.	
		Three phase on full phase	F	N.D.	
Parallel delta	110-115-120-127-133-138- 145 (from 75 to 150)	Single phase	H	SCC0160	
		Three phase	H	SCC0158	
	152-160-165-220-230-265- 277 (from 150 to 300)	Single phase	F	SCC0161	
		Three phase	F	SCC0159	
Zig-Zag[2]	330-346-360-380-400-415- 430 (from 260 to 500)	Single phase on full phase	F	N.D.	
		Three phase on full phase	F	SCC0203	2 channels in series
Single phase parallel	220-230-240-254-265-277- 290 (from 150 to 300)	Single phase - partial	H	SCC0160	
		Single phase - complete	F	N.D.	
	305-320-330-440-460-530- 555 (from 300 to 600)	Single phase - partial	F	SCC0161	
		Single phase - complete	F	N.D.	2 channels in series

(1) Compatibly with the rated characteristics of the alternator

(2) Sensing only on full phase

InteliLite

InteliLite® AMF

Modular Gen-set Controller

Compact Controller for Stand-by Operating Gen-sets

(IL-CU AMF20/25 unit)

SW version 2.5, November 2006

ComAp

User guide

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ISO 9001 CERTIFIED Quality Management ComAp spol. s r.o.

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General guidelines

What describes this manual?

This manual describes „AMF 20/25" software, which is designed for single set, stand-by applications.
What is the purpose of the manual?
This manual provides general information how to install and operate InteliLite AMF20/25 controller.
This manual is dedicated for

Operators of gen-sets
Gen-set control panel builders
For everybody who is concerned with installation, operation and maintenance of the gen-set

!! Warnings !!

Remote control

InteliLite controller can be remotely controlled. In case of the work on the gen-set check, that nobody can remotely start the engine.
To be sure:

Disconnect remote control via RS232 line
Disconnect input REMOTE START/STOP

or

Disconnect output STARTER and outputs GCB CLOSE/OPEN and MCB CLOSE/OPEN

Because of large variety of InteliLite parameters settings, it is not possible to describe any combination. Some of InteliLite functions are subject of changes depend on SW version.
The data in this manual only describes the product and are not warranty of performance or characteristic.

Text

PAGE	(Capital letters in the frame) buttons on the front panel
Break Return	(Italic) set points
Generator protections	(Bold) Set point group
REMOTE START/STOP	(Capital letters) binary inputs and outputs
*Something	(Symbol * before text) valid only for iL AMF 25

Note:
ComAp believes that all information provided herein is correct and reliable and reserves the right to update at any time. ComAp does not assume any responsibility for its use unless otherwise expressly undertaken.

Note:
SW and HW must be compatible (AMF25 firmware and AMF25 HW) otherwise the function will be disabled. If wrong software is downloaded, message HARDWARE INCOMPATIBLE appears on controller screen. In this case use Boot load (jumper) programming – close Boot jumper and follow instructions in LiteEdit, download correct software.
Similarly use only Chinese HW together with Chinese SW.

WARNING – VERY IMPORTANT !!!

Every time you want disconnect following InteliLite controller terminals:

- Mains voltage measuring and / or
- Binary output for MCB control and / or
- MCB feedback

Switch InteliLite to MAN or OFF mode or disconnect the Binary outputs Starter and Fuel to avoid unexpected automatic start of genset and GCB closing.

!!! CAUTION !!!

Dangerous voltage

In no case touch the terminals for voltage and current measurement!
Always connect grounding terminals!
In any case do not disconnect InteliLite CT terminals !

Adjust set points

All parameters are preadjusted to their typical values. But the set points in the "**Basic settings**" settings group !!**must!!** be adjusted before the first startup of the gen-set.

!!! WRONG ADJUSTMENT OF BASIC PARAMETERS CAN DESTROY THE GEN-SET !!!

The following instructions are for qualified personnel only. To avoid personal injury do not perform any action not specified in this User guide !!!

General description

Description of the controller system (with all options)

InteliLite iL-CU AMF20/25 is a comprehensive AMF-controller for single generating sets operating in stand-by mode. IL-CU AMF 25 features extended support of electronic engines.
InteliLite controllers are equipped with a powerful graphic display showing icons, symbols and bar-graphs for intuitive operation, which sets, together with high functionality, new standards in Gen-set controls.
InteliLite automatically starts the Gen-set, closes the Gen-set C.B. when all conditions are met, then stops the engine on external signal or by pressing push buttons.
InteliLite provides gas engine support without ventilation.
The key feature of InteliLite is its easy-to-use operation and installation. Predefined configurations for typical applications are available as well as user-defined configurations for special applications.

What is in the package?

Accessories	Description	Optional / Obligatory
iL – AMF	InteliLite central unit	Obligatory
iGL -RA15	Remote announciator	Optional for AMF25
iG-IOM/PTM	I/O extension module	Optional for AMF25
AT-LINK-CONV	External RS232 interface	Optional for AMF20

Remote announciator iGL - RA15

The remote announciator iGL-RA15 can be connected to the AMF25 unit via CAN bus. Any of the binary outputs can be configured (using LiteEdit software) to each LED diode on the RA15. The module can be also enabled or disabled using LiteEdit software.
See the documentation of RA15 for the technical and function description.

iG IOM/PTM module

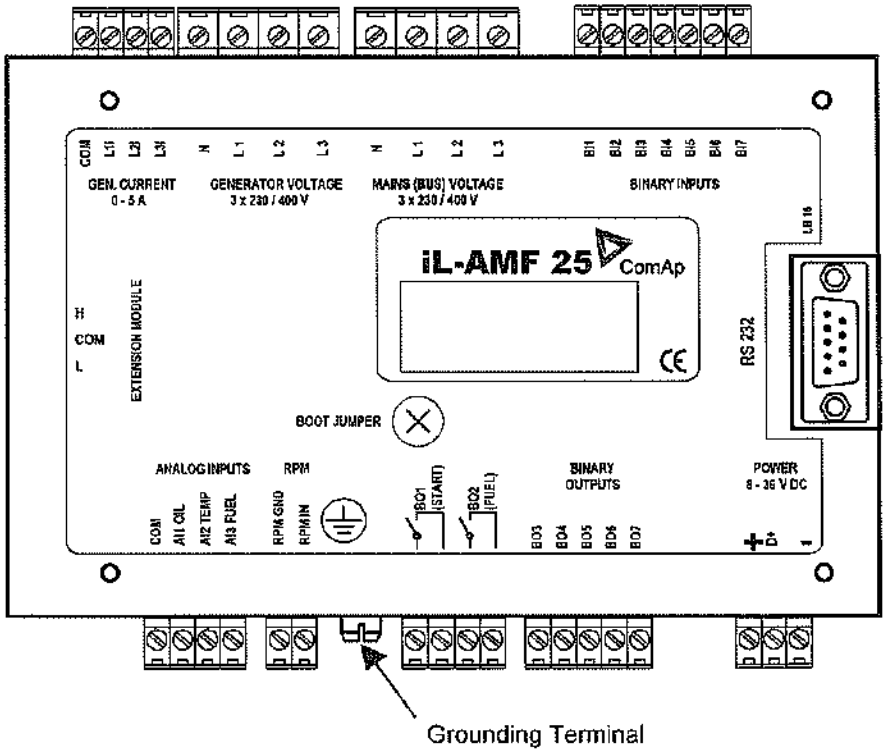
iG-IOM and iGS-PTM modules are I/O extension modules equipped with 8 binary inputs, 8 binary outputs, 4 analogue inputs and one analogue output. The module can be used for AMF25 only.

- Binary inputs and outputs are configurable the same way like inputs and outputs on iL.
- Analogue inputs are configurable like iL with the limitation that the binary and tristate mode can not be used on PTM module.
- The protection of analogue IOM/PTM inputs is activated by overcrossing the limits, active only when the engine is running.
- iG-IOM analogue inputs are resistive (the same parameters like iL) 0 Ω-2,4 kΩ. The module IOM is designed for especially VDO resistive sensors.
- iGS-PTM analogue inputs are configurable by jumpers to ranges 0-250Ω, 0-100mV, 0-20mA. The module can be used especially for Pt100 sensors and current sensors. The module PTM is not suitable for VDO temperature sensor.

See the documentation of iGS-PTM for the technical and function description.

Terminals and dimensions

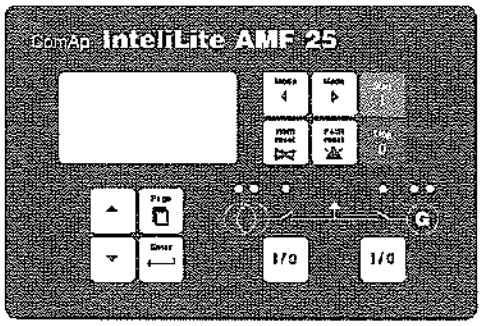
IL-CU Terminals

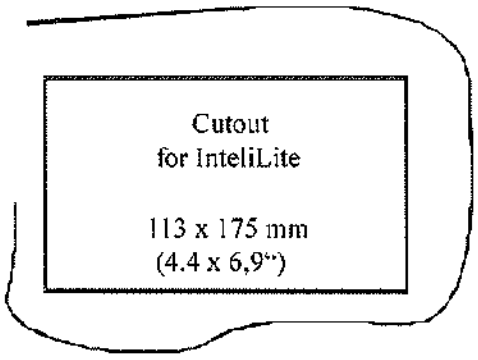


Hint:
EXTENSION MODULE and TEST PORT serves for Extension IGS-PTM or IG-IOM and IGL-RA15 CAN bus connection only. This port is used for production tests as well.

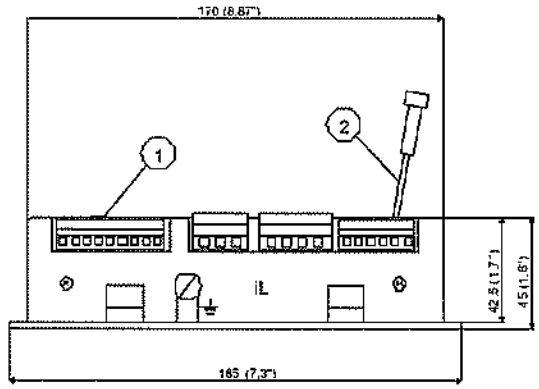
Dimensions

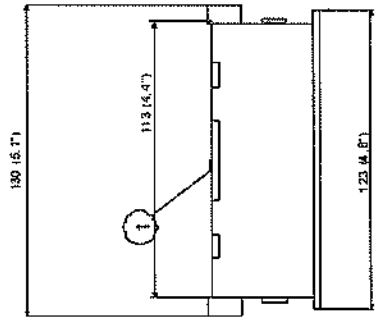
IL-CU





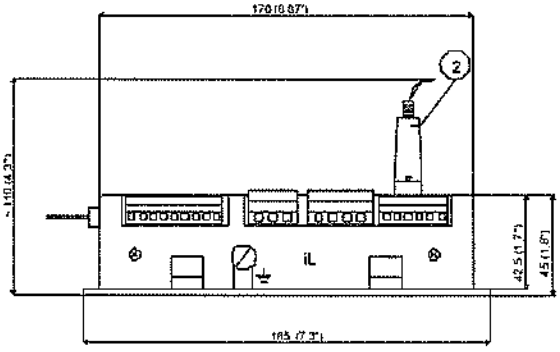
IL-AMF 20

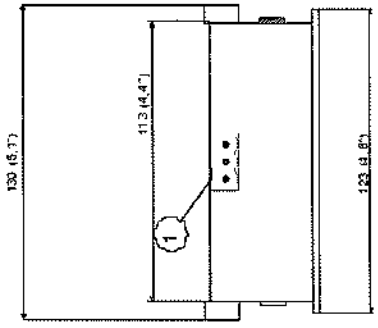




(1) Only for service purpose
(2) AT-LINK-CONV

IL-AMF 25

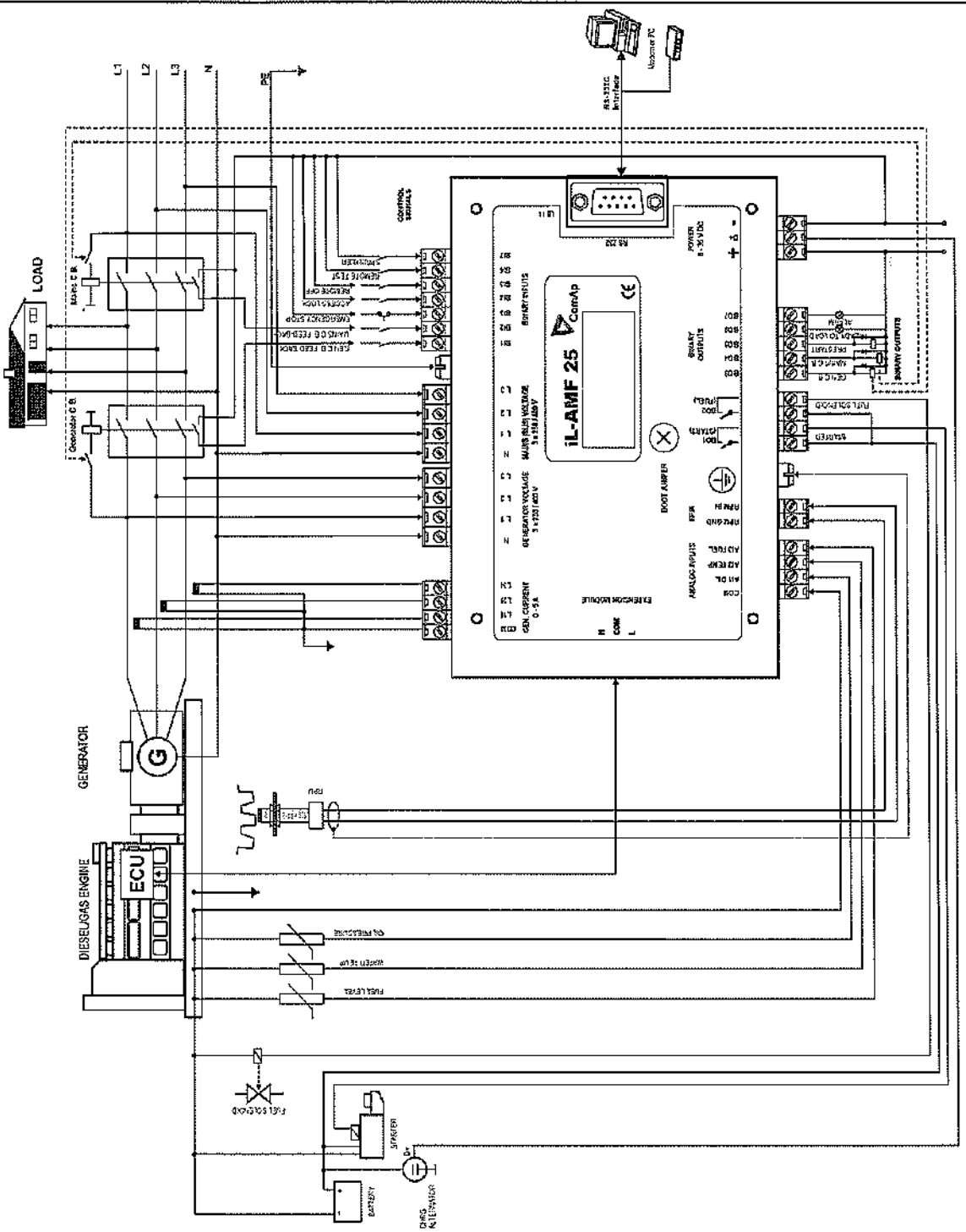




(1) Extension module via CAN bus
(2) RS 232 Cable

Recommended wiring

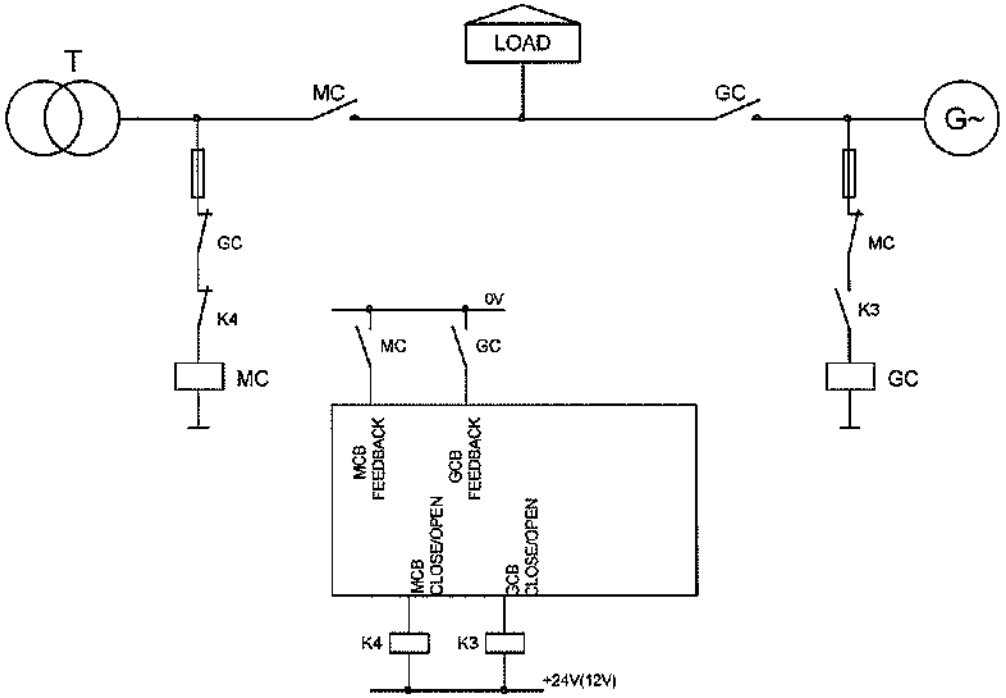
AMF – Wiring Diagram



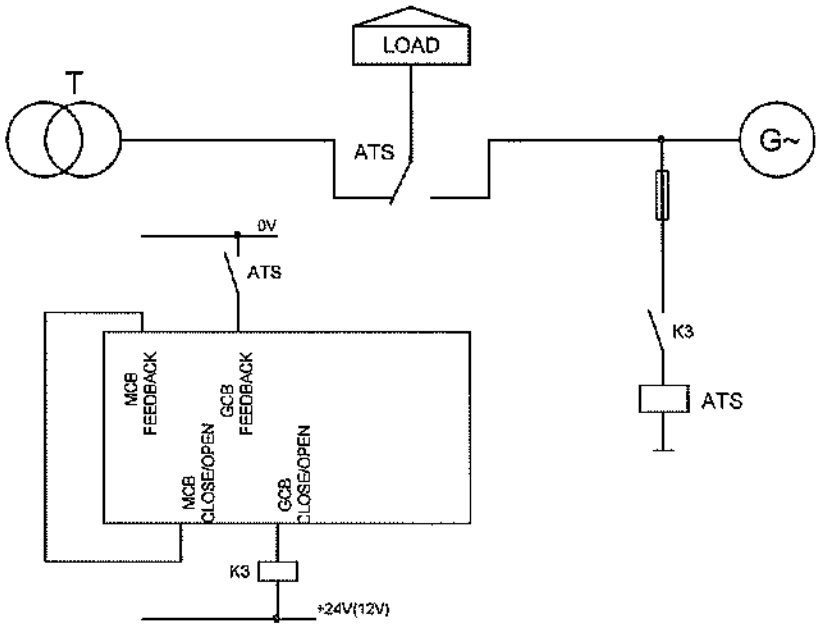
Hint:
MCB and GCB is recommended to be mechanically interlocked.
From IL-2.1 it is possible to start Volvo and Scania engines via CAN bus. See Engines started via CAN bus.

Stand-by applications

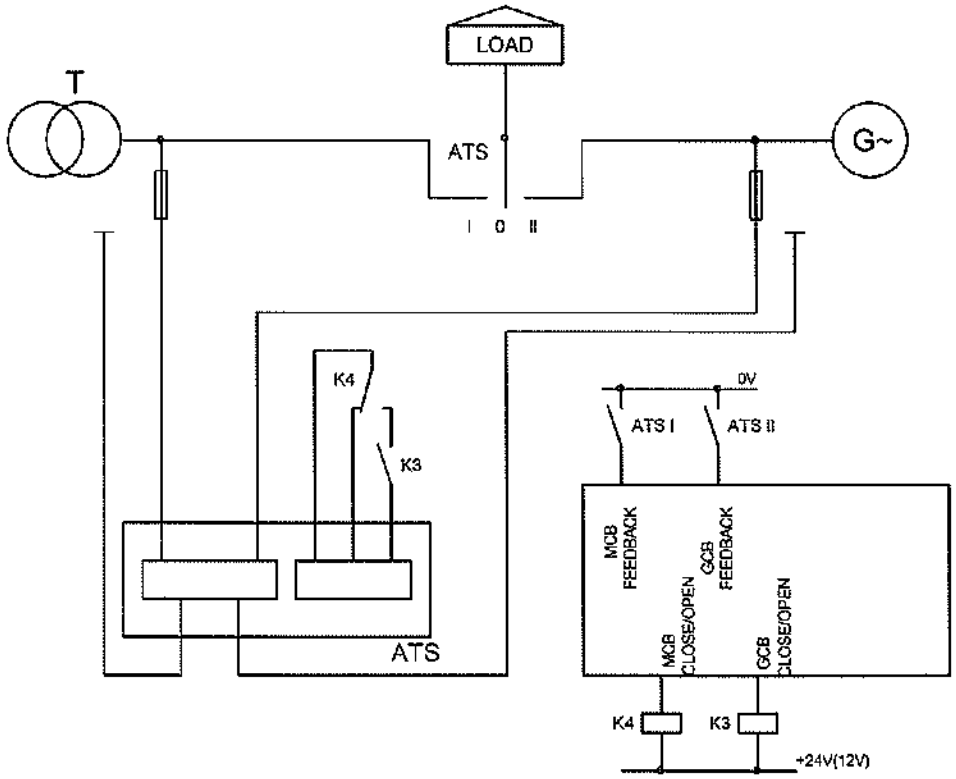
Contactors (set point MCB Logic = *"CLOSE-OFF")*



ATS with two stable positions (set point MCB Logic = *"CLOSE-ON")*



ATS with three stable positions (set point MCB Logic = *"CLOSE-OFF")*



Getting started

How to install

General

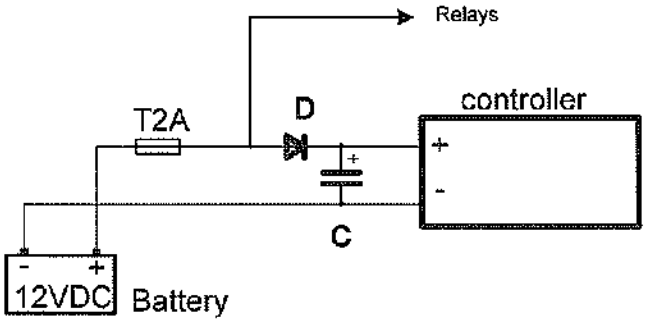
To ensure proper function:

Use grounding terminals.
Wiring for binary inputs and analog inputs must not be run with power cables.
Analog and binary inputs should use shielded cables, especially when length >3m.

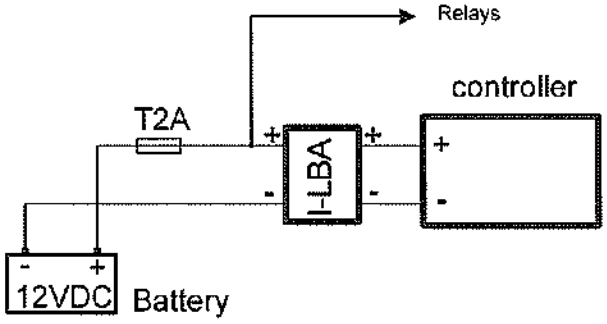
Power supply

To ensure proper function:
Use min. power supply cable of 1.5mm^2
Maximum continuous DC power supply voltage is 36VDC. Maximum allowable power supply voltage is 39VDC. The InteliLite's power supply terminals are protected against large pulse power disturbances. When there is a potential risk of the controller being subjected to conditions outside its capabilities, an outside protection devise should be used.
Hint:
The InteliLite controller should be grounded properly in order to protect against lighting strikes!!
The maximum allowable current through the controller's negative terminal is 4A (this is dependent on binary output load).

For the connections with 12VDC power supply, the InteliLite includes internal capacitors that allow the controller to continue operation during cranking if the battery voltage dip occurs. If the voltage before dip is 10V, after 50ms the voltage recovers to 7 V, the controller continues operating. During this voltage dip the controller screen backlight can turn off and on but the controller keeps operating.
It is possible to further support the controller by connecting the external capacitor and separating diode:

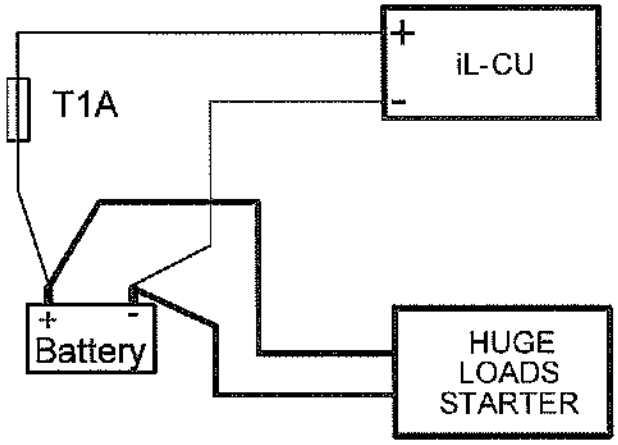


The capacitor size depends on required time. It shall be approximately thousands of microFarads.
Or by connecting special I-LBA module:



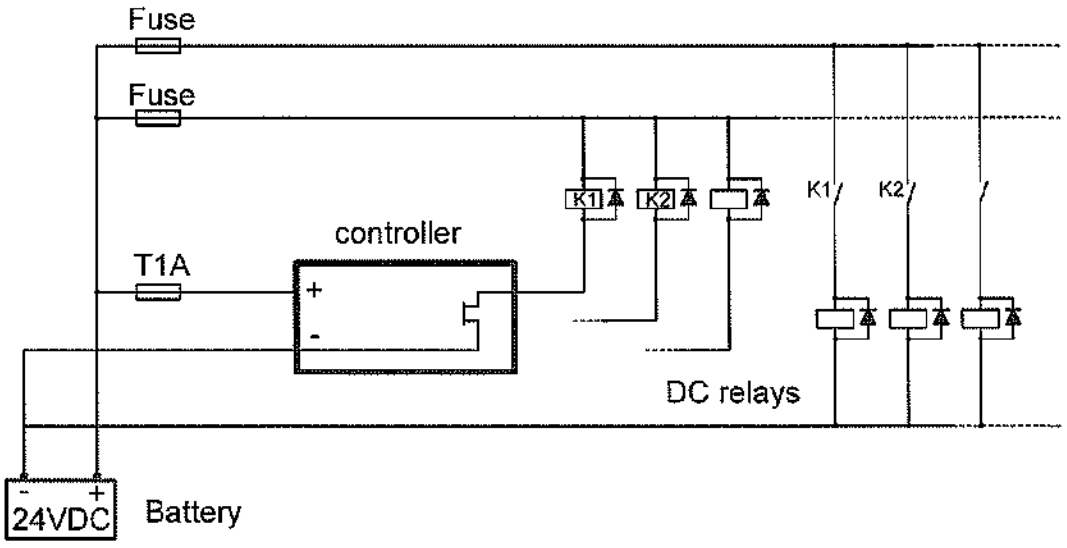
Power supply fusing

A one-amp fuse should be connected in-line with the battery positive terminal to the controller and modules. These items should never be connected directly to the starting battery.
Fuse value and type depends on number of connected devices and wire length.
Recommended fuse (not fast) type - T1A. Not fast due to internal capacitors charging during power up.



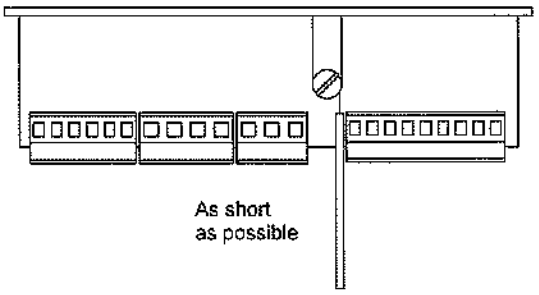
Binary output protections

Do not connect binary outputs directly to DC relays without protection diodes, even if they are not connected directly to controller outputs.



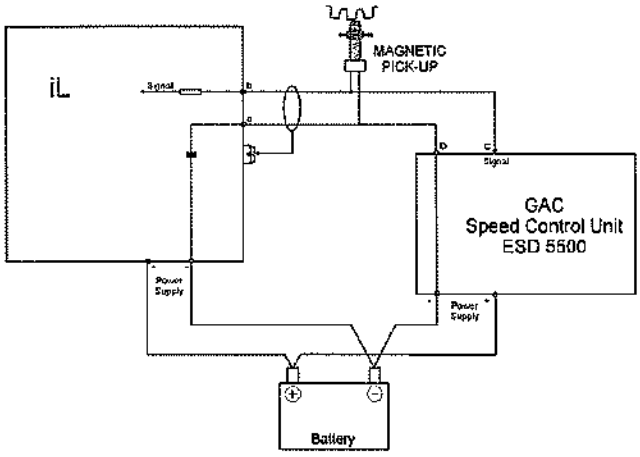
Grounding

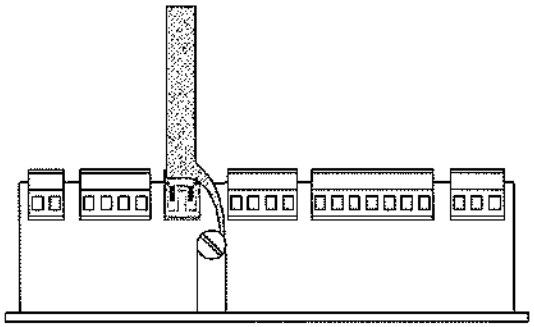
To ensure proper function:
Use as short as possible cable to the grounding point on the switchboard
Use cable min. 2,5mm^2
The "-" terminal of the battery has to be properly grounded



Magnetic pick-up

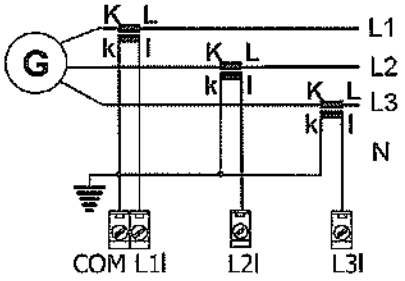
To ensure proper function:
Use a shielded cable



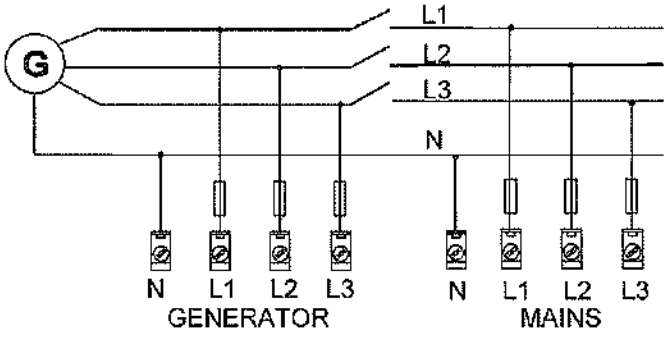


Current measurement

To ensure proper function
Use cables of 2,5mm^2
Use transformers to 5A
Connect CT according to following drawings



Voltage measurement



Hint:
Switchboard lighting strikes protection according standard regulation is expected !!!

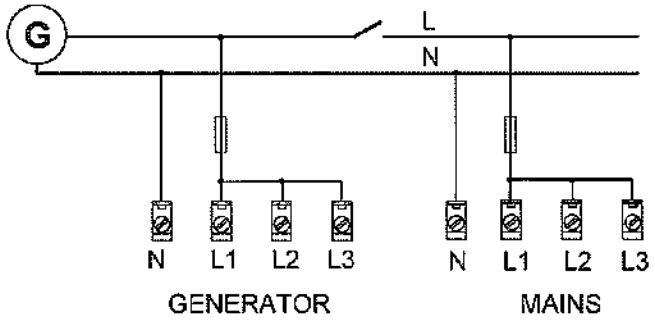
Single phase applications

There is not a separate archive file for single-phase applications. Use standard ail archives.

Recommended wirings

Generator (and mains) single-phase voltage has to be connected to all three-voltage terminals **L1**, **L2** and **L3**. Generator current has to be connected to **L1I** and **COM** terminals only.

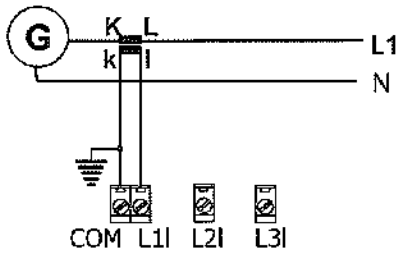
Voltage measurement



Hint:
Switchboard lighting strikes protection according standard regulation is expected !!!

Current measurement

To ensure proper function
Use cables of 2,5mm^2
Use transformers to 5A
Connect CT according to following drawings. Terminals **L2I** and **L3I** are opened.



Set points adjustment

To run a single-phase application, the following set points have to be set:

Gener protect:	*Curr unbal*	to 200 %
Gener protect:	*Curr unbal del*	to 60,0 s

Hint:
In version 1.4 and lower increase **Basic setting**: *Nomin current* to avoid activation of current unbalance protection after 1 minute full load running. (Current unbalance limit is 100% of *Nomin current* in IL version 1.4 and lower.)

Analog inputs

Three analog inputs are available on the IL-CU

Configuration

Each analog input can be configured by LiteEdit software following way.

Analog input item	LiteEdit			Possibility
Type	Type	Not used Alarm		Analog input isn't used
Analog input name	Name			Up to 14 ASCII characters
Config of input	Config	Analog Binary (not supp. by PTM) Tri-state (not supp. by PTM) ECU		Analog measuring in specified range. Binary: open/close - threshold 750 Ω. Three-state: open/close - threshold 750 Ω, Failure <10 Ω or > 2400 Ω Value is read from ECU
Physical dimension	Dim	bar,%,°C, ...		Up to 3 ASCII characters (Valid only for analog inputs)
Polarity	Contact type	NC NO		Valid only for binary and three-state inputs Valid only for binary and three-state inputs
Protection direction	Protection	Over		Overstep. Sensor fail does not activate protection.
		Over+Fls		Overstep and Sensor fail activates protection.
		Under		Under step. Sensor fail does not activate protection.
		Under+Fls		Under step and Sensor fail activates protection.
Sensor characteristic	Sensor	Curve A Curve B Curve C PT 1000 NI 1000 VDO Temp VDO Press VDO Level 4-20mA/100 4-20mA/ 60 Pt100 Ni100 0-20mA/100 4-20mA/100 0-100mV/100	iL, IOM,PTM iL, IOM,PTM iL, IOM,PTM iL, IOM iL, IOM iL, IOM iL, IOM,PTM iL, IOM,PTM iL, IOM iL, IOM PTM PTM PTM PTM PTM	User curve A User curve B User curve C IEC 751, range -20 to 120 °C DIN 43760, range -20 to 120 °C See chapter sensor specification 20mA/10.0Bar, ext. R 120 Ω 20mA/6.0Bar ext R 120 Ω 0-20mA/10.0Bar 4-20mA/10.0Bar
Decimal points	Dec	0, 1, 2		Number of decimal points (Valid only for analog inputs)

User Curve A, B, C are adjustable in LiteEdit.
Each Analog input has separate set points for two level alarm setting. Analog input alarm levels and delay adjust in **Engine protect** group.

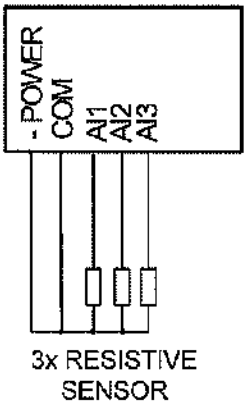
Default current sensor characteristic with external resistor 120 ohms

	4-20mA/100		0-20mA/100		0-20mA/-20 - 120°C
Primary	Converted	Note 1	Note 2	Note 3	Note 4
120			0 mA	0%	-20°C
170	0	0%	4 mA	20%	8°C
200	13				22°C

230	25	25%	8 mA	40%	36°C
280	38				50°C
330	50	50%	12 mA	60%	64°C
390	63				78°C
460	75	75%	16 mA	80%	92°C
560	88				106°C
690	100	100%	20 mA	100%	120°C

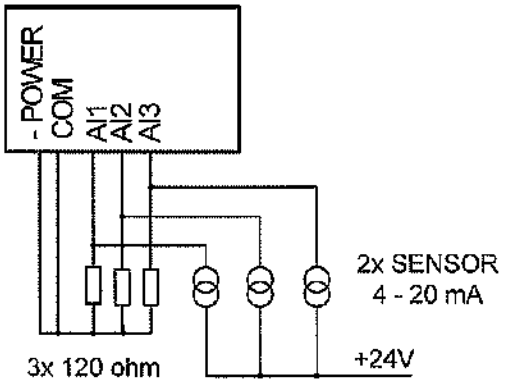
Note 1 - % range for 4-20 mA input
Note 2 - range 0-20 mA
Note 3 - % range for 0-20 mA input
Note 4 - characteristic 0-20 mA / -20 - +120 °C

Connection of IL-CU analog inputs



Standard connection of three resistive sensors to analog inputs.

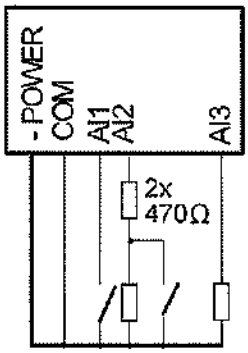
Common point of resistive sensors is connected to COM terminal for accurate measuring.



Three current output sensors connection to InteliLite.

External resistors 120 ohms each are connected between minus power supply terminal of IL-CU and analog inputs.

Current sensor connecting reduces the analog input resolution by less than 50% against resistive sensor.
Analog input common terminal COM has to be connected to IL minus Power supply terminal.



Mixed connection of InteliLite analog inputs:

AI1 – binary input
AI2 – three state input
AI3 – analog resistive input

Common point of IL-CU analog inputs is connected to COM terminal.

Analog inputs are designed for resistive sensors with resistance in range of 0Ω to 2,4kΩ.
To ensure a proper function use shielded cables, especially for length over >3m.

Current output transducers

IL-CU analog inputs are mainly designed for resistor sensors.
In special case transducers to 4-20mA output can be used for oil measuring (10.0Bar or 6.0Bar). Use predefined 4-20mA/100 or 4-20mA/60 sensors.
This method reduces the input resolution by less than 50%. Some types of transducers are not suitable for connection to InteliLite analog inputs because of influencing by InteliLite analog input.

As binary input

Open, close state are detected, threshold level is 750 Ω.

As three state input

Open, close and failure state are detected. Threshold level is 750 Ω, failure is detected when circuit resistance is <10 Ω or > 2400 Ω.

Hint:
Protections on binary and three state inputs are following:

IL-CU:	AI1	Shutdown	*IG-IOM*:	AI1	Shutdown
	AI2	Shutdown		AI2	Shutdown
	AI3	Warning		AI3	Shutdown
				AI4	Shutdown

Unused analog inputs

Configure Type = Not used

Example of analog input configuration

Configure Oil press input for measuring in Bar, VDO oil pressure sensor, range 0 to 10.0 bars. Alarm protection level set to 3.5 bars, shut down level 1.2 bars.
Start LiteEdit and select – Controller - Configuration – Modify – Oil Press.
Set configuration for Oil Press analog input:

Type: selection between Not used and Alarm
"Not used" – analog input isn't used
"Alarm" – analog input is used
Set to: Alarm

Config: selection between Analog, Binary Tri-state input.
"Analog" – resistor sensor is connected to Analog input.
"Binary" – open/close contact is connected between Analog input and COM terminal of Analog inputs. Analog input detects only open/close state.
"Tri-state" – open/close contact is connected parallel to one of two serial resistors between Analog input and COM terminal of Analog inputs.
Set to: Analog

Dim: Physical dimension of measured value (°C, %, Bar, ..) Maximal dimension length is three characters.
Set to: Bar

Contact type: selection of polarity only when analog input is configured as Binary or Tri-state. When is analog input configured as analog this setting has no sense.
„NC" – polarity of binary or tri-state input
„NO" – polarity of binary or tri-state input

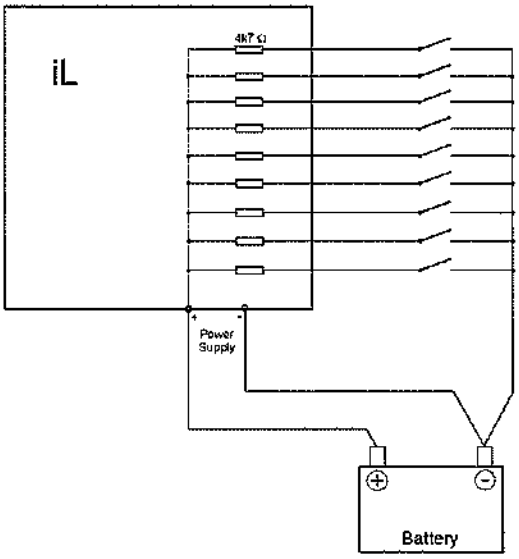
Sensor: selection of sensor characteristic
„Unused input" - when Analog input is not used. On the InteliLite screen is displayed „*####*" value, no alarm is detected.
„Curve A" – User curve A is defined in LiteEdit (default VDO temperature sensor)
„Curve B" – User curve B is defined in LiteEdit (default VDO pressure sensor)
„Curve C" – User curve C is defined in LiteEdit (default VDO fuel level sensor)

„Pt1000" – PT1000 sensor characteristic according to IEC 751
„Ni1000" – Ni1000 sensor characteristic according to DIN 43 760
„VDO temp" – VDO temperature sensor
„VDO press" – VDO pressure sensor
„VDO level" – VDO level sensor
„4-20mA/60" – current output sensor characteristic – requires external resistor 120 ohms between Analog input and COM terminal of Analog inputs
„4-20mA/100" – current output sensor characteristic – requires external resistor 120 ohms between Analog input and COM terminal of Analog inputs
Set to: VDO press

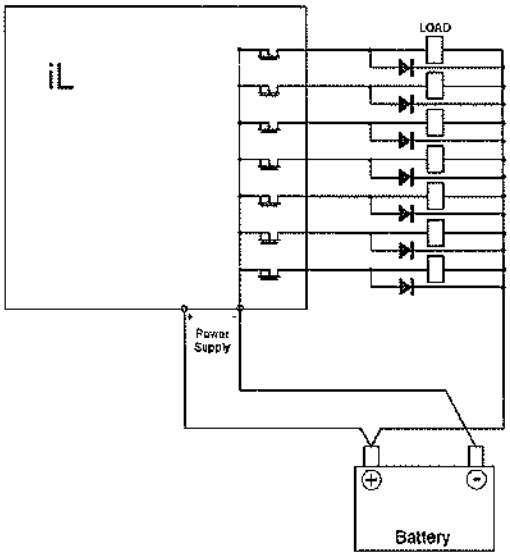
Decimals: setting of number of decimal points of measured value.
„0" - e.g. 360 kPa, 100%, 50 °C
„1" – e.g. 3.6 Bar
„2"- e.g. 0.36 MPa
„3" - e.g. 0.366 MPa
Set to: 1

When Analog input configuration is finished set the setpoints *Wrn Oil press, Sd Oil press, Oil press del* in **Engine protection** group.
Each Analog input has separate triplet of setpoints: *Wrn level, Sd level, Anl Inp del*. Names of these setpoints are fix defined
Number of decimal points of *Wrn level1* and *Sd level* is the same as the configured number of decimal points of measured value.

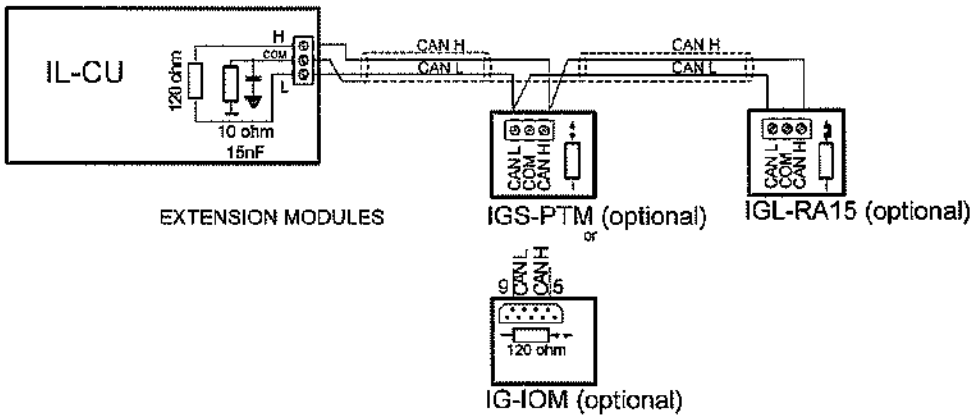
Binary inputs



Binary outputs



Extension modules (CAN bus) connection



Connection rules

CAN bus line must be connected in series, from one unit to the next (no star, no cable stubs, no branches) both ends must by the 120-ohm (internal or external) resistor terminated. Maximal CAN bus length is up to 200 meters.

For CAN data cables details see chapter Technical data – Communication interface. CAN cable shielding connect to IL-CU COM terminal.

IL-CU contains internal fix 120-ohm resistor and must be located on the CAN bus end.

New IG-IOM and IGS-PTM units contain internal jumper removable 120-ohm resistor (in older IOM types are fix resistors). To be sure check resistor presence by ohmmeter. Unit with internal resistor connect to the end of CAN line.

Following connections are supported (IOM, PTM, ECU order is not important).

IL-CU – IG-IOM

IL-CU – IGS-PTM
IL-CU – IGL-RA15
IL-CU – IG-IOM – IGL-RA15
IL-CU – IGS-PTM – IGL-RA15

It is possible to connect only one IG-IOM or IGS-PTM and one IGL-RA15 to IL-CU.

Inputs and outputs

Hint:
Any Binary input or output can be configured to any IL-CU controller terminal or changed to different function by LiteEdit software. There is fix 1 sec delay when any binary input is configured as protection.

Binary inputs IL-CU - default

BI1 GCB feedback

BI2 MCB feedback

BI3 Emergency stop

BI4 Access lock

BI5 Remote OFF

BI6 Remote TEST

BI7 Sprinkler

Binary inputs – list

Not used
Binary input has no function. Use this configuration when Binary input is not connected.

Alarm
If the input is closed (or opened) selected alarm is activated.
Binary Alarm configuration items

Name		14 characters ASCII string
Contact type	NC	Normally closed
	NO	Normally opened
Alarm type	Warning	
	Shut down	
Alarm active	All the time	
	Engine running only	

GCB feedback
Use this input for indication, whether the generator circuit breaker is open or closed.
If the feedback is not used, connect this input to the output GCB CLOSE/OPEN

MCB feedback
This input indicates whether MCB is closed or opened.

Emergency stop
If the input is opened, shut down is immediately activated. Input is inverted (normally closed) in default configuration.

Hint:

In case of controller hardware or software fail, safe stop of the engine doesn't have to be ensured. To back-up the Emergency stop function it is recommended to connect separate circuit for disconnection of Fuel solenoid and Starter signals.

Sprinkler

If the input is closed all alarms are disabled except the binary input EMERGENCY STOP and "engine overspeed protection".

- all IL alarms are detected,
- IL front panel gen-set RED LED blinks or lights,
- alarm is recorded on the IL alarm list screen,
- BUT gen-set remains running.

Hint:
Warning *SprinklActive* is indicated in the AlarmList if sprinkler mode active to inform the operator that the engine is not protected.

Access lock

If the input is closed, no setpoints can be adjusted from controller front panel and gen-set mode (OFF-MAN-AUT-TEST) cannot be changed.
Hint:
Access lock does not protect setpoints and mode changing from LiteEdit. To avoid unqualified changes the selected setpoints can be password protected.

Remote OFF

If closed, iL is switched to OFF mode (there are four modes OFF-MAN-AUT-TEST). When opens controller is switched back to previous mode.
Hint:
This binary input should be connected to schedule timer switch, to avoid start of engine.

Remote TEST

If closed, iL is switched to TEST mode (there are four modes OFF-MAN-AUT-TEST). When opens controller is switched back to previous mode.

Remote MAN

If the input is active, MAN mode is forced to the controller independently on the position of the MODE selector.

Remote AUT

If the input is active, AUT mode is forced to the controller independently on the position of the MODE selector. If another of „remote" inputs is active, then the REMOTE AUT input has the lowest priority.

RemControlLock

If the input is active, setpoints writing or command sending from the external terminal is disabled.

Emergency manual

If the input is activated the controller behaves like when switched to OFF mode. Opens all binary outputs. There is one exception – STOP SOLENOID doesn't activate on this transition.

Detection of "running" engine and subsequent alarm message "Sd Stop fail" is blocked.
The controller shows "Emerg Man" state and the engine can not be started.
Generator current and power measurement is active in this mode, regardless of the actual state of the engine.

After the input is open again, the controller recovers to previous state and behaves according to the actual situation .
Function is active in any controller mode.

TestOnLoad

Affects the behaviour in TEST mode. When input is closed, the controller automatically transfers load from the mains to the genset. Setpoint AutoMainsFail: Ret from test must be set to MANUAL. Load is automatically transferred back to the mains when any genset shut down protection activates.

Start button

Binary input has the same function as Start button on the InteliLite front panel. It is active in MAN mode only.

Stop button

Binary input has the same function as Stop button on the InteliLite front panel. It is active in MAN mode only.

FaultResButton

Binary input has the same function as Fault reset button on the InteliLite front panel.

HornResButton

Binary input has the same function as Horn reset button on the InteliLite front panel.

GCB button

Binary input has the same function as GCB button on the InteliLite front panel. It is active in MAN mode only.

MCB button

Binary input has the same function as MCB button on the InteliLite front panel. It is active in MAN mode only.

MainsFailBlock

If the input is closed, the automatic start of the gen-set at Mains failure is blocked. In case of running gen-set the GCB is opened, gen-set goes to Cooling procedure and stops.
The input simulates healthy Mains.

Binary outputs IL-CU - default

BO1 **Starter (relay output)**

BO2 **Fuel solenoid (relay output)**

BO3 **GCB close/open**

BO4 **MCB close/open**

BO5 **Prestart**

BO6 **Read to Load**

BO7 **Alarm**

Binary outputs - list

Not used

Output has no function.

Starter

The closed relay energizes the starter motor.
The relay opens if:

- the "firing" speed is reached or
- maximum time of cranking is exceeded or
- request to stop comes up

Fuel solenoid

Closed output opens the fuel solenoid and enables the engine start.
The output opens if:

- EMERGENCY STOP comes or
- Cooled gen-set is stopped or
- in pause between repeated starts

Ignition

The output closes after reaching value of CrankRPM, fixed 30RPM. Opens after stopping of the engine or in pause during repeated start.

Prestart

The output closes prior to the engine start (*Prestart*) and opens when *Starting RPM* speed is reached. During repeated crank attempts the output is closed too.
The output could be used for pre-glow, pre-heat or prelubrication.

Cooling pump

The output closes when gen-set starts and opens **Engine params**:*AfterCool time* after stop of the engine.

Idle/Nominal

The output *Idle/Nominal* closes after the timer *Idle time* elapses. The *Idle time* counter starts to countdown when *Start speed* reached. The *Underspeed* protection is not evaluated during idle period. A *Start fail* protection occurs if the RPM drop below 2RPM during idle.
Hint:
Connect Binary output IDLE RATED to speed governor to switch the speed: opened = IDLE, closed=RATED. If the IDLE contact not supported on the governor, set the *Idle time* nevertheless to minimum 5s to avoid *Underspeed* possibly caused by instability of the engine short after start.

GCB close/open

The output controls the generator circuit breaker.
Hint:
Supposed time to close (reaction time) of GCB is 0,1 sec.

GCB on coil

The output activates Generator Circuit Breaker coil.

GCB off coil

The output deactivates Generator Circuit Breaker coil.

GCB UV coil

The output controls Generator Circuit Breaker coil after voltage drop-out.

MCB close/open

The output controls the mains circuit breaker.

MCB on coil

The output activates Mains Circuit Breaker coil.

MCB off coil

The output deactivates Mains Circuit Breaker coil.

MCB UV coil

The output controls Mains Circuit Breaker coil after voltage drop-out.

Air valves

Closes together with *Prestart*. Opens after the engine is stopped.
Stopped engine conditions: RPM = 0, **Engine params**: *Starting Poil*, D+ (when enabled).

GenParamsOK

The output is copy of generator status LED on iL front panel. The output is closed if genset is running and all genset electric values are in limits.

Alarm

The output closes if :

- any alarm comes up or
- the gen-set malfunctions

The output opens if

- FAULT RESET is pressed

The output closes again if a new fault comes up.

Horn

The output closes if:

- any alarm comes up or
- the gen-set malfunctions

The output opens if:

- FAULT RESET is pressed or
- HORN RESET is pressed or
- Max time of HORN is exceeded (*Horn timeout*)

The output closes again if a new fault comes up.

Ready to AMF

The output is active if the controller is able to run the engine (the output Ready to run is active) and simultaneously the controller is in AUT mode.

Ready

The output is closed if following conditions are fulfilled:

- Gen-set is not running and
- No Shut down or Slow stop alarm is active
- Controller is not in OFF mode

Ready to load

The output is closed if genset is running and all electric values are in limits no alarm is active - it is possible to close GCB or it is already closed. The output opens during cooling state.

Stop solenoid

The closed output energizes stop solenoid to stop the engine.
The output is active at least for *Stop time*, if the stop lasts longer, it stays active until all symptoms say the engine is stopped.
The engine is stopped if:

RPM < 2 and
Generator voltage < 10V and
Oil pressure < **Engine params**: *StartingPoil*.

Hint:
The engine can be started anytime, if all symptoms say the engine is steady regardless of the fact the *Stop solenoid* can still be active (in that case it is deactivated before cranking).

MainsParams OK

The output is copy of mains status LED on IL front panel. The output is closed if mains voltage and frequency are within limits.

Vgen fail

The output closes if the generator over/under voltage alarm or voltage asymmetry alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

fgen fail

Output closes if the generator over/under frequency alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Vmains fail

The output closes if the mains over/under voltage alarm or voltage asymmetry alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

fmains fail

Output closes if the mains over/under frequency alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Overload

Output closes if the generator overload alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Stop fail

Output closes when the engine have to be stopped, but speed or frequency or voltage or oil pressure is detected. This protection goes active 60s after stop command. With start goes this protection inactive.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Overspeed

Output closes if the gen-set overspeed alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Underspeed

Output closes if the gen-set underspeed alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Start fail

Output closes after the gen-set start-up fails.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Overcurrent

Output closes if the generator
*IDMT over current or
current unbalance or
short current alarm activates.
The output opens, if
Alarm is not active and
FAULT RESET is pressed

Battery flat

Output closes when iL preforms reset during start procedure (probably due to weak battery).
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

V batt failed

Output closes when battery over/under voltage warning appears.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

OilPress

Output closes if the oil pressure shutdown alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

OilPressWrn

Output closes if the oil pressure warning alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

WaterTemp

Output closes if the water temperature shutdown alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

WaterTempWrn

Output closes if the water temperature warning alarm activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

FuelLevel

Output closes if the Fuel level shutdown alarm activates.

FuelLevelWrn

Output closes if the Fuel level warning alarm activates.

Running

Output closes if the engine is in Running state.

Common Wrn

Output closes when any warning alarm appears.
The output opens, if

- No warning alarm is active and
- FAULT RESET is pressed

Common Sd

Output closes when any shut-down alarm appears.
The output opens, if

- No sd alarm is active and
- FAULT RESET is pressed

Common Fls

Output closes when any sensor fail alarm appears.
The output opens, if

- No warning alarm is active and
- FAULT RESET is pressed

OFF mode

The output is closed, if OFF mode is selected.

MAN mode

The output is closed, if MAN mode is selected.

AUT mode

The output is closed, if AUT mode is selected.

TEST mode

The output is closed, if TEST mode is selected.
The output opens, if
Alarm is not active and
FAULT RESET is pressed

ChrgAlternFail

Output closes if gen-set is running and D+ input not energized.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Hint:
Treshhold level for D+ input is 80% supply voltage.

ServiceTime

Output closes if the ServiceTime alarm activates.
The output opens, if

- alarm is not active and

- FAULT RESET is pressed

ECU CommOK

If the ECU is not communicating and all values from ECU show #### the output is not active. If the ECU communicates the output is active.

ECU PwrRelay

The output closes at the beginning of prestart and opens if the engine shall be stopped.

ECU YellowLamp

The output copies warning information from ECU.

ECU RedLamp

The output copies shutdown information from ECU.

CtrlHeartBeat

Output signalizes watchdog reset. In a healthy state it blinks at 500ms : 500ms rate. When watchdog reset occurs, it stops blinking.

Stop Pulse

Output is active for 1 second after *Stop solenoid* output activation. This signal is sent to ECU in case of engine stop request.

ECU CommError

The output is an inversion of binary output *ECU CommOK*, i.e. the output is closed when ECU is not communicating and all values from ECU show ######. Communication error causes stop of the engine.

BI1..7 – stat

*BI1..8IOM - stat

The outputs give an information about the assigned binary input.
In case the assigned binary input is configured to alarm type, then the output closes when the alarm activates. It opens if

- alarm is not active and
- FAULT RESET is pressed

In case the assigned binary input is configured to any control function, the output propagates the state of the input.

*AnInIOM1..4 Wrn

Output closes if warning alarm on the appropriate IOM/PTM analog input activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

*AnInIOM1..4 Sd

Output closes if shutdown alarm on the appropriate IOM/PTM analog input activates.
The output opens, if

- alarm is not active and
- FAULT RESET is pressed

Cooling

The output closes when gen-set is in Cooling state.

Analog inputs

Three analog inputs for resistive sensor 0 to 2400 Ω measuring. Each analog input can be adjusted to convert resistor measured value to displayed value in bars or other dimensions. Warning and shut-down limits are adjusted in **Engine protect** group.
Since version 2.0 the analog inputs are configurable. Default configuration is:

Oil press

Oil pressure analog input. Default range 0 to 10.0 bars.

Water temp

Water temperature analog input. Default range 0 to 100 °C.

Fuel level

Fuel level analog input. Default VDO sensor 0-180R = 0-100%

Hint:
For further information about analog inputs' configuration see Analog inputs.

Setpoints

Password

EnterPassword

Password is a four-digit number. Password enables change of relevant protected set points Use ⇧ or ⇩ keys to set and ENTER key to enter the password.

ChangePassword

Use ⇧ or ⇩ keys to set and ENTER key to change the password.
Hint:
At first the Password has to be entered before the new Password can be changed.

Basic settings

Gen-set name

User defined name, used for InteliLite identification at remote phone or mobile connection.
Gen-set name is max 14 characters long and have to be entered using LiteEdit software.

Nomin power [kW]

Nominal power of the generator
Step: 1kW
Range: 1 – 4000 kW

Nomin current [A]

It is current limit for generator *IDMT over current and short current protection and means maximal continuous generator current. See **Generator protections**: **2Inom del, Ishort* setpoints.
Nominal current can be different from generator rated current value.
Step: 1 A
Range: 1 - 5000 A

CT Ratio [/5A]

Gen-set phases current transformers ratio.
Step: 1 A
Range: 1 – 5000 A / 5A

*PT ratio [/1]

Gen-set potential transformers ratio.
Step: 0,1 V / V
Range: 0,1 – 500,0 V / V

*Vm PT ratio [/1]

Mains potential transformers ratio.
Step: 0,1 V / V
Range: 0,1 – 500,0 V / V

Nomin voltage [V]

Nominal generator voltage (phase to neutral)

Step: 1V
Range: 100 – 300 V

Nominal freq [Hz]

Nominal generator frequency (usually 50 or 60 Hz)
Step: 1Hz
Range: 45 – 65 Hz

Gear teeth [-]

Number of teeth on the engine gear for the pick-up.
Set to zero, if no pick-up is used. Engine speed is counted from the generator frequency.
Step: 1
Range: 0 – 500
Hint:
Generator frequency can be used only when generator voltage (min 5V) is present before reaching of the firing speed (*Starting RPM*) after start.

Nominal RPM [RPM]

Nominal engine speed.
Step: 1RPM
Range: 100 – 4000 RPM

FltResGoToMAN [ENABLED/DISABLED]

DISABLED: Controller stays in AUT mode after Fault reset .
ENABLED: Automatic switch from AUT (or TEST) to MAN mode after Fault reset to avoid automatic engine start. This function is active for Shut down protection only.

DispBaklightTO [min]

Timeout after which the display backlight is switched off.
Step: 1 min
Range: 0 – 60 min
Default value: 0 ... means that the display lights all the time

ControllerMode [OFF, MAN, AUT,*TEST]

Equivalent to Controller mode changes by MODE→ or ←MODE buttons.
Hint:
Controller Mode change can be separately password protected.

Contr. addr (1 .. 32) [-]

Controller identification number. It is possible to set controller address different from the default value (1) so that more IL controllers can be interconnected (via RS485) and accessed e.g. from Modbus terminal.
Hint:
When opening connection to the controller it's address has to correspond with the setting in PC tool. From LiteEdit it is only possible to connect to controllers with address 1.

* RS232 mode [STANDARD/MODBUS/CumminsMB]

Communication protocol switch.
Standard: LiteEdit communication protocol.
Modbus: Modbus protocol.
CumminsMB: Protocol for communication with Cummins engines via Modbus.

Hint:
For detail description see chapter Modbus protocol.

*NumberRings AA [-]

Number of rings prior to open modem connection.
Step: 1
Range: 1 – 30
Hint:
NumberRings AA change is not activated immediately. It is activated after controller is switched on or when modem is connected to controller.

Engine params

Starting RPM [%]

"Firing" speed when iL controller stops cranking (starter goes OFF).
Step: 1% of nominal RPM
Range: 5 – 50 %

Starting POil [Bar]

When reached controller stops cranking (starter goes OFF).
Step: 0,1 bar
Range: -10,0 – 1000,0
Hint:
There are three conditions for stop cranking: Starting RPM, StartingPOil and D+ (when enabled). Starter goes off when any of these conditions is vaid.

Prestart time [s]

Time of closing of the PRE-START output prior to the engine start.
Set to zero if you want to leave the output PRE-START open.
Step: 1s
Range: 0 – 600 s

MaxCrank time [s]

Maximum time limit of cranking.
Step: 1s
Range: 1 – 60 s

CrnkFail pause [s]

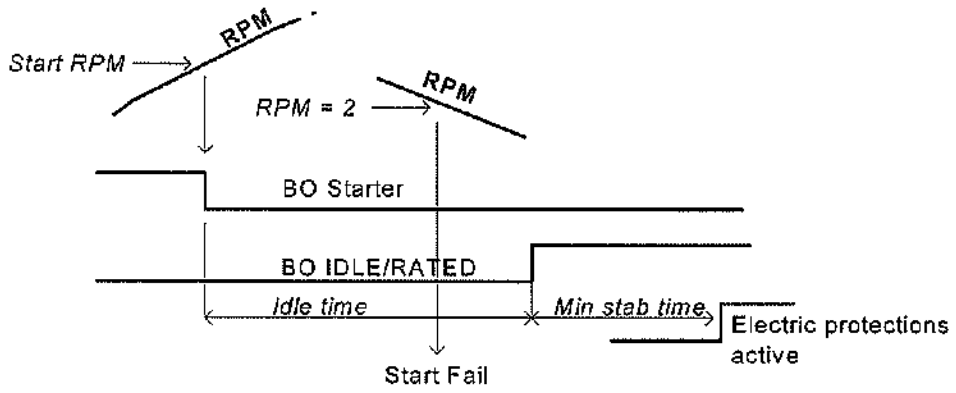
Pause between crank attempts.
Step: 1s
Range: 5 – 60 s

Crank attemps [-]

Max number of crank attempts.
Step: 1
Range: 1 – 10

Idle time [s]

Idle time delay starts when RPM exceeds *Start RPM* . Start fail is detected when during Idle state RPM decreases below 2.
During the *Idle time* timer running the binary output IDLE/NOMINAL is opened, when it elapses the IDLE/NOMINAL output closes. Binary output IDLE/NOMINAL opens during Cooling period again.
Step: 1 s
Range: 0 – 600 s



Hint:
If the IDLE function not supported on the governor, set the *Idle time* nevertheless to minimum 5s to avoid *Underspeed* possibly caused by instability of the engine short after start.

Min stab time [s]

Minimum time after reaching of defined level of RPM to the closing GCB.
Step: 1s
Range: 0 – 300 s

Max stab time [s]

Maximum time after start to get proper voltage level of the generator.
Step: 1s
Range: 0 – 300 s
Hint:
When generator voltage within *Max stab time* does not reach defined limits (Generator protection group) , an alarm occurs and the genset will shut down

Stop time [s]

Under normal conditions the engine must certainly stop within this period. The period starts by issuing stop command.
Step: 1s
Range: 0 – 600 s
Hint:
Stop of engine is detected when all following conditions are met: RPM <2, Oil pressure < *StartingPOil* and Generator voltage < 10 VAC.
Stop fail is detected when there is difference between those conditions, e.g RPM<2 and Generator voltage > 10V.

Cooling time [s]

Runtime of the unloaded gen-set to cool the engine before stop.
Step: 1s
Range: 0 – 3600 s

Cooling speed [NOMINAL / IDLE]

Selects the function of the Binary output IDLE/NOMINAL during engine Cooling state.
NOMINAL : Cooling is executed at Nominal speed and generator protections are active.
IDLE: Cooling is executed at Idle speed and generator protections are switched off.
Hint:
Binary output IDLE/NOMINAL must be configured and connected to speed governor. Engine Idle speed must be adjusted on speed governor.

AfterCool time [s]

Runtime of engine after cooling pump. Binary output *Cooling pump* is closed when the engine starts and opens *AfterCool time* delayed after gen-set stops.
Step: 1s
Range: 0 – 3600s

Fuel solenoid [DIESEL / GAS]

Determines behavior of the Binary output FUEL SOLENOID.
DIESEL: Output closes 1 sec before Binary output STARTER.
The output opens if Emergency stop comes or Cooled gen-set is stopped and in pause between repeated starts.
GAS: Output closes together with Binary output IGNITION if RPM is over the *30 RPM (fix value)*.
Output opens after stop command or in pause between repeated start.

D+ function [ENABLED/CHRGFAIL/DISABLED]

ENABLED: The D+ terminal is used for both functions – "running engine" detection and charge fail detection.
CHRGFAIL: The D+ terminal is used for charge fail detection only
DISABLED: The D+ terminal is not used.

Hint:
The magnetization current is provided independently on this setpoint value.
The D+ charge fail protection becomes active after **Engine params**:*Idle time* reaches zero.

ECU FreqSelect [PRIMARY/SECONDARY/DEFAULT]

This setpoint should be used only for Volvo and Scania engines.

Volvo – "Volvo Aux" is selected in ECU configuration:
Primary or secondary engine speed is set by *Frequency select* bits in **VP Status** frame.

Scania – "Scania S6 Singlespeed" is selected in ECU configuration:
Nominal engine speed is chosen by *Nominal speed switch 1* and *2* from **DLN1** frame when the engine is running on nominal speed, i.e. binary output *Idle/Nominal* is active. When the output is not active (engine is running on Idle speed), the setpoint *ECU FreqSelect* is not taken into account.

Frequency change for Volvo Penta engines with EMS2

This description refers to the Volvo Penta Application bulletin 30-0-003.
The procedure for changing engine speed on the D9 and D16 engines is different from the D12 engine.
There is no system reset on the EMS2 unit; therefore the procedure is changed.

Procedure if ECU not energized:
1. Switch the IL controller to MAN mode.
2. Power up the ECU.
3. Change the setpoint *ECU FreqSelect* and confirm it by pressing Enter
4. Press the Stop button on the IL controller.

The whole procedure (step 2 to 4) must not exceed **10 seconds**.

Procedure with ECU powered on:
1. Switch the IL controller to MAN mode.
2. Press the Stop button on the IL controller.
3. Change the setpoint *ECU FreqSelect* and confirm it by pressing Enter
4. Press the Stop button on the IL controller.

The whole procedure (step 2 to 4) must not exceed **10 seconds**.

ECU SpeedAdj [%]

Enables to adjust engine speed in ECU via CAN bus. Nominal speed corresponds to 50%.
This setpoint should be used only for Volvo Penta and Scania engines. It has no effect on other engine brands.
Step: 1%
Range: 0 – 100%

Engine protect

Eng prot del [s]

During the start of the gen-set, some engine protections have to be blocked (e.g. Oil pressure).
The protections are unblocked after the *Protection del* time. The time starts after reaching *Start RPM*.
Step: 1s
Range: 0 – 300 s

Horn timeout [s]

Max time limit of horn sounding. Set to zero if you want to leave the output HORN open. Horn timeout starts again from the beginning if a new alarm appears before previous Horn timeout has elapsed.
Step: 1s
Range: 0 – 600 s

Overspeed [%]

Threshold for over speed protection
Step: 1% of nominal RPM
Range: 100 – 150%

AnIInp1 level1 [Bar]

Warning threshold level for ANALOG INPUT 1
Step: 0,1 bar
Range: AnIInp1 level2 – 10000

AnIInp1 level2 [Bar]

Shutdown threshold level for ANALOG INPUT 1
Step: 0,1 bar
Range: -100 – AnIInp1 level1

AnIInp1 del [s]

Delay for ANALOG INPUT 1
Step: 1 s
Range: 0 – 180 s

AnIInp2 level1 [ ]

Warning threshold level for ANALOG INPUT 2
Step: 1 °C
Range: -100 – AnIInp2 level2

AnIInp2 level2 [ ]

Shutdown threshold level for ANALOG INPUT 2
Step: 1 °C
Range: AnIInp2 level1 – 10000

AnIInp2 del [s]

Delay for ANALOG INPUT 2 alarm.
Step: 1 s
Range: 0 – 180 s

AnIInp3 level1 [ ]

Warning threshold level for ANALOG INPUT 3
Step: 1 %
Range: AnIInp3 level2 – 10000

AnIInp3 level2 [ ]

Shutdown threshold level for ANALOG INPUT 3
Step: 1 %
Range: -100 – AnIInp3 level1

AnIInp3 del [s]

Delay for ANALOG INPUT 3
Step: 1 s
Range: 0 – 180 s

Batt undervolt [V]

Warning threshold for low battery voltage.
Step: 0,1 V
Range: 8V – Batt overvolt

Batt overvolt [V]

Warning threshold for high battery voltage.
Step: 0,1 V
Range: Batt undervolt – 40 V

Batt volt del [s]

Delay for low battery voltage alarm.
Step: 1s
Range: 0 – 600 s

NextServTime [h]

Counts down when engine running. If reaches zero, an alarm appears.
Step: 1h
Range: 0 – 65535h

Gener protect

Hint:
All electric protections when activated result in shutdown.

Overload [%]

Threshold for generator overload (in % of Nominal power)
Step: 1% of Nominal power
Range: 0 – 200%

Overload del [s]

Delay for generator overload alarm.
Step: 0.1s
Range: 0 – 60.0 s

*2Inom del [s]

IDMT curve shape selection. *2Inom del* is Reaction time of IDMT protection for 200% overcurrent Igen = 2* *Nominal current*.
Step: 0,1 s
Range: 0,1 - 20 s

IDMT is "very inverse" generator over current protection. Reaction time is not constant but depends on generator over current level according following formula.

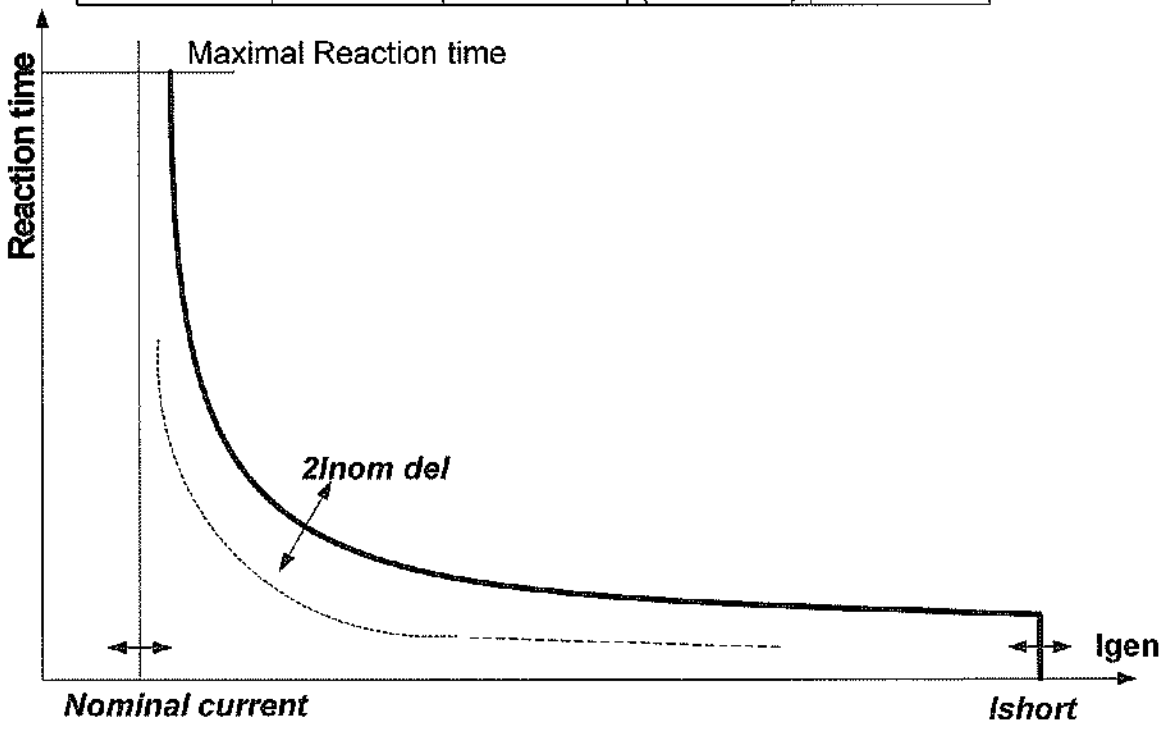
$$\text{Reaction time} = \frac{2Inom\ del * Nomin\ current}{Igen - Nomin\ current}$$

Hint:
Reaction time is limited up to 900 sec = 15 minutes. IDMT protection is not active for Reaction time values longer than 15 minutes.

Igen is maximal value of all measured phases of generator current.

EXAMPLE of Reaction time for different over current levels. Values in column 200% are *2Inom del.*

	Overcurrent			
	200 % = 2Inom del	≤ 100 %	101 %	110 %
Reaction time	**0,2 s**	No action	20 s	2 s
	2 s	No action	200 s	20 s
	20 s	No action	No action (time > 900 s)	200 s



Ishort [%]

Shutdown occurs when short circuit limit *Ishort* limit is reached.
Step: 1 % of *Nominal current*
Range: 100 - 500 %

Curr unbal [%]

Threshold for generator current asymmetric (unbalance).

Step: 1% of Nominal current
Range: 1 – 200% of Nominal current

Curr unbal del [s]

Delay for generator current unbalance
Step: 0.1 s
Range: 0 – 60.0 s

Gen >V Sd [%]

Threshold for generator overvoltage. All three phases are checked. Maximum out of three is used.
Step: 1% of Nominal voltage
Range: Gen <V – 200%

Gen <V Sd [%]

Threshold for generator undervoltage. All three phases are checked. Minimum out of three is used.
Step: 1% of Nominal voltage
Range: 0% – Gen >V

Gen V del [s]

Delay for generator undervoltage and overvoltage alarm
Step: 0.1s
Range: 0 – 60 s

Volt unbal [%]

Threshold for generator voltage unbalance alarm.
Step: 1% of Nominal voltage
Range: 0 – 100% of Nominal voltage

Volt unbal del [s]

Delay for generator voltage unbalance alarm.
Step: 0.1s
Range: 0 – 60.0 s

Gen >f [%]

Threshold for generator phase L3 overfrequency.
Step: 0.1% of Nominal frequency
Range: Gen <f – 200.0%

Gen <f [%]

Threshold for generator phase L3 underfrequency.
Step: 0.1% of Nominal frequency
Range: 0.0 – Gen >f of Nominal frequency

Gen f del [s]

Delay for generator underfrequency and overfrequency alarm.
Step: 0.1s
Range: 0 – 60.0 s

Auto Mains Fail

Ret fromIsland [MANUAL, AUTO]

MANUAL: After closing GCB, iL goes to MAN mode automatically.
AUTO: No automatic switching to MAN mode.

EmergStart del [s]

Delay after the mains failure to the start of the gen-set
Step: 1s
Range: 0 – 6000 s

Mains ret del [s]

Delay after the mains return to the GCB opening.
Step: 1s
Range: 1 – 3600 s

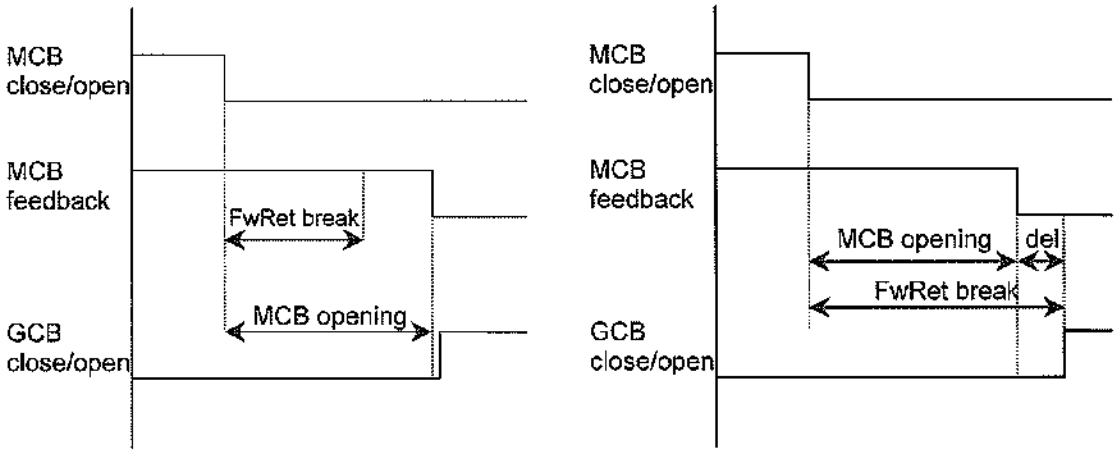
FwRet break [s]

Delay after GCB opening to MCB closing during the return procedure.
Delay after MCB opening to GCB closing if the setpoint *MCB opening* set to GEN START
Step: 0.1s
Range: 0 – 600.0 s

The time charts bellow show recommended setting of **AutoMains fail**:*FwRet break* setpoint.

If the *FwRet break* setpoint is set shorter than the time required for opening of the circuit breaker, the controller closes *GCB close/open* output straight away (100 ms) after the *MCB feedback* input deactivates.

If some delay between *MCB feedback* deactivation and closing of *GCB close/open* output is required, then the *FwRet break* must be set to sum of "MCB opening" + "del" time.



MCB close del [s]

Delay after mains returns to MCB closing, if gen-set is not running(e.g. is in start-up procedure)
Step: 0.1s
Range: 0 – 60.0 s

Mains >V [%]

Threshold for mains overvoltage. All three phases are checked. Maximum out of three is used.
Step: 1% of Nominal voltage
Range: Mains <V – 200%

Mains <V [%]

Threshold for mains undervoltage. All three phases are checked. Maximum out of three is used.
Step: 1% of nominal voltage
Range: 0% – Mains >V

Mains V del [s]

Delay for mains undervoltage and overvoltage
Step: 0.1 s
Range: 0 – 60 s

MVolt unbal [%]

Threshold for mains voltage unbalance
Step: 1% of Nominal voltage
Range: 1 – 150%

MVoltUnbal del [s]

Delay for mains voltage unbalance
Step: 0.1 s
Range: 0- 60.0

Mains >f [%]

Threshold for mains overfrequency. All three phases are checked. Maximum out of three is used.
Step: 0.1% of Nominal frequency
Range: Mains <f – 200.0%

Mains <f [%]

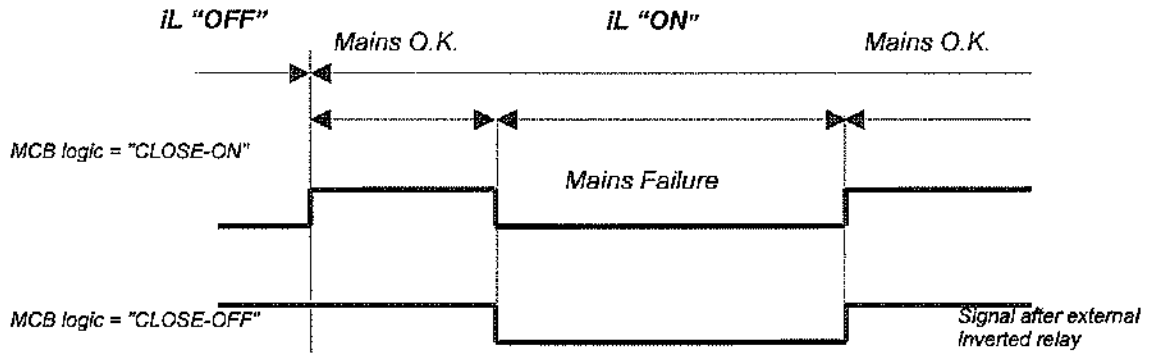
Threshold for mains underfrequency. All three phases are checked. Maximum out of three is used.
Step: 0.1% of nominal frequency
Range: 0% – Mains >f

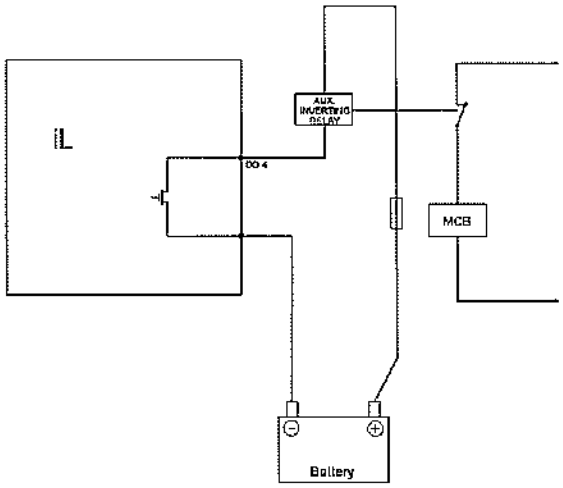
Mains f del [s]

Delay for mains underfrequency and overfrequency
Step: 0.1s
Range: 0 – 60.0 s

MCB Logic [CLOSE-ON / CLOSE-OFF]

The set point influences the behavior of the output MCB CLOSE/OPEN
CLOSE-ON: When the output MCB CLOSE/OPEN is closed – MCB should be closed.
CLOSE-OFF: When the output MCB CLOSE/OPEN is closed – MCB should be opened.





Hint:
In the case **MCB logic** = "CLOSE-OFF" it is necessary to change externally the polarity of the output signal.

Ret from test [MANUAL / AUTO]

The set point influences the behavior of the TEST mode.
MANUAL:
1) Select TEST, gen-sets starts and running unloaded
2) To transfer load from mains to the gen-set press MCB ON/OFF or wait for power-cut.
3) When mains recovers, the gen-set remains running loaded.
4) To stop the gen-set select AUT mode
5) In AUT mode:
   a) After the *MainsReturn del* InteliLite opens the GCB
   b) After the *Return Break* delay InteliLite closes the MCB.
   c) The gen-set is cooled and stopped

AUTO:
1) Select TEST, gen-sets starts and running unloaded
2) To transfer load from mains to the gen-set wait for the power-cut. the controller does not response for MCB ON/OFF button.
3) When the mains recovers:
   a) After the *MainsReturn del* the controller opens the GCB
   b) After the *Return Break* delay the controller closes the MCB.
4) The gen-set remains running.
5) To stop the gen-set select a different mode than TEST.

MCB opened [MAINSFAIL / GENRUN]

MAINSFAIL
The command to open the MCB is given immediately after mains fail condition evaluated.

GEN START
The command to open the MCB is not given till the Genset starts (with respecting the setpoint *EmergStart del*), reaches *Running* state, reaches proper voltage and frequency and *MinStabTime* elapses. After that, the MCB is opened, *FwRet break* timer is started and the GCB is closed after the timer elapses.
Hint:
This option should be used for MCBs using 230V control and not equipped with the undervoltage coil.

Sensor spec

Calibr AI1,AI2,AI3 [...]

Calibrating constant to adjust the measured value of IL analog inputs. Physical dimension of calibrating constant is corresponding to Analog input.
Step: 1
Range: -1000 – +1000
Hint:
Calibration constants have to be adjusted when measured value is near the alarm level.
User curves A, B, C can be defined by LiteEdit software.

*IOM module

AnOut-kW/20mA [kW/20mA]

Conversion coefficient from gen-set power to IG-IOM, IGS-PTM analog output – in kW to full output scale 20 mA.
Step: 1 kW / 20mA
Range: 1 - 32000 kW / 20mA

AnInIOM1 lev1 [ ]

The level for IOM ANALOG INPUT 1 alarm detection.
Step: 1
Range: -100 - +10000

AnInIOM1 lev2 [ ]

The level for IOM ANALOG INPUT 1 alarm detection.
Step: 1
Range: -100 - +10000

AnInIOM1 del [s]

Delay for IOM ANALOG INPUT 1 alarm.
Step: 1 s
Range: 0 - 180 s

AnInIOM2 lev1 [ ]

The level for IOM ANALOG INPUT 2 alarm detection.
Step: 1
Range: -100 - +10000

AnInIOM2 lev2 [ ]

The level for IOM ANALOG INPUT 2 alarm detection.
Step: 1
Range: -100 - +10000

AnInIOM2 del [s]

Delay for IOM ANALOG INPUT 2 alarm.
Step: 1 s
Range: 0 - 180 s

AnInIOM3 lev1 [ ]

The level for IOM ANALOG INPUT 3 alarm detection.
Step: 1
Range: -100 - +10000

AnIInIOM3 lev2 [ ]

The level for IOM ANALOG INPUT 3 alarm detection.
Step: 1
Range: -100 - +10000

AnIInIOM3 del [s]

Delay for IOM ANALOG INPUT 3 alarm.
Step: 1 s
Range: 0 - 180 s

AnIInIOM4 lev1 [ ]

The level for IOM ANALOG INPUT 4 alarm detection.
Step: 1
Range: -100 - +10000

AnIInIOM4 lev2 [ ]

The level for IOM ANALOG INPUT 4 alarm detection.
Step: 1
Range: -100 - +10000

AnIInIOM4 del [s]

Delay for IOM ANALOG INPUT 4 alarm.
Step: 1 s
Range: 0 - 180 s
The protection of IOM/PTM inputs is activated by overcrossing the limits.

Calibr AI4,AI5,AI6,AI7 [...]

Calibrating constant to adjust the measured value of IOM/PTM analog inputs. Physical dimension of calibrating constant is corresponding to Analog input.
Step: 1
Range: -1000 – +1000

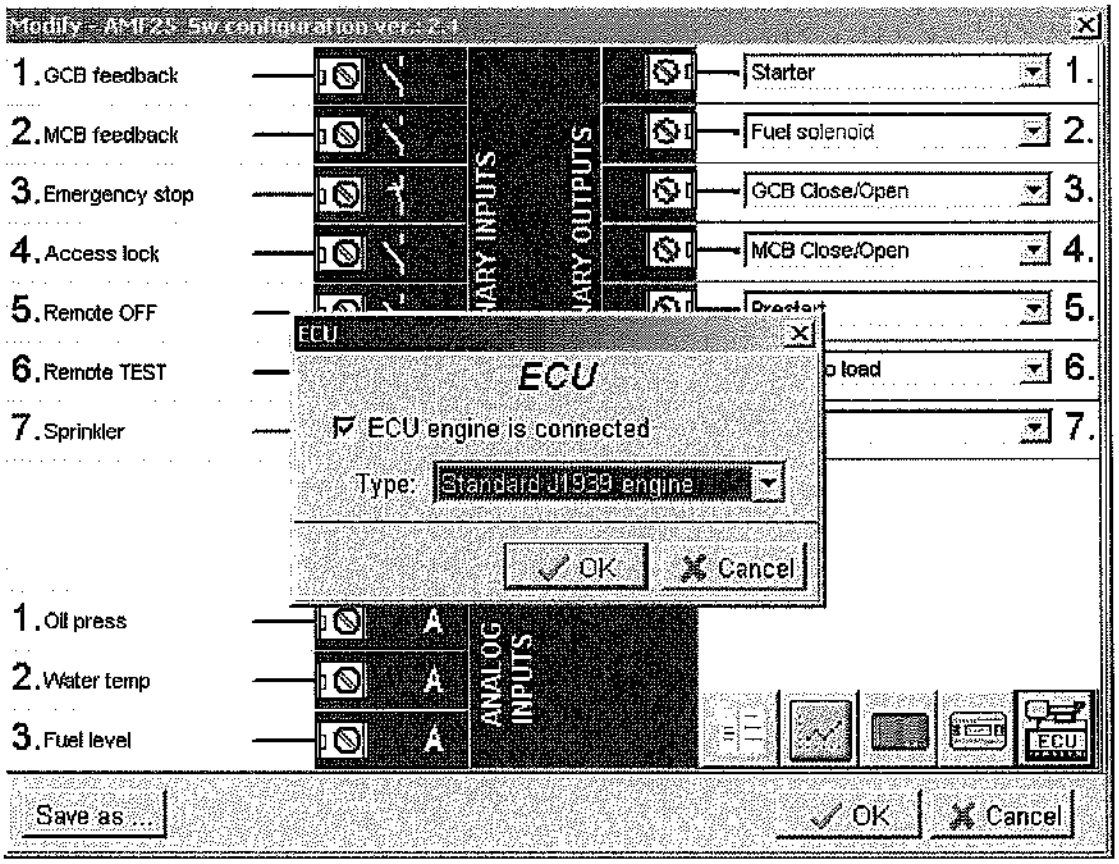
*ECU-controlled engine support

There exists only one firmware branch for both standard and electronic controlled (monitored) engines.

Presence of the ECU on the CAN bus/RS232 is configured via LiteEdit like other peripheries (iG-IOM, iGL-RA15). Pressing the 

button in Configuration window of LiteEdit (version 2.0 and higher), opens ECU dialog window where the appropriate engine/ECU type should be selected. There are several groups of engine/ECU types:

Type selection	Supported engine/ECU
Cummins MODBUS	Cummins engines with Modbus communication support
Volvo Aux	Volvo Penta engines with EMSII, EDCIII units
Scania S6 Singlespeed	Scania engines with S6 unit
Standard J1939 engine	All other engine brands with J1939 support



If the connected engine is Cummins communicating via RS232, it is necessary to set the setpoint **Basic settings**:*RS232 mode* = CUMMINSMB.

Loss of communication causes shutdown of the running engine. On the contrary, the ECU can be switched off at quiescent engine, that means not-communicating ECU is in that moment normal situation. All values from ECU shall show ####, but no alarm is displayed. The output *ECU CommOK* follows the real situation, that means it is not active anytime when the ECU does not communicate.

The output *ECU PwrRelay* closes at the beginning of prestart and opens if the engine shall be

stopped.

The engine is started via standard contact output or via CAN bus (for Volvo and Scania engines). For other engines J1939 is used for monitoring only.

Values read from ECU

Standard J1939 engines and Scania

When "Standard J1939 engines" and "Scania S6" options are selected, following values are read from standard J1939 frames:

- 5.2.1.9 Engine speed (frame 5.3.7 EEC1)
- 5.2.5.28 Engine oil pressure (frame 5.3.29 Engine Fluid Level/Pressure)
- 5.2.5.5 Engine coolant temperature (frame 5.3.28 Engine Temperature)
- 5.2.5.61 Total engine hours (frame 5.3.19 Engine Hours, Revolutions)
- 5.2.1.7 Percent load at current speed (frame 5.3.6 EEC2)
- 5.2.5.63 Fuel rate (frame 5.3.32 Fuel Economy)
- 5.2.5.36 Boost pressure (frame 5.3.36 Inlet/Exhaust Conditions)
- 5.2.5.4 Intake manifold 1 temperature (frame 5.3.36 Inlet/Exhaust Conditions)

Cummins MODBUS

When "Cummins-Modbus" option is selected, following values are read from Modbus Register Data (for QSX15,QSK45, QSK60):

- Engine Speed (Register Address:30001)
- Oil Pressure (Register Address:30003)
- Coolant Temperature (Register Address:30002)
- Engine Running Time (Register Address:30008-30009)
- Fuel Consumption Rate (Register Address:30018)
- Intake Manifold Absolute Pressure (Register Address:30530 (QSK45, QSK60 only))
- Intake Manifold Temperature (Register Address:30531 (QSK45, QSK60 only))

Diagnostic messages read from ECU

Diagnostic messages are read and displayed in extra ECU Alarm list. For Standard J1939 SPN (Suspect Parameter Number), FMI (Failure Mode Identifier) and OC (Occurrence Counter) are shown together with verbal description if available.
One SPN (Suspect Parameter Number) / FMI (Failure Mode Identify) couple describes one fail information. If FMI is equal to 0 or 1, WRN is displayed in the ECU Alarm list. For any other FMI values, FLS is displayed.
Detail SPN/FMI code specification see in:

- SAE Truck and Bus Control and Communications Network Standards Manual, SAE HS-1939 Publication
- Or refer to corresponding engine manufacturer's ECU error codes list.

Following messages are displayed with the description:

- SPN:100 EngOil Press
- SPN:102 Boost Press
- SPN:105 Intake Temp
- SPN:110 EngCool Temp
- SPN:175 EngOil Temp
- SPN:629 Controller#1
- SPN:636 PositionSensor
- SPN:637 TimingSensor
- SPN:651 InjectorCyl#1
- SPN:652 InjectorCyl#2
- SPN:653 InjectorCyl#3
- SPN:654 InjectorCyl#4
- SPN:655 InjectorCyl#5
- SPN:656 InjectorCyl#6

- SPN:677 EngStartRelay
- SPN:1485 ECU MainRelay

Hint:
InteliLite controller doesn't support J1587 diagnostic line on Volvo engines. This can cause in some cases a J1939 alarm message FC:000608 due to missing J1587 bus. Contact your Volvo distributor to update ECU firmware.

For Scania Fault codes (FC) are displayed. Following messages are available for particular groups of Fault codes:

- FC:1000-1001 Overspeed
- FC:1100-1107 EngSpdSensor1
- FC:1200-1207 EngSpdSensor2
- FC:2000-2002 WtrTempSensor
- FC:2100-2102 ChrgAirTmpSens
- FC:2200-2202 ChrgAirPrsSens
- FC:2400-2403 OilPressSensor
- FC:2600-2601 SensorSupply1
- FC:2700-2701 SensorSupply2
- FC:2800-2802 ExtrAnalogInp
- FC:3200-3205 BatteryVoltage
- FC:4300-4303 HW Watchdog
- FC:6200-6201 FanActuator
- FC:6400-6401 WasteGateAct
- FC:6600-6601 StarterActuatr
- FC:6A00-6A01 ExhaustBrkAct
- FC:B000-B001 OilPressProt
- FC:B100-B101 CoolantLevProt
- FC:B200 OverheatCoolWt
- FC:B300 EmergencyStop
- FC:C000-C006 PDEInjctorCyl1
- FC:C100-C106 PDEInjctorCyl2
- FC:C200-C206 PDEInjctorCyl3
- FC:C300-C306 PDEInjctorCyl4
- FC:C400-C406 PDEInjctorCyl5
- FC:C500-C506 PDEInjctorCyl6
- FC:C600-C606 PDEInjctorCyl7
- FC:C700-C706 PDEInjctorCyl8
- FC:E200 OverheatProt
- FC:E600 CoordEmergStop

Analog inputs

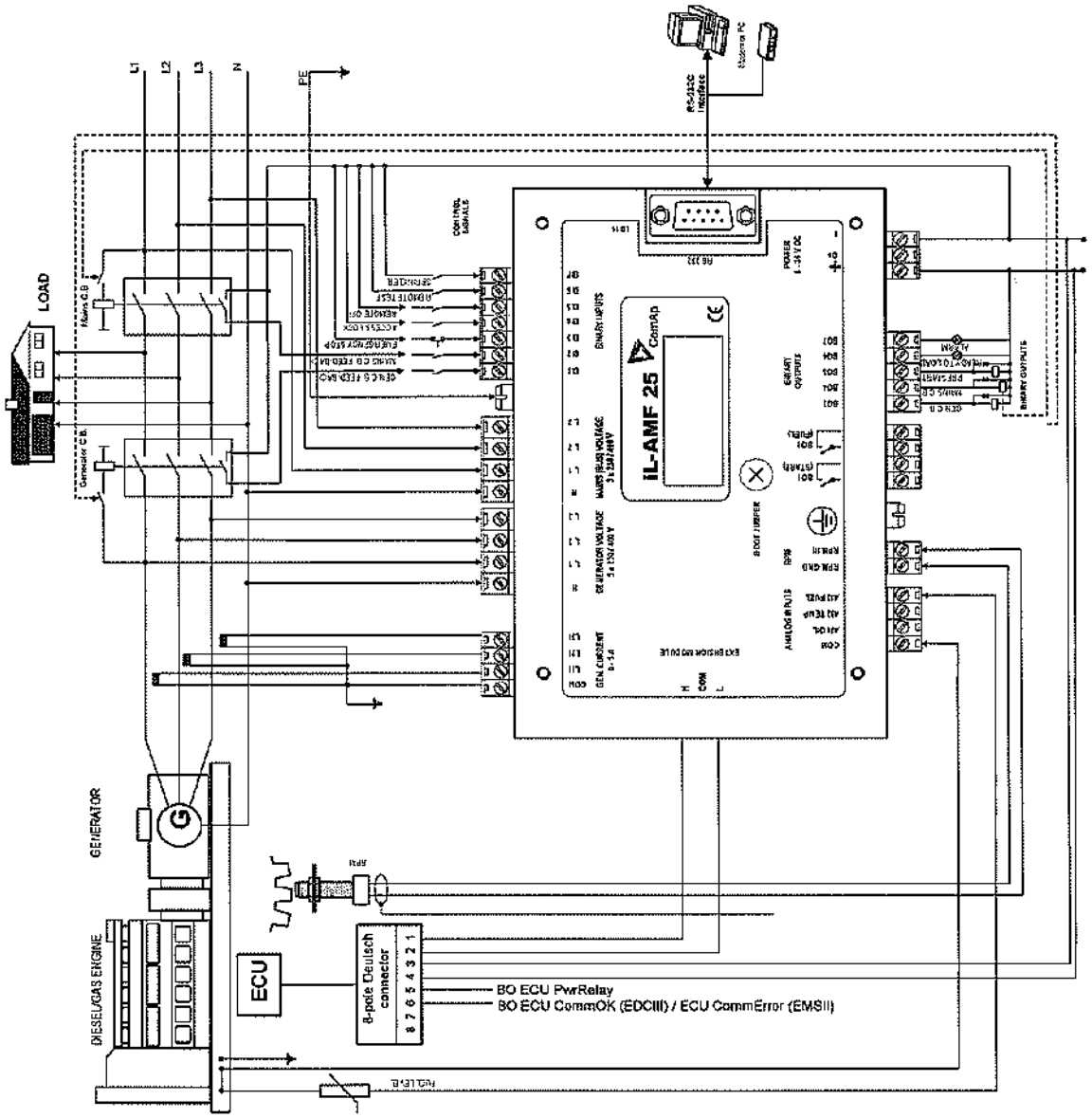
Reading of mentioned values from ECU enables to use analog inputs of the unit for other purposes, e.g. measuring, displaying and alarm activation related to various quantities. The configuration thus allows to use three analog inputs on the central unit and four analog inputs on IG-IOM/IGS-PTM module if connected.
If the engine without ECU is controlled by InteliLite, the first analog input is permanently configured to Oil pressure, other analog inputs remain freely configurable.

Connection description

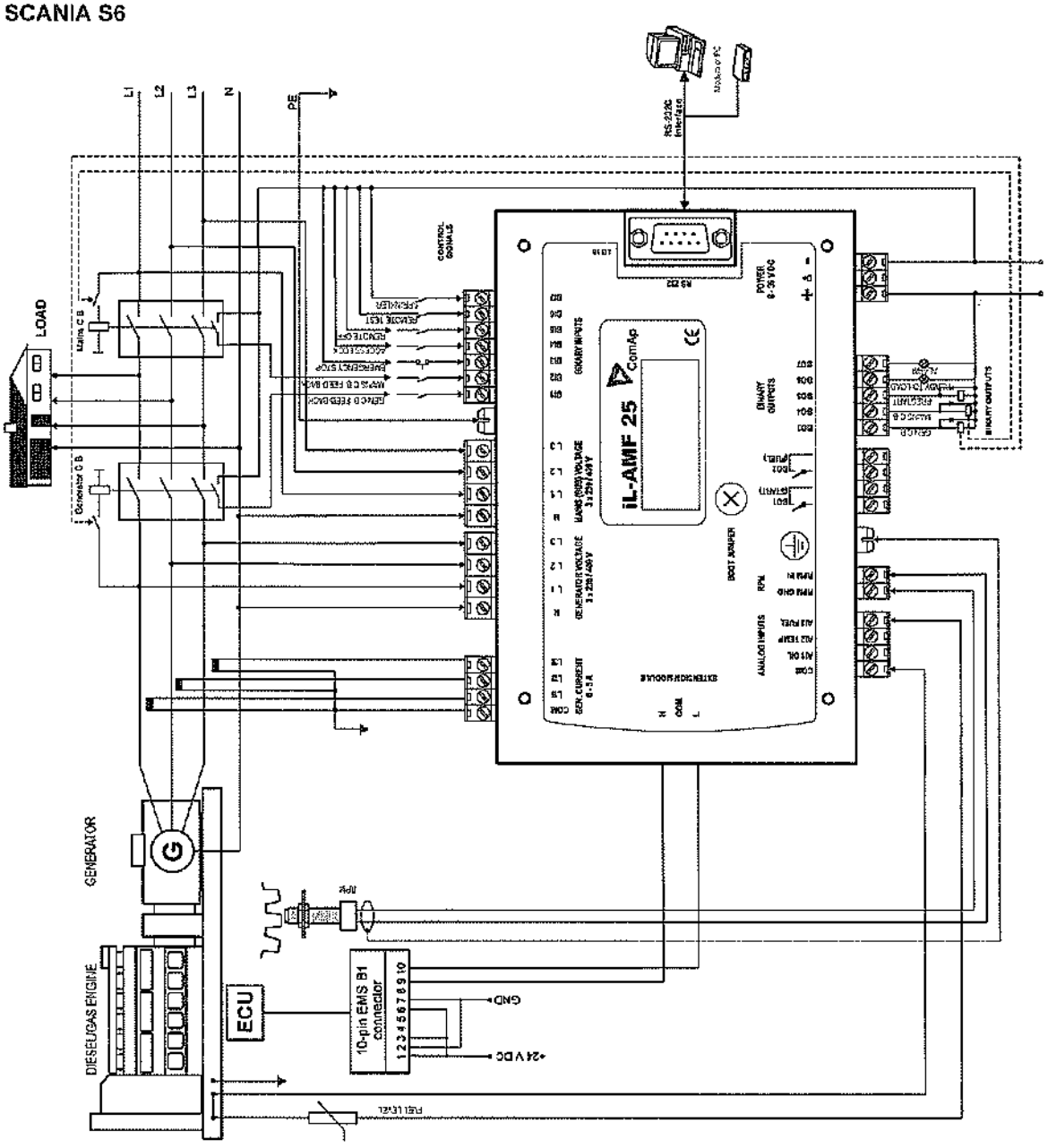
The following diagrams show how to connect the engine control unit to the InteliLite controller:

Engines with J1939 support started via CAN bus

VOLVO PENTA engines (EMS II, EDC III units)



SCANIA S6


L1
L2
L3
N
PE
LOAD
GENERATOR
DIESEL/GAS ENGINE
ECU
10-pin EMS B1 connector
GND
+24 V DC
iL-AMF 25
ComAp
RS 232 interface
CONTROL SIGNALS
BINARY INPUTS
BINARY OUTPUTS
ANALOG INPUTS
BOOT JUMPER
POWER 8 - 36 V DC
MPU
FUEL LEVEL

Engines with J1939 support not started via CAN bus

PERKINS 2800 series

IL-CU binary output description	Perkins Customer interface connector
Start output	connects directly to engine starter solenoid
Fuel output	1,10,15,33,34 powers up ECU and enables the injectors

IL-CU CAN description	Perkins Customer interface connector
CAN bus common	Screen for the J1939 cable.
CAN bus H	31
CAN bus L	32

JOHN DEERE

IL-CU binary output description	John Deere 21 pin Deutsch connector
Start output	D
Fuel output	G (switched ECU power),J (ignition)

IL-CU CAN description	John Deere 21 pin Deutsch connector
CAN bus common	Screen for the J1939 cable.
CAN bus H	V
CAN bus L	U

CUMMINS ISB/ISBE

IL-CU binary output description	Cummins ISB OEM Harness connector B
Start output	connects directly to engine starter solenoid
Fuel output	39

IL-CU CAN description	Cummins ISB 9 pin Deutsch connector
CAN bus common	SAE J1939 shield - screen for J1939 cable.
CAN bus H	SAE J1939 signal
CAN bus L	SAE J1939 return

Cummins engines with MODBUS communication

InteliLite set up (available from version 2.0):

Basic settings:*RS232 mode* = CUMMINS MB

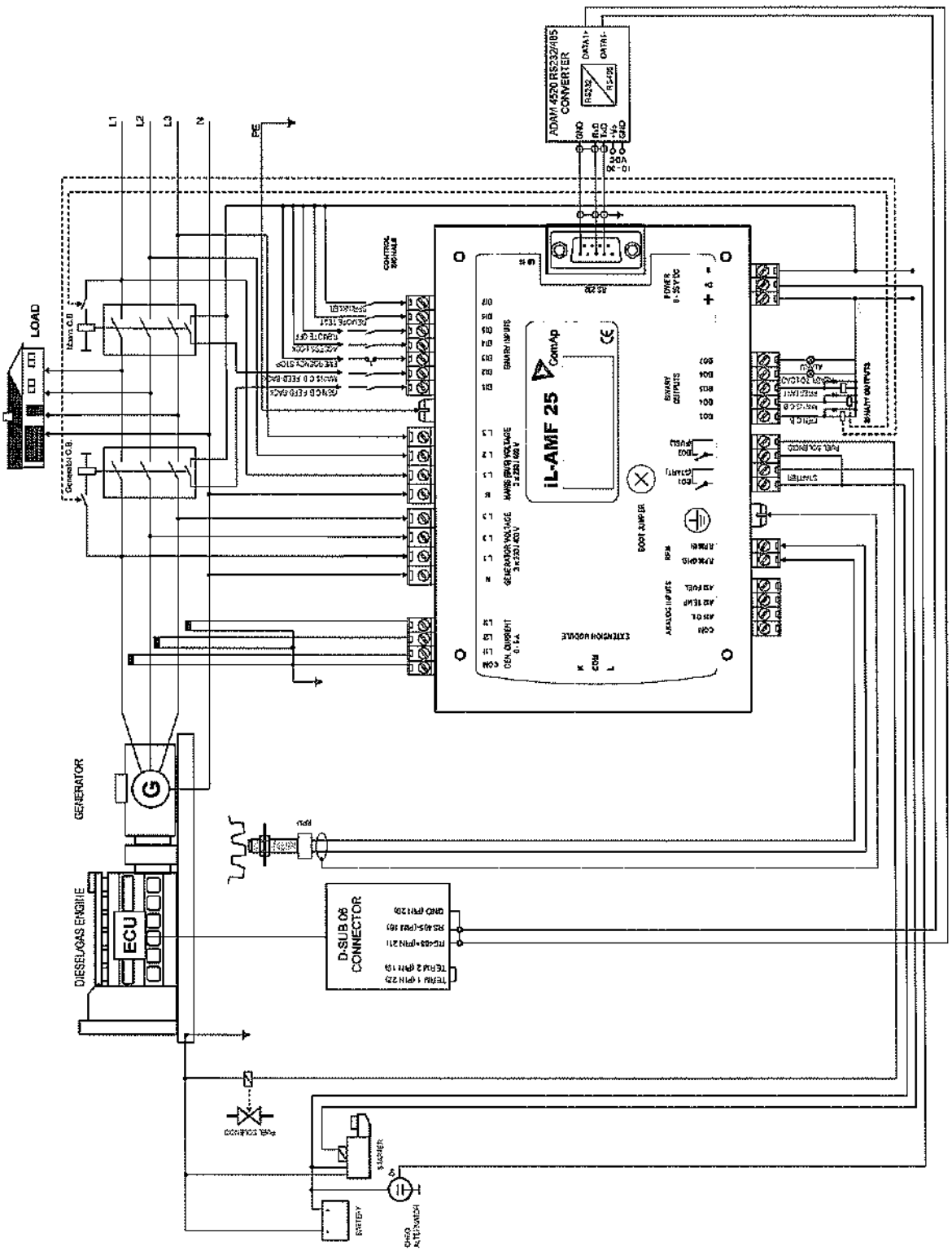
Software configuration: ECU → ECU engine is connected → Type: Cummins MODBUS

RS232/RS485 converter (see following diagram) set up:

Data format settings (SW1) 11 bits (1 start bit, 8 data bits, 2 stop bits)

Baud rate settings (SW2) 9600 bps

(more info available on http://www.advantech.com/products/Model_Detail.asp?model_id=1-D6FLH)


ADAM 4520 RS232/485 CONVERTER
DATA+
DATA-
RS232
RS485
GND
RxD
TxD
Vcc
GND
L1
L2
L3
N
PE
LOAD
Main C.B.
Gener. C.B.
CONTROL SIGNALS
RS 232
POWER 8-35V DC
iL-AMF 25
ComAp
BINARY INPUTS
BINARY OUTPUTS
BOOT JUMPER
GENERATOR VOLTAGE
EXTENSION MODULE
ANALOG INPUTS
GENERATOR
ECU
DIESELGAS ENGINE
D-SUB 06 CONNECTOR
STARTER
BATTERY
CHRG. ALTERNATOR

Sensor specification

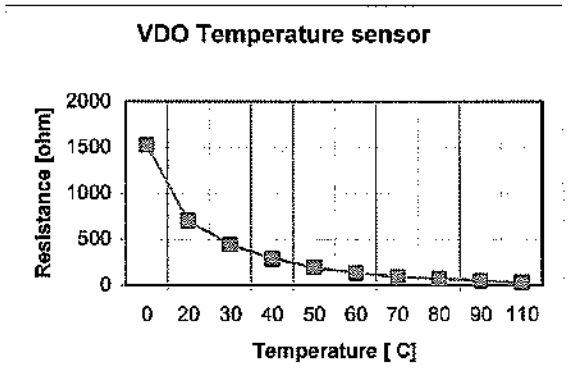
Background of the sensor calibration

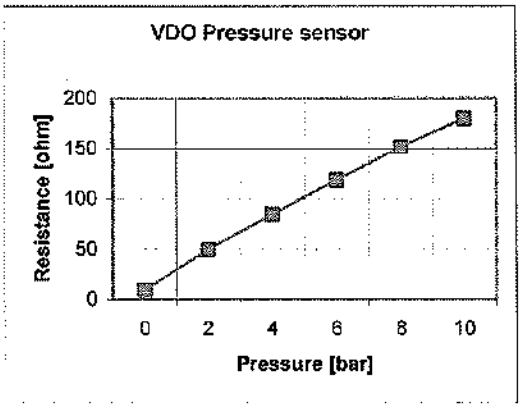
To correct measuring error of each analog input (pressure, temperature, level) calibrating constants within 10 % of measure range should be set. Three (seven) calibrating constants are set in physical units - bar, °C, % . From these constants are counted equivalent calibrating resistance which are internally (in software) add to sensor resistance.
At the moment of calibration (ENTER pressing) is calculated (and in memory saved) calibrating resistance (in Ω). This value is added to measured sensor resistance before calculation of the AI1 (AI2 or AI3) value.
Example: iL-CU display Temperature 70 °C and real value is 73 °C.
After setting *Calibr AI1* to +3 °C (and pressing ENTER) InteliLite calculates corresponding resistance (e.g.5Ω) and saves this value into the memory. The resistance is then added to all calculations (e.g. instead of 70°C -> 73°C, or e.g. instead of 5°C -> 6°C).
Hint:
The calibration must be done at the operational point of the analog input (e.g. 80°C, 4.0Bar etc..)

Default sensor settings

Analog input 1: 6 points VDO characteristic, pressure measuring in bar
Analog input 2: 10 points VDO characteristic, temperature measuring in °C
Analog input 3: 2 points VDO fuel level sensor, 0% = 10Ω, 100% = 180Ω

For VDO sensor characteristic see chapter Value and set points codes.



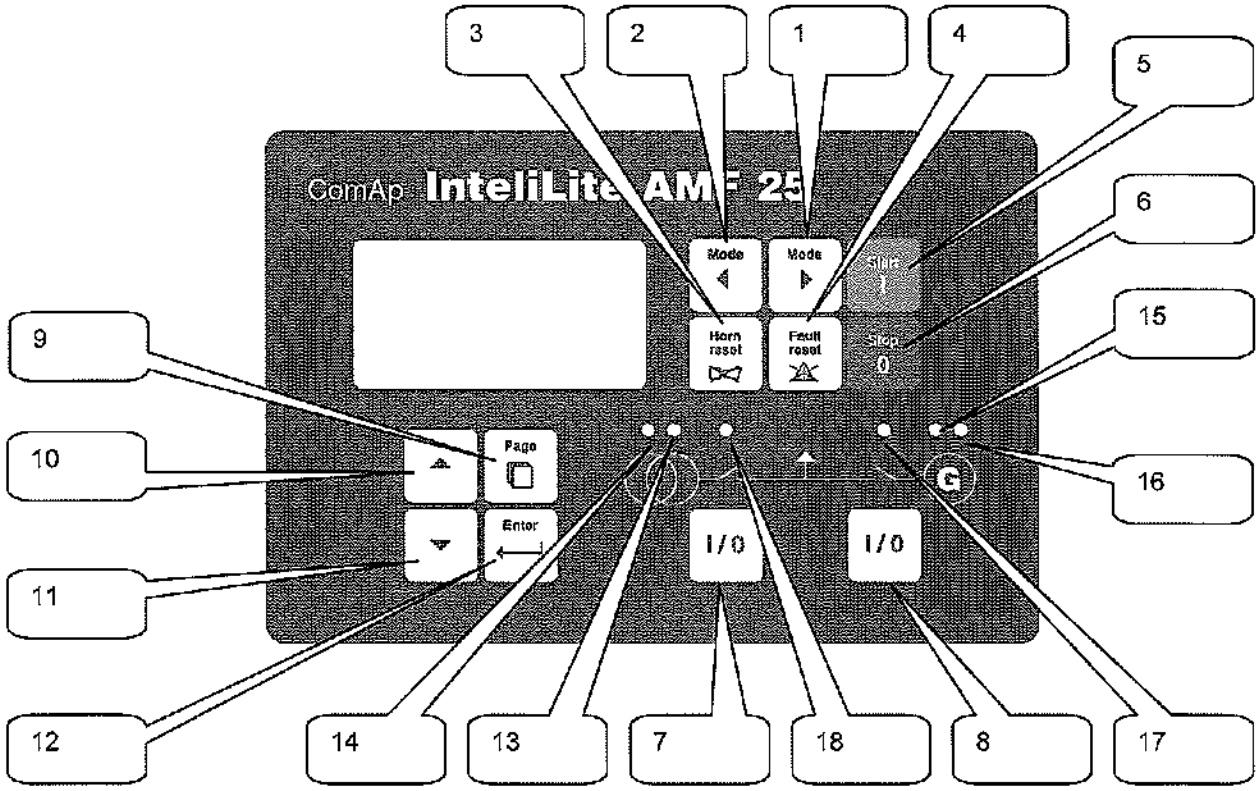


Temperature °C	Pt 1000 ohm		Ni 1000 ohm	
-20	922		893	
-10	961		946	
0	1000		1000	
30	1117		1171	
60	1232		1353	
80	1309		1483	
90	1347		1549	
100	1385		1618	
110	1423		1688	
120	1461		1760	
0	-1		-1	

Hint:
When measured value is 6% out of range the Sensor fail FLS is detected.

Operator interface

Pushbuttons and LEDs



Pushbuttons

1. MODE→ Cyclic forward selection the gen-set operation mode (OFF -> MAN -> AUT -> TEST)
2. ←MODE Cyclic backward selection the gen-set operation mode (TEST -> AUT -> MAN ->OFF)
3. HORN RESET Deactivates the HORN
4. FAULT RESET Acknowledges faults and alarms
5. START Start of the gen-set
6. STOP Stop of the gen-set
7. MCB ON/OFF Manual open/close of the Mains circuit breaker
8. GCB ON/OFF Manual open/close of the Generator circuit breaker
9. PAGE Cyclic selection of the display mode(MEASUREMENT->ADJUSTEMENT)
10. Select the set point, select the screen or increase set point value
11. Select the set point, select the screen or decrease set point value
12. ENTER Confirm set point value

LEDs

13. MAINS PRESENT: GREEN LED is on, if mains is present and within limits
14. MAINS FAILURE: RED LED starts flashing when the mains failure occurs and gen-set does not run, goes to steady light when the gen-set starts and goes off when the mains restores.
15. GEN VOLTAGE PRESENT: GREEN LED is on, if gen. voltage is present and within limits
16. GEN-SET FAILURE: RED LED starts flashing when gen-set failure occurs. After FAULT RESET button is pressed, goes to steady light (if an alarm is still active) or is off (if no alarm is active)
17. GCB ON: GREEN LED is on, if GCB is closed. Driven by the feedback signal.
18. MCB ON: GREEN LED is on, if MCB is closed. Driven by the feedback signal.

How to select the gen-set mode ?

Use MODE→ or ←MODE to select requested gen-set operation mode
(OFF – MAN – AUT – TEST)

When to use buttons GCB ON/OFF and MCB ON/OFF?

In AUT mode these buttons are disabled.
In MAN mode are enabled, but before closing of any circuit beaker, voltage must be within limits.
Internal protection against closing of both circuit breakers is implemented.
In TEST mode MCB OFF is enabled, to allow test with load.

Display menus

There are 2 display menus available: MEASUREMENT and ADJUSTMENT
Each menu consists of several screens. Press repeatedly PAGE button to select requested menu.

How to view measured data?

1. Use repeatedly PAGE button to select the MEASUREMENT menu.
2. Use ↑ and ↓ to select the screen with requested data.

How to view and edit set points?

1. Use repeatedly PAGE button to select the ADJUSTMENT menu.
2. Use ↑ or ↓ to select requested set points group.
3. Press ENTER to confirm.
4. Use ↑ or ↓ to select requested set point.
5. Set points marked "*" are password protected.
6. Press ENTER to edit.
7. Use ↑ or ↓ to modify the set point. When ↑ or ↓ is pressed for 2 sec, auto repeat function is activated.
8. Press ENTER to confirm or PAGE to leave without change.
9. Press PAGE to leave selected set points group.

How to change the display contrast ?

Press ENTER and ↑ or ↓ at the same time to adjust the best display contrast
Hint:
Only in MEASUREMENT menu

How to check the serial number and software revision?

Press ENTER and then PAGE. On the display you can see InteliLite INFO screen for 10 seconds.
InteliLite INFO screen contains :

1) *Controller name* (see **Basic setting** group)
2) InteliLite serial number (8 character number)
3) SW version: the first is the firmware version number, the second is configuration table number.
4) Application: AMF25
5) Branch: Standard

Hint:
Only in MEASUREMENT menu.

How to find active alarms ?

Active alarm list is the last screen in the MEASUREMENT menu.

Select MEASUREMENT menu. Press ⇧ You will see the list of all active alarms with the number of alarms at the top-right corner. Three state alarms are introduced:

Versions 1.4 and lower	Version 2.0 and higher	Description
Wrn Water temp	* Wrn Water temp	Active not accepted alarm Active accepted alarm Inactive not accepted alarm Inactive accepted alarm

Press FAULT RESET accepts all alarms. Non-active alarms immediately disappear from the list. Active alarm list appears on the screen when a new alarm comes up and Main MEASUREMENT screen is active.

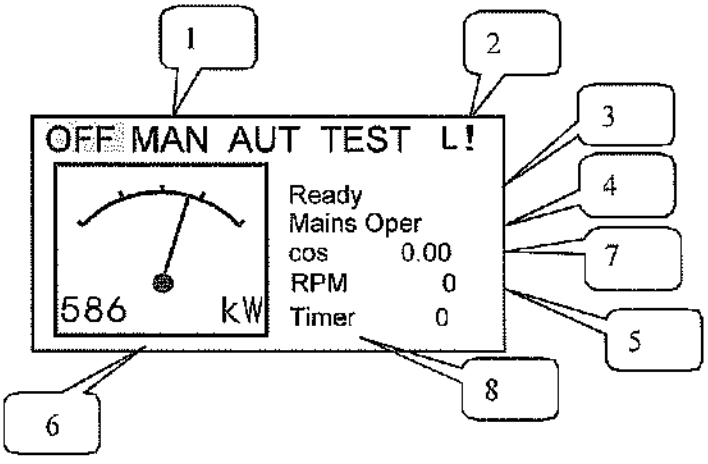
Hint:
Alarm list does not activate when you are reviewing the values or setpoints.

In AMF25 since version 2.0 second alarm list for ECU alarms is added. It is displayed one screen above the standard alarm list on the controller display or under the standard alarm list in Control window of LiteEdit (also since version 2.0).
If an alarm appears in this alarm list, it is signalized in the standard alarm list and by exclamation mark on the main measure screen.
Control from the front panel:

↑↓	One screen up/down
Enter	Cursor move within the ECU alarm list
Enter + Fault reset	ECU fault code reset

MEASUREMENT screens description

Main measure screen



1. Operation mode of the gen-set
2. Indication of active access lock, Remote OFF or Remote TEST **L** and alarm **!**
3. Status of the gen-set
4. Actual condition
5. RPM of the gen-set
6. Active power
7. Power factor
8. Timer - event s counting time (e.g. prestart, cooling, etc.)

Generator screen

Gen freq
Gen V1-2, V2-3, V3-1 ph-ph
Gen V1, V2, V3 ph-N
Gen I1, I2, I3 (triple bargraph)

Mains screen

Mains freq

Mains V1-2, V2-3, V3-1 ph-ph
Mains V1, V2, V3 ph-N (triple bargraph)

IL-CU Analog inputs screen

(depends on configuration)
Oil pressure (single bargraph)
Water temperature (single bargraph)
Fuel level (single bargraph)
Battery voltage (single bargraph)

IL-CU binary inputs

BI1 to BI7

IL-CU binary outputs

BO1 to BO7

*ECU state

ECU YellowLamp
ECU RedLamp
WaitToStart

Hint:
This screen is shown/hidden depending on whether the ECU is configured or not.

*ECUValues

Oil press
Water temp
PercLoadAtCS
Boost pressure
ManifoldTemp
Fuel rate

Hint:
This screen is shown/hidden depending on whether the ECU is configured or not.

Gen-set power screen

Active power (total and per phase)
Power factor (total and per phase)
React power (total and per phase)
Appar power (total and per phase)

Statistic

Run hours
Number of starts

*Kilowatt-hours kWh (total)
*Reactive power hours kVAh (total only)

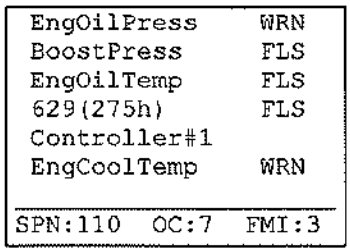
NextServTime

Hint:
Running time is measured in complete minutes, displayed in complete hours. Values are stored in nonvolatile memory.

*ECU AlarmList

Diagnostic messages are read from ECU and displayed in this second alarm list. For Standard J1939 engines SPN (Suspect Parameter Number), FMI (Failure Mode Identifier) and OC (Occurrence Counter) are shown together with verbal description if available.

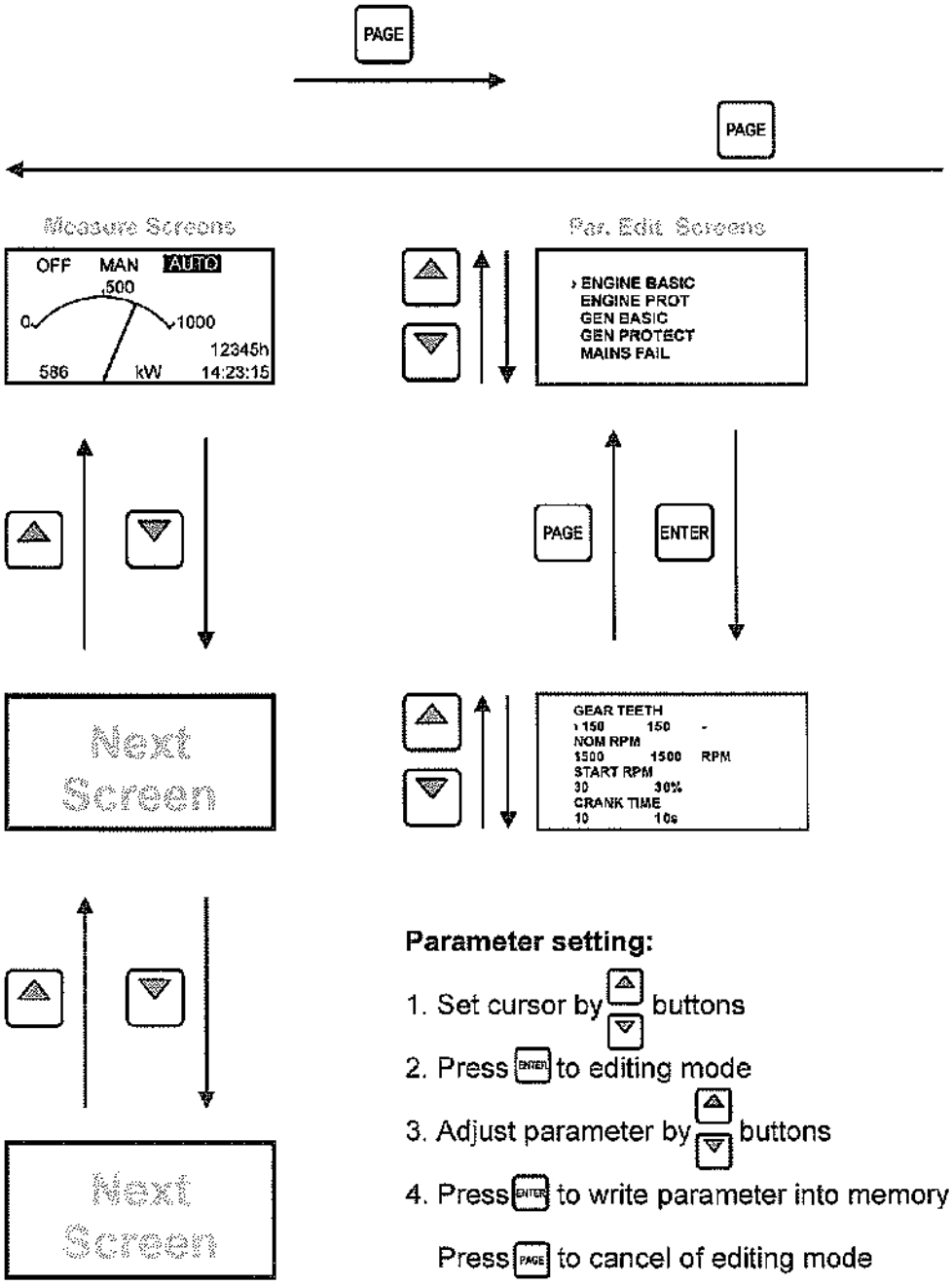
Following image shows displaying of ECU alarms in the second alarm list. The additional information for the row selected by cursor is on the last row (SPN, OC and FMI codes).
If the verbal description of alarm is not available, the SPN (decimal and hexadecimal) is displayed.



Hint:
For FMI = 0 and 1, WRN is displayed. For other FMI codes, FLS is displayed.

Alarm list

Chart guide to menus and pushbutton's operation



Parameter setting:

1. Set cursor by ▲ ▼ buttons
2. Press ENTER to editing mode
3. Adjust parameter by ▲ ▼ buttons
4. Press ENTER to write parameter into memory

   Press PAGE to cancel of editing mode

Function description

OFF mode

No start of the gen-set is possible. Outputs STARTER, GCB CLOSE/OPEN and FUEL SOLENOID are not energized.
No reaction if buttons START, STOP, GCB ON/OFF, MCB ON/OFF are pressed.
When power-cut comes, MCB CLOSE/OPEN opens. After mains returns, MCB CLOSE/OPEN closes with *MCB close del.*

MAN mode

START - starts the gen-set.
GCB ON/OFF

- The controller closes GCB to dead bus.
- The controller opens GCB when closed.
- If the generator voltage is out of the limits, the controller does not to respond to the GCB ON/OFF

MCB ON/OFF

- The controller closes MCB to dead bus.
- The controller opens MCB when closed.

STOP stops the gen-set.

Hint:
The engine can run without load unlimited time.
The controller does not automatically stop the running gen-set in MAN mode.
The controller does not start the gen-set when power cut comes.
!! The controller provides interlock between GCB and MCB, it means it is never possible to close both CB together

Start-stop sequence (simplified)

MODE = MAN (Engine start/stop request is given by pressing buttons START and STOP)
MODE = AUT (Engine start/stop request is evaluated form Mains failure/return)

State	Condition of the transition	Action	Next state
Ready	Start request	PRESTART on *Prestart time* counter started	*Prestart*
	RPM > 2 or Oil pressure detected or Gen voltage > 10V		*Stop (Stop fail)*
	OFF mode selected or Shut down alarm active		*Not Ready*
Not Ready	RPM < 2, Oil pressure not detected, Vgen < 10V, no shutdown alarm active, other than OFF mode selected		*Ready*
Prestart [3]	Prestart time *elapsed*	*STARTER on* *FUEL SOLENOID on*[4] *MaxCrank time* counter started	*Cranking*

State	Condition of the transition	Action	Next state
Cranking [3]	*RPM*> Start RPM	*STARTER off* *PRESTART off*	*Starting*
	D+ input activated or oil pressure detected or Gen voltage > 25% Vgnom	*STARTER off* *PRESTART off*	*Cranking*
	MaxCrank time *elapsed, 1st attempt*	*STARTER off* *FUEL SOLENOID off* *STOP SOLENOID on* *CrankFail pause* timer started	*Crank pause*
	MaxCrank time *elapsed, last attempt*	*STARTER off* *PRESTART off*	*Shutdown (Start fail)*
Crank pause [3]	CrankFail pause *elapsed*	*STARTER on* *FUEL SOLENOID on*[4] *STOP SOLENOID off* *MaxCrank time* counter started	*Cranking*
Starting [3]	*80%* Nominal speed *reached*	*READY TO LOAD on* [1] *Min, MaxStabTime* counter started	*Running*
	RPM = 0 or any other shutdown condition	*FUEL SOLENOID off* *STOP SOLENOID on*	*Shutdown*
	60 sec. *Elapsed*	*FUEL SOLENOID off* *STOP SOLENOID on*	*Shutdown (Start fail)*
Running	Stop request	READY TO LOAD off *Cooling time* timer started	*Cooling*
	RPM = 0 or any other shutdown condition	*READY TO LOAD off* [2] *FUEL SOLENOID off*	*Shutdown*
	GCB CLOSE/OPEN *closed*		*Loaded*
Loaded	GCB CLOSE/OPEN *opened*		*Running*
	RPM = 0 or any other shutdown condition	*FUEL SOLENOID off* *STOP SOLENOID on* *READY TO LOAD off*	*Shutdown*
Cooling	Cooling time *elapsed*	*FUEL SOLENOID off* *STOP SOLENOID on*	*Stop*
	RPM = 0 or any other shutdown condition	*FUEL SOLENOID off* *STOP SOLENOID on*	*Shutdown*
	Start request	*READY TO LOAD on* [1]	*Running*
Stop	*RPM = 0,* Oil pressure not detected, Vgen < 10V		*Ready*
	60 sec. *Elapsed*		*Stop (Stop fail)*

[1] if all generator parameters OK and MinStab Time elapsed, indicates that GCB is possible to close. In AUT mode closes in this moment GCB automatically.

[2] If GCB output used GCB opens automatically

[3] The start-up sequence can be interrupted in any time by comming stop request

[4] Fuel solenoid is switched on with time advance of 1s fixed before starter motor is switched on.

Hint:
Threshold level for D+ input is 80% supply voltage, activation delay is 1s (to override short firings during cranking – for example in cold conditions).

AUT mode

The controller does not respond to buttons START, STOP, MCB ON/OFF, GCB ON/OFF. Engine start/stop request is evaluated form Mains failure/return.

AMF sequence (simplified)

State	Condition of the transition	Action	Next state
Mains operation	Mains failed[1] or MCB feedback dropout *MCB openning* = MAINSFAIL	MCB CLOSE/OPEN off *EmergStart del* timer started	Mains failure
	Mains failed[1] or MCB feedback dropout *MCB openning* = GEN START	*EmergStart del* timer started	Mains failure
Mains failure	Mains voltage and frequency OK *MCB openning* = MAINSFAIL	After elapsing *MCB close del* MCB CLOSE/OPEN on	Mains operation
	Mains voltage and frequency OK *MCB openning* = GEN START	None	Mains operation
	EmergStart del elapsed *MCB openning* = MAINSFAIL	Engine start sequence performed, then GCB CLOSE/OPEN on [2]	Island operation
	EmergStart del elapsed *MCB openning* = GEN START	Engine start sequence performed, then MCB CLOSE/OPEN off, time delay *FwRet break* performed and GCB CLOSE/OPEN on [2]	Island operation
Island operation	Mains voltage and frequency OK	*Mains ret del* timer started	Mains return
Mains return	Mains failed		Island operation
	Mains ret del elapsed	GCB CLOSE/OPEN off, then after *Return break* MCB CLOSE/OPEN on and then engine stop sequence performed [3]	Mains operation

[1] **Mains failed** means mains over/under -voltage, over/under -frequency, voltage assymetry (preset delay must elapse)

[2] If during start-up sequence mains returns, then MCB is reclosed with delay *MCB close del* (if opened, depending on *MCB opening* setpoint) and start-up sequence is interrupted.

[3] If mains fails during stop procedure (cooling) again, stop sequence is interrupted, MCB opened and GCB reclosedclosed with delay *Return break*.

See also chapter **Circuit breakers timing.**

TEST mode

The setpoint *Ret from test* influences the behavior of TEST mode.
Caution: The genset starts automatically and is always running in TEST mode!

The setpoint *Ret from test* = MANUAL

While TEST mode is selected, gen-set starts and is running unloaded.
To load the gen-set

a) Power cut comes or
b) MCB ON/OFF is pressed

When power cut: MCB is opened, after *Return break* elapses, GCB is closed.
When the mains recovers gen-set stays supplying island load. To transfer the load back to the healthy mains, switch the controller to AUT mode.

Hint:
The controller does not respond to GCB ON/OFF , STOP, START
The load is automatically transferred back to the mains when any genset shut down protection activates.

Test on load

When binary input TestOnLoad is closed, the controller automatically (if TEST mode selected) transfers load from the mains to the genset. Setpoint AutoMainsFail: Ret from test must be set to MANUAL.

The setpoint *Ret from test* = AUTO

While TEST mode is selected, gen-set is running unloaded.
When power cut comes the controller opens MCB.
After *Return break* elapses, GCB is closed.
When the mains recovers:

a) After *MainsReturn del* the controller opens the GCB
b) After *Return break* delay MCB is closed.
c) The engine stays running

To stop the gen-set select other mode than TEST

Hint:
The controller does not respond to GCB ON/OFF , MCB ON/OFF , STOP, START

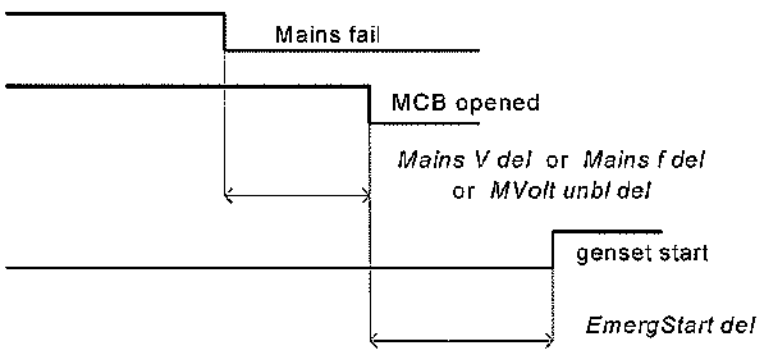
Circuit breakers timing

Relation between Mains fail and MCB and start of genset

MCB open = MAINSFAIL:

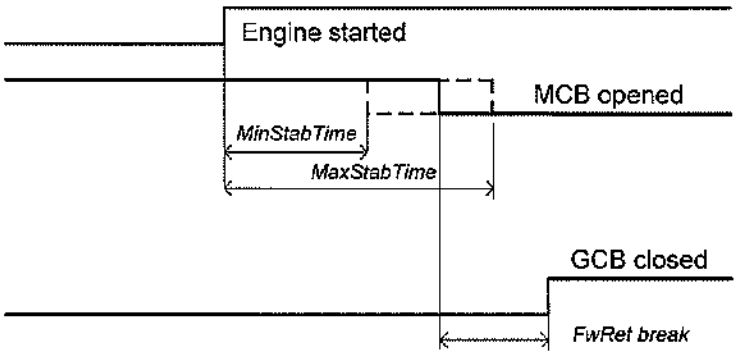
Mains fail is detected as Mains <V, Mains >V, MVolt unbl, Mains <f, Mains >f. After detection MCB is opened.

Hint:
When MCB feedback drop-out and measured mains electrical limits (voltage, frequency) are still in limits, the controller switches MCB ON again.



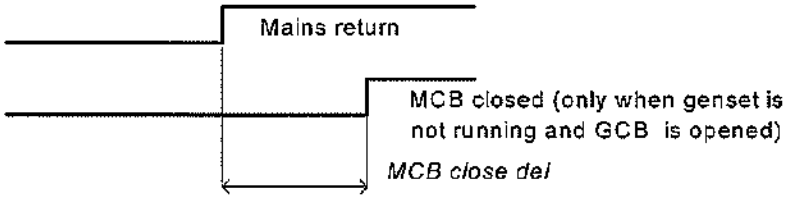
MCB open = GEN START:

The MCB is not opened till the engine starts and gets ready to take the load.



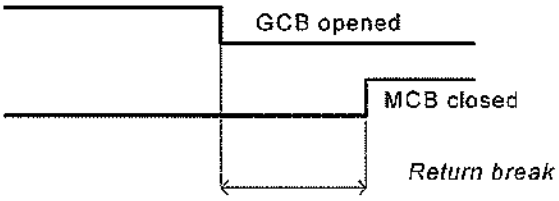
Relation between Mains return and MCB

OFF mode, GCB and MCB are opened



Relation between GCB and MCB

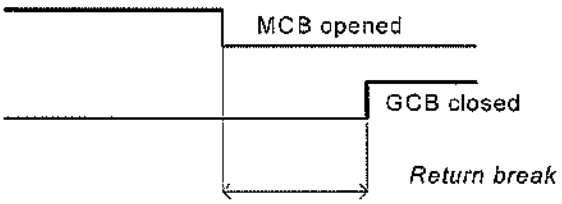
Conditions: AUT mode, Mains =off, MCB = opened, GCB = closed, genset loaded.
Mains returns: GCB opens (according 3., *Mains ret del*), MCB closes (*Return break*)



Relation between GCB and MCB (Test mode)

Situation 1: Mains =OK, MCB = closed, GCB = opened, RPM=0.
Change mode to TEST: genset starts, GCB = opened.
Mains cut: MCB opens (according 1.) , GCB closes (*Return break*)

Situation 2: *Ret from test*=MANUAL, Mains =OK, MCB is closed, genset is running.
Press MCB on/off -> MCB opens, GCB closes (*Return break*), genset is running loaded.



Alarm management

Following alarms are available:
- Sensor fail
- Warning
- Shut down
- Mains failure

Sensor fail (FLS)

Sensor fail is detected when measured value is 6% out of selected sensor characteristic. Sensor fail is indicated by ##### symbol instead measured value.

Warning (WRN)

When warning comes up, only alarm outputs and common warning output are closed.

Possible warnings:

See List of possible events

Shut down (SD)

When the shut-down alarm comes up, InteliLite opens outputs GCB CLOSE/OPEN, FUEL SOLENOID, STARTER and PRESTART to stop the engine immediately. Alarm outputs and common shutdown output are closed. Active or not reset protection disables start.

Possible shut-down alarms:

See List of possible events

Mains failure (MF)

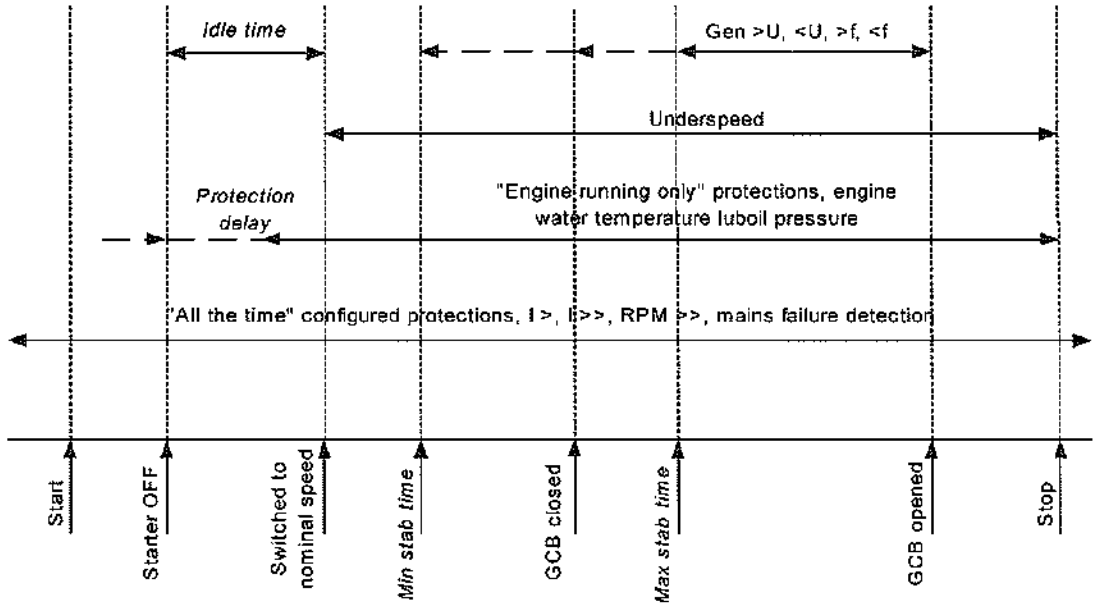
Mains failure detection depends on **Auto mains failure** setpoints (levels and delays) adjusting. When the mains failure comes up, mains circuit breaker is opened.

Possible mains failure reasons:

See List of possible events

Hint:
Mains failure is not written to alarm list!

Alarm time chart



Voltage phase sequence detection

InteliLite controller detects phase sequence on both generator and mains/bus voltage terminals. This protections are important after controller installation to avoid wrong voltage phases phase connection. Following alarms can be detected:

Wrong phase sequence

There is fix defined phase sequence in InteliLite controller L1, L2, L3. When the phases are connected in different order (e.g. L1,L3,L2 or L2,L1,L3) following alarms are detected:

G ph opposed = wrong generator phase sequence
M ph opposed = wrong mains phase sequence
B ph opposed = wrong bus phase sequence

Inverted phase polarity

inverted phase polarity can be detected due to wrong connection of separation transformers between controller and generator / mains / bus voltage. Phase sequence is OK but some phase(s) is connected in opposite way (180° shift).
Following alarms can be detected:

GEN L1 neg = generator phase L1 is inverted
GEN L2 neg = generator phase L2 is inverted
GEN L3 neg = generator phase L3 is inverted
M L1 neg = mains phase L1 is inverted
M L2 neg = mains phase L2 is inverted
M L3 neg = mains phase L3 is inverted

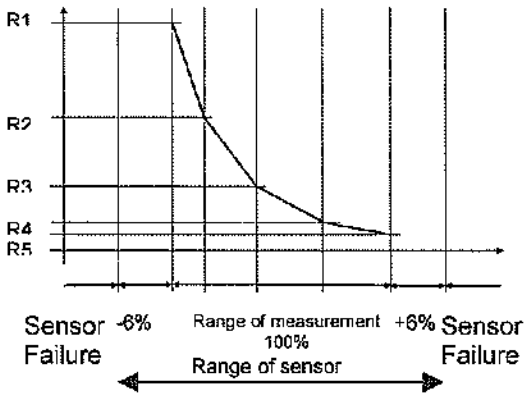
Wrong phase sequence and inverted polarity

It is combination of both previous alarms

G ph+L1 neg = wrong generator phase sequence and phase L1 is inverted
G ph+L2 neg = wrong generator phase sequence and phase L2 is inverted
G ph+L3 neg = wrong generator phase sequence and phase L3 is inverted
M ph+L1 neg = wrong mains phase sequence and phase L1 is inverted
M ph+L2 neg = wrong mains phase sequence and phase L2 is inverted
M ph+L3 neg = wrong mains phase sequence and phase L3 is inverted

Sensor fail detection

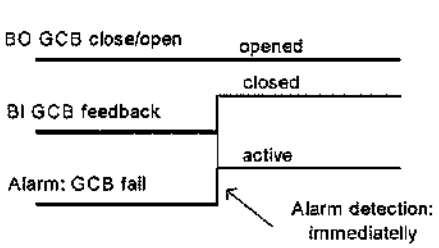
Sensor fail FIs is detected when measured value is 6,2 percent out of range. Controller screen displays in this case string #### instead measured value.

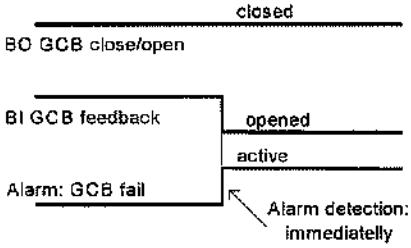


GCB, MCB fail detection

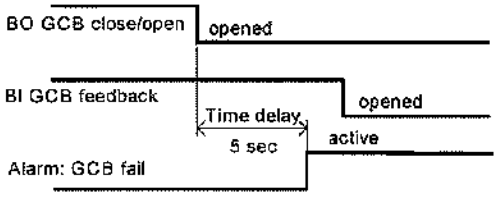
MCB or GCB fail detection is based on binary output CB close/open comparing with binary input CB feedback.
There are three different time delays for CB fail detection – see following diagrams.

When is BO GCB close/open (MCB close/open) in steady state and GCB feedback (MCB feedback) is changed the GCB fail is detected immediately (no delay).

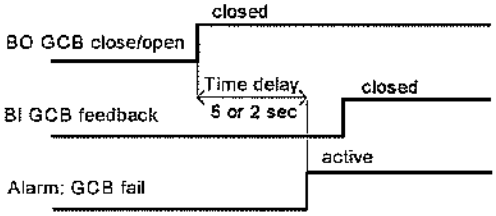




When BO GCB close/open (MCB close/open) opens there is 5 sec delay for GCB fail (MCB fail) detection.



When BO GCB close/open (MCB close/open) closes, there is 5sec delay for GCB fail (MCB fail) detection:



Gen-set operation states

Engine state machine

Init	Autotest during controller power on
Not ready	Genset is not ready to start
Prestart	Prestart sequence in process, Prestart output is closed
Cranking	Engine is cranking
Pause	Pause between start attempts
Starting	Starting speed is reached and the *Idle timer* is running
Running	Genset is running at nominal speed
Loaded	Genset is running at nominal speed and GCB OPEN/CLOSE is closed
Stop	Stop
Shutdown	Shut-down alarm activated
Ready	Genset is ready to run
Cooling	Genset is cooling before stop (at idle speed)

Electric state machine

MainsOper	Mains is present
MainsFlt	Mains cut off – immediate state
ValidFlt	Mains cut off – takes EmergStart del
IslOper	Island operation
MainsRet	Mains recover
Brks Off	GCB, MCB opened

List of possible alarms

Events specification	Protection type	Information on binary output available (See list of Binary outputs)	Description
Oil Press Wrn	WRN	YES	Oil pressure is smaller than *Wrn Oil press* setpoint.
Oil Press Sd	SD	NO	Oil pressure is smaller than *Sd Oil press* setpoint.
Water Temp Wrn	WRN	YES	Water temperature is greater than *Wrn Water temp* setpoint.
Water Temp Sd	SD	NO	Water temperature is greater than *Sd Water temp* setpoint.
Fuel Level Wrn	WRN	YES	Fuel level is smaller than *Wrn Fuel Level* setpoint.
Fuel Level Sd	SD	NO	Fuel level is smaller than *Sd Fuel Level* setpoint.
Analog inp IOM/PTM - Wrn	WRN	YES	Warning alarm configurable on the input of IG-IOM/IGS-PTM.
Analog inp IOM/PTM - Sd	SD	YES	Shutdown alarm configurable on the input of IG-IOM/IGS-PTM.
Binary input	Configurable	YES	Configurable Warning/Shutdown alarms on the inputs of IL-CU.
Battery voltage <, >	WRN	YES	Battery voltage is out of limits given by *Batt overvolt* and *Batt undervolt* setpoints.

Events specification	Protection type	Information on binary output available (See list of Binary outputs)	Description
Battery flat	SD	YES	If the controller switches off during starting sequence due to bad battery condition it doesn't try to start again and activates this protection.
Start failed	SD	YES	Gen-set start failed.
ParamFail	NONE	NO	Wrong checksum of parameters. Happends typically after downloading new firmware or changing of the parameter. The controller stays in INIT mode. Check all parameters, write at least one new parameter.
Vgen <, >	SD	YES	The generator voltage is out of limits given by *Gen <V* and *Gen >V* setpoints.
Vgen unbl	SD	NO	The generator voltage is unbalanced more than the value of *Volt unbal* setpoint.
Fgen <,>	SD	YES	The generator frequency is out of limits given by *Gen >f* and *Gen <f* setpoints.
Igen unbl	SD	NO	The generator current is unbalanced.
Overload	SD	YES	The load is greater than the value given by *Overload* setpoint.
Overspeed	SD	YES	The protection comes active if the speed is greater than *Overspeed* setpoint.
Underspeed	SD	YES	During starting of the engine when the RPM reache the value of *Starting RPM* setpoint the starter is switched off and the speed of the engine can drop under *Start RPM* again. Then the Underspeed protection becomes active. Protection evaluation starts 5 seconds after reaching *StartingRPM*.
EmergencyStop	SD	NO	If the input *Emergency stop* is opened shutdown is immediately activated.
GCB fail	SD	NO	Failure of generator circuit breaker.
MCB fail	MF	NO	Failure of mains circuit breaker.
PickupFault	SD	NO	Failure of magnetic pick-up sensor for speed measurement.
Stop fail	SD	YES	Gen-set stop failed.
WrnServiceTime	WRN	NO	The period for servicing is set by the *NextServTime* setpoint. The protection comes active if the running hours of the engine reach this value.
ChrgAlternFail	WRN	YES	Failure of alternator for charging the battery.
SprinklActive	WRN	NO	The protection is active if the output *Sprinkler* is closed.
*Wrn RA15 fail	WRN	NO	Warning alarm in case of lost connection to IGL-RA15 module.
*Sd IOM fail	SD	NO	Shutdown alarm in case of lost connection to IG-IOM/IGS-PTM module.
Wrn ECU Alarm	WRN	NO	ECU alarm list is not empty

Remote control and data logging

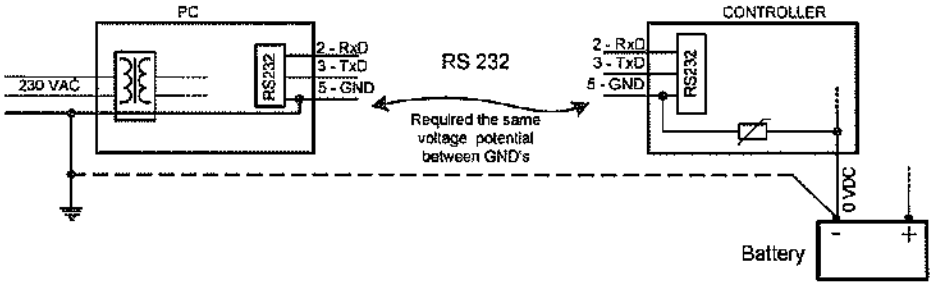
Direct connection to the PC

InteliLite can be connected directly with PC via RS232 interface.

- iL AMF25 is equipped built-in RS232 interface
- iL AMF20 needs external RS232 interface AT-LINK-CONV (ordered separately)

Use the standard serial cable to connect PC with InteliLite.

Hint:
Make sure the grounding system on controller and PC – COM port (negative of the PC DC supply) are identical – before the first direct connection. There must not be any voltage between these two points otherwise the internal resistor in controller burns out. The simple solution is to assure, that the PC supply 240/20V is ground free (GND terminal is not connected).



PC software - LiteEdit

On the PC (for direct or modem connection) has to be installed the ComAp's software package LiteEdit. (based on Windows 95 or newer platform)
LiteEdit enables:
read the quantities
adjust all set points
control the engine
configure the controller
select software configuration
modify alarm inputs and outputs
modify password, commands protections
direct or *modem communication

Modbus protocol

The selection of the function of iL serial port is done via the setpoint *RS232 mode* in *Basic settings*

- 9600 bps, 8 data bits, 1 stop bit, no parity
- Transfer mode RTU
- Function 3 (Read Multiply Registers)
- Function 6 (Write Single Register)
- Function 16 (Write Multiply Registers)
- The response to an incoming message is sent with minimum 4.096 ms delay after message reception

The complete description of Modbus communication protocol can be found in *Modbus Protocol Reference Guide PI-MBUS-300* and *Open Modbus Specification Release 1.0.* Both documents are available from web site at http://www.modicon.com/openmbus/ .

Communication object vs. Register
All the data intended for communication has its representation as communication objects in the controller. The communication object is represented by the n-byte array in the controller memory and identified by the unique 16-bit communication object number. The register, according to Modbus communication protocol, represents a two-byte data and in communication functions is referenced by 16-bit register address. Further in the description of communication functions **the communication object number will always be used as a register address** and length of the communication object will be expressed by number of registers. **Just one communication object can be read or written by one communication function.**
Hint:
To obtain communication object numbers it is possible to download the Actual IL controller description on-line from controller or from (all) archive and use "export data" function from LiteEdit software.

Communication object list (exported from default archive)

Setpoints:

Name	Firmware ver.	Application	Date	App. ver.	Ser. num.	Filename		
InteliLite	IL-2.4 R:19.04.2005	AMF25	19.4.2005	2,4	0200FFFF			
Group	Name	Value	Dimension	Password	Com. obj.	Low limit	High limit	Data type
Basic settings	Gen-set name	InteliLite		No	8637			Short string
Basic settings	Nomin power	200	kW	No	8276	1	4000	Unsigned 16
Basic settings	Nomin current	350	A	No	8275	1	5000	Unsigned 16
Basic settings	CT ratio	2000	/5A	No	8274	1	5000	Unsigned 16
Basic settings	PT ratio	1,0	/1	No	9579	0,1	500,0	Unsigned 16
Basic settings	Vm PT ratio	1,0	/1	No	9580	0,1	500,0	Unsigned 16
Basic settings	Nomin voltage	231	V	No	8277	100	22000	Unsigned 16
Basic settings	Nominal freq	50	Hz	No	8278	45	65	Unsigned 16
Basic settings	Gear teeth	120		No	8252	0	500	Unsigned 16
Basic settings	Nominal RPM	1500	RPM	No	8253	100	4000	Unsigned 16
Basic settings	FltResGoToMAN	DISABLED		No	9983			String list
Basic settings	DispBaklightTO	0	min	No	10121	0	60	Unsigned 8
Basic settings	ControllerMode	OFF		No	8315			String list
Basic settings	RS232 mode	STANDARD		Yes	24522			String list
Basic settings	NumberRings AA	3		Yes	24512	1	30	Unsigned 8
Engine params	Starting RPM	25	%	No	8254	5	50	Unsigned 8
Engine params	Starting POil	4,5	Bar	No	9681	-10,0	1000,0	Integer 16
Engine params	Prestart time	2	s	No	8394	0	600	Unsigned 16

Engine params	MaxCrank time	5	s	No	8256	1	60	Unsigned 8
Engine params	CrnkFail pause	8	s	No	8257	5	60	Unsigned 8
Engine params	Crank attempts	3		No	8255	1	10	Unsigned 8
Engine params	Idle time	12	s	No	9097	0	600	Unsigned 16
Engine params	Min stab time	2	s	No	8259	0	300	Unsigned 16
Engine params	Max stab time	10	s	No	8313	0	300	Unsigned 16
Engine params	Stop time	60	s	No	9815	0	600	Unsigned 16
Engine params	Cooling time	30	s	No	8258	0	3600	Unsigned 16
Engine params	AfterCool time	180	s	No	8662	0	3600	Unsigned 16
Engine params	Cooling speed	NOMINAL		No	10046			String list
Engine params	Fuel solenoid	DIESEL		No	9100			String list
Engine params	D+ function	DISABLED		No	9683			String list
Engine params	ECU FreqSelect	PRIMARY		No	10266			String list
Engine params	ECU SpeedAdj	50	%	No	9948	0	100	Unsigned 16
Engine protect	Eng prot del	5	s	No	8262	0	300	Unsigned 16
Engine protect	Horn timeout	10	s	No	8264	0	600	Unsigned 16
Engine protect	Overspeed	115	%	No	8263	50	150	Unsigned 16
Engine protect	AnlInp1 level1	2,0	Bar	No	8369	-10,0	1000,0	Integer 16
Engine protect	AnlInp1 level2	1,0	Bar	No	8370	-10,0	1000,0	Integer 16
Engine protect	AnlInp1 del	3	s	No	8365	0	180	Unsigned 16
Engine protect	AnlInp2 level1	80	°C	No	8375	-100	10000	Integer 16
Engine protect	AnlInp2 level2	90	°C	No	8376	-100	10000	Integer 16
Engine protect	AnlInp2 del	5	s	No	8371	0	180	Unsigned 16
Engine protect	AnlInp3 level1	20	%	No	8381	-100	10000	Integer 16
Engine protect	AnlInp3 level2	10	%	No	8382	-100	10000	Integer 16
Engine protect	AnlInp3 del	10	s	No	8377	0	180	Unsigned 16
Engine protect	Batt overvolt	36,0	V	No	9587	18,0	40,0	Integer 16
Engine protect	Batt undervolt	18,0	V	No	8387	8,0	36,0	Integer 16
Engine protect	Batt volt del	5	s	No	8383	0	600	Unsigned 16
Engine protect	NextServTime	65534	h	No	9648	0	65535	Unsigned 16
Gener protect	Overload	120	%	No	8280	0	200	Unsigned 16
Gener protect	Overload del	5,0	s	No	8281	0,0	60,0	Unsigned 16
Gener protect	Ishort	250	%	No	8282	100	500	Unsigned 16

Gener protect	2Inom del	4,0	s	No	8283	0,1	20,0	Unsigned 16
Gener protect	Curr unbal	50	%	No	8284	1	200	Unsigned 16
Gener protect	Curr unbal del	5,0	s	No	8285	0,0	60,0	Unsigned 16
Gener protect	Gen >V Sd	110	%	No	8291	70	200	Unsigned 16
Gener protect	Gen <V Sd	70	%	No	8293	0	110	Unsigned 16
Gener protect	Gen V del	3,0	s	No	8292	0,0	60,0	Unsigned 16
Gener protect	Volt unbal	10	%	No	8288	1	100	Unsigned 16
Gener protect	Volt unbal del	3,0	s	No	8289	0,0	60,0	Unsigned 16
Gener protect	Gen >f	110,0	%	No	8296	85,0	200,0	Unsigned 16
Gener protect	Gen <f	85,0	%	No	8298	0,0	110,0	Unsigned 16
Gener protect	Gen f del	3,0	s	No	8297	0,0	60,0	Unsigned 16
AutoMains Fail	Ret fromIsland	AUTO		No	9590			String list
AutoMains Fail	EmergStart del	5	s	No	8301	0	600	Unsigned 16
AutoMains Fail	Mains ret del	20	s	No	8302	1	3600	Unsigned 16
AutoMains Fail	FwRet break	1,0	s	No	8303	0,0	600,0	Unsigned 16
AutoMains Fail	MCB close del	1,0	s	No	8389	0,0	60,0	Unsigned 16
AutoMains Fail	Mains >V	110	%	No	8305	60	200	Unsigned 16
AutoMains Fail	Mains <V	60	%	No	8307	0	110	Unsigned 16
AutoMains Fail	Mains V del	2,0	s	No	8306	0,0	60,0	Unsigned 16
AutoMains Fail	MVolt unbal	10	%	No	8446	1	150	Unsigned 16
AutoMains Fail	MVoltUnbal del	2,0	s	No	8447	0,0	60,0	Unsigned 16
AutoMains Fail	Mains >f	102,0	%	No	8310	98,0	200,0	Unsigned 16
AutoMains Fail	Mains <f	98,0	%	No	8312	0,0	102,0	Unsigned 16
AutoMains Fail	Mains f del	0,5	s	No	8311	0,0	60,0	Unsigned 16
AutoMains Fail	MCB Logic	CLOSE-OFF		No	8444			String list
AutoMains Fail	Ret from test	MANUAL		No	8618			String list
AutoMains Fail	MCB opened	GENRUN		No	9850			String list
Sensors spec	Calibr AI 1	0,0	Bar	No	8431	-100,0	100,0	Integer 16
Sensors spec	Calibr AI 2	0	°C	No	8407	-1000	1000	Integer 16
Sensors spec	Calibr AI 3	0	%	No	8467	-1000	1000	Integer 16

IOM/PTM module	AnOut-kW/20mA	200		No	9019	1	32000	Integer 16
IOM/PTM module	AnInIOM1 lev1	0	U4	No	8762	-100	10000	Integer 16
IOM/PTM module	AnInIOM1 lev2	0	U4	No	8766	-100	10000	Integer 16
IOM/PTM module	AnInIOM1 del	0	s	No	8770	0	180	Unsigned 16
IOM/PTM module	AnInIOM2 lev1	0	U5	No	8763	-100	10000	Integer 16
IOM/PTM module	AnInIOM2 lev2	0	U5	No	8767	-100	10000	Integer 16
IOM/PTM module	AnInIOM2 del	0	s	No	8771	0	180	Unsigned 16
IOM/PTM module	AnInIOM3 lev1	0	U6	No	8764	-100	10000	Integer 16
IOM/PTM module	AnInIOM3 lev2	0	U6	No	8768	-100	10000	Integer 16
IOM/PTM module	AnInIOM3 del	0	s	No	8772	0	180	Unsigned 16
IOM/PTM module	AnInIOM4 lev1	0	U7	No	8765	-100	10000	Integer 16
IOM/PTM module	AnInIOM4 lev2	0	U7	No	8769	-100	10000	Integer 16
IOM/PTM module	AnInIOM4 del	0	s	No	8773	0	180	Unsigned 16
IOM/PTM module	CalibrAInIOM 1	0	U4	No	8793	-1000	1000	Integer 16
IOM/PTM module	CalibrAInIOM 2	0	U5	No	8794	-1000	1000	Integer 16
IOM/PTM module	CalibrAInIOM 3	0	U6	No	8795	-1000	1000	Integer 16
IOM/PTM module	CalibrAInIOM 4	0	U7	No	8796	-1000	1000	Integer 16

Values:

Name	Firmware ver.	Application	Date	App. ver.	Ser. num.
InteliLite	IL-2.4 R:19.04.2005	AMF25	19.4.2005	2.4	0200FFFF
Group	Name	Value	Dimension	Com. obj.	Data type
Engine params	Engine Speed	0	RPM	8209	Unsigned 16
Engine params	ECU State	000		10034	Binary 8
Analog	Batt volt	27,0	V	8213	Integer 16
Analog	Oil press	3,5	Bar	8227	Integer 16
Analog	Water temp	15	°C	8228	Integer 16
Analog	Fuel level	#####	%	8229	Integer 16
Generator	Act power	0	kW	8202	Integer 16
Generator	Act pwr L1	0	kW	8524	Integer 16
Generator	Act pwr L2	0	kW	8525	Integer 16
Generator	Act pwr L3	0	kW	8526	Integer 16

Generator	React pwr kVAr	0		8203	Integer 16
Generator	React pwr L1	0		8527	Integer 16
Generator	React pwr L2	0		8528	Integer 16
Generator	React pwr L3	0		8529	Integer 16
Generator	Appar pwr	0	kVA	8565	Integer 16
Generator	Appar pwr L1	0	kVA	8530	Integer 16
Generator	Appar pwr L2	0	kVA	8531	Integer 16
Generator	Appar pwr L3	0	kVA	8532	Integer 16
Generator	Pwr factor	0,00		8204	Integer 8
Generator	Pwr factor L1	0,00		8533	Integer 8
Generator	Pwr factor L2	0,00		8534	Integer 8
Generator	Pwr factor L3	0,00		8535	Integer 8
Generator	Load char			8395	Char
Generator	Load char 1			8626	Char
Generator	Load char 2			8627	Char
Generator	Load char 3			8628	Char
Generator	Gen freq	0,0	Hz	8210	Unsigned 16
Generator	Gen V L1-N	0	V	8192	Unsigned 16
Generator	Gen V L2-N	0	V	8193	Unsigned 16
Generator	Gen V L3-N	0	V	8194	Unsigned 16
Generator	Gen V L1-L2	0	V	9628	Unsigned 16
Generator	Gen V L2-L3	0	V	9629	Unsigned 16
Generator	Gen V L3-L1	0	V	9630	Unsigned 16
Generator	Gen curr L1	0	A	8198	Unsigned 16
Generator	Gen curr L2	0	A	8199	Unsigned 16
Generator	Gen curr L3	0	A	8200	Unsigned 16
Mains	Mains freq	0,0	Hz	8211	Unsigned 16
Mains	Mns V L1-N	0	V	8195	Unsigned 16
Mains	Mns V L2-N	0	V	8196	Unsigned 16
Mains	Mns V L3-N	0	V	8197	Unsigned 16
Mains	Mns V L1-L2	0	V	9631	Unsigned 16
Mains	Mns V L2-L3	0	V	9632	Unsigned 16
Mains	Mns V L3-L1	0	V	9633	Unsigned 16
Binary I/O	BInpIL	0110000		8235	Binary 16
Binary I/O	BOutIL	0001001		8239	Binary 16
Statistics	kWhours	0		8205	Integer 32
Statistics	kVArhours	0		8539	Integer 32

Statistics	NumStarts	0		8207	Unsigned 16
Statistics	RunHours	0	h	8206	Integer 32
Statistics	NextServTime	65534	h	9648	Unsigned 16
IL info	TimerText	Stop		8954	Unsigned 16
IL info	TimerValue	0	s	8955	Unsigned 16
IL info	SW version	2,4		8393	Unsigned 8
IL info	SW branch	1		8707	Unsigned 8
IL info	Application	6		8480	Unsigned 8
IL info	ControllerMode	0		9651	Unsigned 8
IL info	DiagData	0		10050	Unsigned 32
IL info	PasswordDecode	2481875985		9090	Unsigned 32
RA15 module	BOutRA15	000010000000000		9849	Binary 16
IOM/PTM module	AnInIOM 1	0	U4	8978	Integer 16
IOM/PTM module	AnInIOM 2	0	U5	8759	Integer 16
IOM/PTM module	AnInIOM 3	0	U6	8760	Integer 16
IOM/PTM module	AnInIOM 4	0	U7	8761	Integer 16
IOM/PTM module	BInpIOM	00000000		8602	Binary 16
IOM/PTM module	BOutIOM	00000000		8604	Binary 16
ECU	Fuel rate	#####	L/h	9860	Unsigned 16
ECU	Water temp	#####	°C	9855	Integer 16
ECU	ManifoldTemp	#####	°C	9878	Integer 16
ECU	Oil press	#####	Bar	10354	Integer 16
ECU	Boost pressure	0,0	Bar	9877	Unsigned 8
ECU	PercLoadAtCS	0	%	9925	Unsigned 8

[1] In case of software malfunction DiagData shows the value that enables to locate possible bug in software. Include this number when reporting a software problem.

Remote communication

*Recommended ISDN modem

- Askey TAS-200E
- ASUScom TA-220ST

*Recommended GSM modem

- Wavecom M1200 (previously WMOD2; baud rate to 9600 bps)
- Siemens M20
- Siemens TC35
- FALCOM A2D

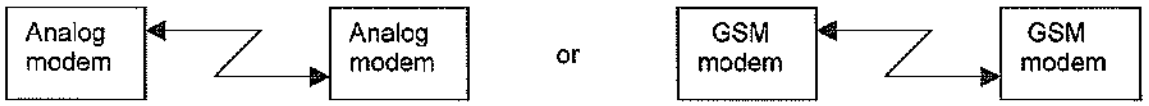
GSM Modem setup

Prior to start work with GSM modem run following program for GSM proper setup.
Program writes all the necessary AT commands to configure the GSM modem properly for use with IL-CU.
This program runs independent on LiteEdit:

- Start MS Windows-Start-Program files - LiteEdit –Gm_setup.exe.
- Select COM port
- Select iG-CU (=IS-CU) or iG-MU unit
- Press Setup button
- Follow commands in GSM Modem Setup window

Typical real baud rate for GSM data communication is 80 to 90 Bps.

Hint:
It is strongly recommended to use the same type of modem on the both sides (IL and PC) of connection.



*Mobile SIM card setting

Adjust SIM card in GSM modem following way:
enable data connection (when required)
no PIN code

Technical data

Power supply

Voltage supply	8-36V DC
Consumption	0,5-0,1A depend on supply voltage
Allowed supply voltage drop-out:	50ms from min. 10V, return to min. 8V (valid for InteliLite of hardware version 3.2 and higher)
Battery voltage measurement tolerance	2 % at 24V

Hint:
For the supply voltage less than 7V the backlight of the display is switched off.

Operating conditions

Operating temperature IL-CU	-20..+70°C
Operating temperature IL-CU-LT#	-30..+70°C
Storage temperature	-30..+80°C
Protection front panel	IP65
Humidity	95% without condensation
Standard conformity	
Low Voltage Directive	EN 61010-1:95 +A1:97
Electromagnetic Compatibility	EN 50081-1:94, EN 50081-2:96 EN 50082-1:99, EN 50082-2:97
Vibration	5 - 25 Hz, ±1,6mm 25 - 100 Hz, a = 4 g
Shocks	a = 200 m/s^2

#Low Temperature modification

LCD display limits controller operating temperature range to –20 °C - + 70 °C even if the other electronic components work in wider temperature range.

Internal preheating foil is mounted in InteliLite LT to extend display operational temperature range.

Preheating starts at temperature below 5 °C and preheating power depends on temperature and power supply voltage.

Technical data

	IL-CU Standard	Order code:IL-CU-LT
Operating temperature	-20 °C..+70°C	-30 °C..+70°C
Storage temperature	-30 °C..+80°C	-30 °C..+80°C

Preheating foil increases controller current consumption

Controller consumption at	No preheating	Preheating at ambient temperature		
		0 °C	-15 °C	-30 °C
12VDC	360 mA	+50 mA	+180 mA	+300 mA
24VDC	230 mA	+25 mA	+85 mA	+150 mA
36VDC	100 mA	+20 mA	+65 mA	+100 mA

InteliLite LT works immediately after switch on at -30 °C and display becomes visible after a few minutes.

Short-term voltage drops (e.g. during the engine cranking) do not affect the operation at all.

Dimensions and weight

Dimensions	180x120x55mm
Weight	800g

Mains and generator

Nominal frequency	50-60Hz
Frequency measurement tolerance	0,1Hz

Current inputs

Nominal input current (from CT)	5 A
Load (CT output impedance)	< 0,1 Ω
CT input burden	< 0,2 VA per phase (In=5A)
Max. measured current from CT	10 A
Current measurement tolerance	2% from the Nominal current
Max. peak current from CT	150 A / 1s
Max. continuous current	12 A

Voltage inputs

Measuring voltage	231VAC phase to neutral 400VAC phase to phase
Maximal measured voltage	290VAC phase to neutral
Input resistance	0,6 MΩ phase to phase 0,3 MΩ phase to neutral
Voltage measurement tolerance	2 % from the Nominal voltage
Overvoltage class	III (EN61010)

Binary inputs and outputs

Binary inputs

Number of inputs	7
Input resistance	4,7 kΩ
Input range	0-36 VDC
Switching voltage level for close contact indication	0-2 V
Max voltage level for open contact indication	8-36 V

Contact relay outputs

Number of outputs	2
Electric life cycle	min 100.000 switching cycles
Maximum current	12 A DC resistive load 4 A DC inductive load
Maximum switching voltage	36 VDC
Minimum load	24 V / 0,1 A
Insulation voltage	500 Veff

Binary open collector outputs

Number of outputs	5
Maximum current	0,5 A
Maximum switching voltage	36 VDC

Analog inputs

Not electrically separated	
Resolution	10 bits
Sensor resistance range	0 Ω-2,4 kΩ
Resistance measurement tolerance	4 % ± 2 Ω out of measured value

Speed pick-up input

Type of sensor	magnetic pick-up (connection by shielded cable is recommended)
Minimum input voltage	2 Vpk-pk (from 4 Hz to 4 kHz)
Maximum input voltage	50 Veff
Minimum measured frequency	4 Hz
Maximum measured frequency	10 kHz (min. input voltage 6Vpk-pk)
Frequency measurement tolerance	1,5 %

*RS232 interface

Maximal distance	10m
Speed	19.2kBd (STD) 9.6kBd (MODBUS)

Recommend external converter:
ADVANTECH – ADAM 4520: RS232 to RS422/485 converter, DIN rail, automatic RS485 bus supervision, no external data flow control signals, galvanic isolated.

Recommended internal converter:
ADVANTECH – PCL-745B or PCL745S : Dual port RS422/485 Interface card, automatic RS485 bus supervision, no external data flow control signals, galvanic isolated.

*CAN bus interface

Galvanically separated	
Maximal CAN bus length	200m
Speed	250kBd
Nominal impedance	120Ω
Cable type	twisted pair (shielded)

Following dynamic cable parameters are important especially for maximal 200 meters CAN bus length and 32 iS-COM units connected:

Nominal Velocity of Propagation	min. 75% (max. 4,4 ns/m)
Wire crosscut	min.0,25 mm^2
Maximal attenuation (at 1 MHz)	2 dB / 100m

Recommended Industrial Automation & Process Control Cables:
BELDEN (see http://www.belden.com):

- 3082A DeviceBus for Allen-Bradley DeviceNet
- 3083A DeviceBus for Allen-Bradley DeviceNet
- 3086A DeviceBus for Honeywell SDS
- 3087A DeviceBus for Honeywell SDS
- 3084A DeviceBus for Allen-Bradley DeviceNet
- 3085A DeviceBus for Allen-Bradley DeviceNet
- 3105A Paired EIA Industrial RS485 cable

LAPP CABLE (see http://www.lappcable.com)

- Unitronic BUS DeviceNet Trunk Cable
- Unitronic BUS DeviceNet Drop Cable
- Unitronic BUS CAN
- Unitronic-FD BUS P CAN UL/CSA

HBL G2 High Bay



The HBL G2 Series comes in a range of outputs from 100 W - 200 W, and is complemented by 60° & 80° aluminium reflectors. The unique aluminium fin heatsink provides a large surface area for heat dissipation and air flow, significantly increasing the efficiency of thermal conduction. This design greatly reduces the product weight, as well as reducing material wastage when compared to conventional die-cast/extruded heatsinks. And with the use of LED technology, the HBL Series delivers major energy savings and reduced running costs.

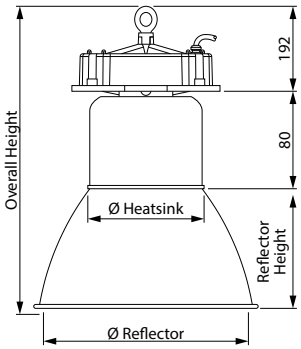
FEATURES

- IP65 rating
- Enhanced performance
- Pendant mount
- Die-cast aluminium construction
- Black powder-coat finish
- Built-in copper heat pipe
- Outputs from 100 W to 200 W
- High performance LEDs, up to 50,000 hr
- Operational voltage 220-240 VAC
- High power factor > 0.95

APPLICATIONS

- Warehousing
- Factories
- Production facilities
- Retail stores
- Indoor sporting venues
- Amusements parks

DIMENSIONS



Model		HBL100G2	HBL120G2	HBL160G2	HBL200G2
Power		100 W	120 W	160 W	200 W
Ø Heatsink		180 mm		220 mm	
Overall Height	60° AL	452 mm		502 mm	
	80° AL	392 mm		412 mm	
Reflector Diameter	60° AL	380 mm		425 mm	
	80° AL	410 mm		470 mm	
Reflector Height	60° AL	180 mm		230 mm	
	80° AL	120 mm		140 mm	

Manufactured under ISO 9001:2008 to standards IEC/AS/NZS 60598.1
IEC/AS/NZS 60598.2.1
IEC/AS/NZS CISPR 15

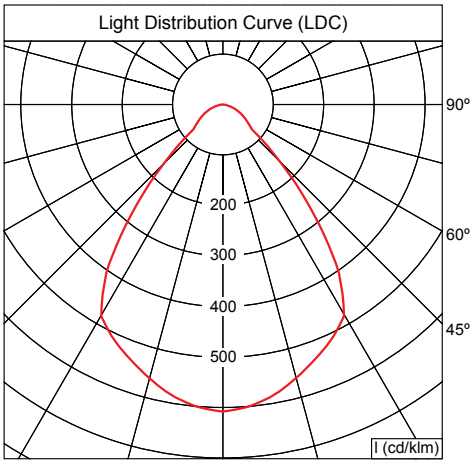
Lighting Council AUSTRALIA MEMBER 2016

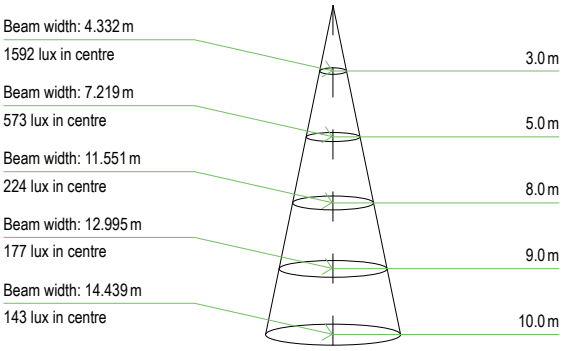
LED HIGH BAY

LED HIGH BAY

LIGHTING DATA

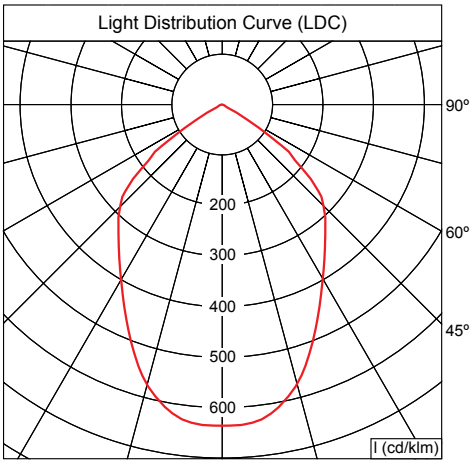
HBL200G24KB06

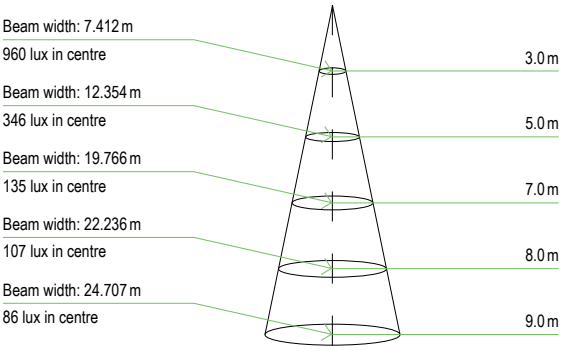




Average Beam Half - Angle = 35.8°

HBL200G24KB08





Average Beam Half - Angle = 37.5°

SPECIFICATIONS

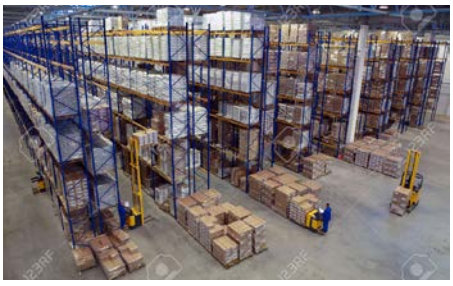
Model	HBL100G2	HBL120G2	HBL160G2	HBL200G2
LED Power (nom.)	100 W	120 W	160 W	200 W
Input Voltage	220-240 VAC 50 / 60 Hz			
	> 0.95			
LED Light Source	Epistar			
Luminous Output (60°)	9,500 lm	12,000 lm	14,450 lm	17,600 lm
Lumens per Watt	95 lm / W	100 lm / W	90 lm / W	88 lm / W
Luminous Output (80°)	10,300 lm	12,800 lm	15,200 lm	18,700 lm
Lumens per Watt	103 lm / W	107 lm / W	95 lm / W	93 lm / W
Colour Temperature	4000 K			
Colour Rendering Index	≥80			
Life Span	> 50,000 hrs			
Fixture Colour	Black / White			
Weight (60° /80°)	4.5 kg	4.5 kg	3.4 kg	4.1 kg

HBL G2 60°



HBL G2 80°





Characteristics and specifications may change without notice. All electrical installations / connections should be carried out by a competent person at all times. Application images are indicative only and may not contain actual Davis product. The information contained in this publication is typical and must not be interpreted as a guarantee of individual product performance.

VOLUX

SB-LED-71

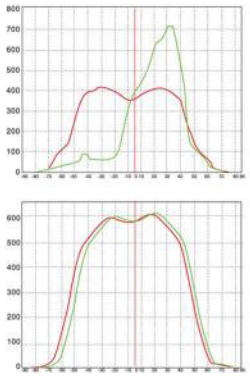


Configuration Data:

Number of LEDs	LED Current	Power Consumpt	Nominal Initial Flux*
192	700mA	420W	42000lm
224	700mA	500W	50000lm

*CCT is Cool White @ 25℃

Polar Diagram



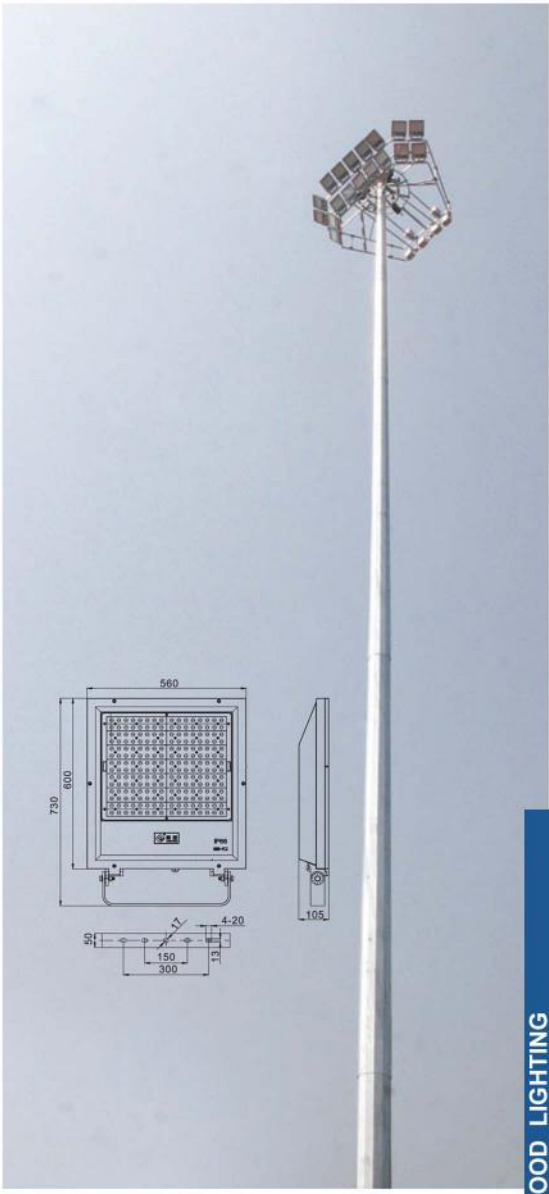
Application: Street、Square

Main Features:

Luminous Efficacy is more than 100 lm/W.
Modern slim die casting aluminum housing.
Closure screen in flat tempered clear glass.
Unique optical design creates consistent distribution and scalability.
Adjustable tile angle design.
CE certification.

Technical Data:

IP66 protection degree.
Insulation class: I
Power supply: 120-277V (50/60Hz)
LED current: 350/530/700mA
Power Factor: > 0.95
Working Ambient: −40℃ to +55℃
Life Span: >50,000 hrs.
CRI: Ra ⩾70
CCT: Warm White (3000 – 3700K),
Neutral White (3700 – 5000K) and Cool White (5000 – 6500K)
Net Weight (Max. Watt): 16kg



LED FLOOD LIGHTING





LED Flood Light EcoMax II

Features

- Slim & Compact design
- Robust housing and refined finish coating
- 50% lower energy consumption and longer lifespan(30Khrs)
- IP65,IK08,up to 80lm/W

Benefits

- Vibration-proof, Wind -proof, Rust-proof
- Excellent thermal management for stable performance
- Long life, low maintenance cost
- Adaptable installation

Application

Landscape · Square · Parking · Architecture · Billboard

Specification

Item Code	Item Description	Power (W)	Power Factor	Lumen (lm)	Efficacy (lm/W)	Input Current (mA)	Lifetime (L70B50)	MOQ (pcs)
140059516	LED floodlight-E II 30W-3000-GY-GP	30	0.95	2400	80	130	30000	108
140059517	LED floodlight-E II 30W-4000-GY-GP	30	0.95	2450	82	130	30000	108
140059518	LED floodlight-E II 30W-6000-GY-GP	30	0.95	2500	83	130	30000	108
140059519	LED floodlight-E II 50W-3000-GY-GP	50	0.95	4000	80	210	30000	108
140059520	LED floodlight-E II 50W-4000-GY-GP	50	0.95	4100	82	210	30000	108
140059521	LED floodlight-E II 50W-6000-GY-GP	50	0.95	4200	84	210	30000	108
140059619	LED floodlight-E II 70W-3000-GY-GP	70	0.95	5800	83	300	30000	108
140059620	LED floodlight-E II 70W-4000-GY-GP	70	0.95	5900	84	300	30000	108
140059621	LED floodlight-E II 70W-6000-GY-GP	70	0.95	6000	86	300	30000	108
140059622	LED floodlight-E II 100W-3000-GY-GP	100	0.95	9200	92	430	30000	108
140059623	LED floodlight-E II 100W-4000-GY-GP	100	0.95	9300	93	430	30000	108
140059624	LED floodlight-E II 100W-6000-GY-GP	100	0.95	9400	94	430	30000	108

Technical Specifications	
CRI	⩾80
Colour Consistency (SDCM)	6
Dimmable	No
Housing Colour	Grey
IP	IP65
IK	IK08
Driver integrated (Yes/No)	Yes
Glow wire test	650°C
Weight (kg/pc)	0.51 / 0.81 / 1.34 / 1.98

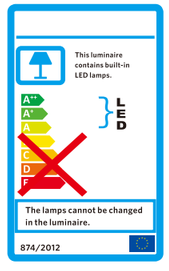
Electrical Supply	
Frequency (Hz)	50/60
Voltage (V)	220-240
AC / DC	AC

Mechanical Properties	
Housing Material	Die-cast Aluminium
Optical Material	PC

Application Conditions	
Operating Temperature	-30-50°C
Storage Environment	-30-65°C

Certification

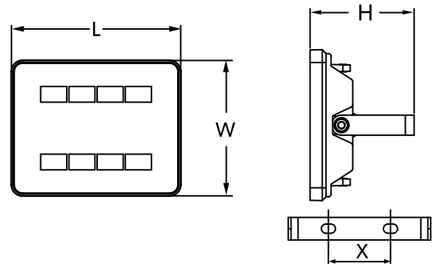
CB



Packaging Information

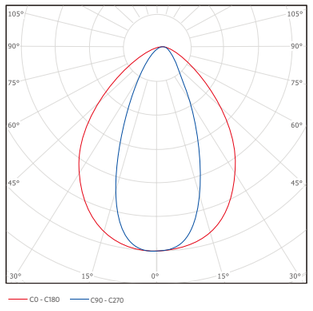
Item		Single Box(1pc/box)		Packaging Unit		
Item Code	Item Description	Dimensions(mm) (LxWxH)	Gross Weight (kg)	Dimensions(mm) (LxWxH)	Gross Weight (kg)	Packing Qty (pcs/unit)
140059516	LED floodlight-E II 30W-3000-GY-GP	155*125*82	0.63	400*330*266	11.34	18
140059517	LED floodlight-E II 30W-4000-GY-GP	155*125*82	0.63	400*330*266	11.34	18
140059518	LED floodlight-E II 30W-6000-GY-GP	155*125*82	0.63	400*330*266	11.34	18
140059519	LED floodlight-E II 50W-3000-GY-GP	205*145*82	0.97	430*310*266	11.64	12
140059520	LED floodlight-E II 50W-4000-GY-GP	205*145*82	0.97	430*310*266	11.64	12
140059521	LED floodlight-E II 50W-6000-GY-GP	205*145*82	0.97	430*310*266	11.64	12
140059619	LED floodlight-E II 70W-3000-GY-GP	275*205*98	1.68	430*290*324	10.10	6
140059620	LED floodlight-E II 70W-4000-GY-GP	275*205*98	1.68	430*290*324	10.10	6
140059621	LED floodlight-E II 70W-6000-GY-GP	275*205*98	1.68	430*290*324	10.10	6
140059622	LED floodlight-E II 100W-3000-GY-GP	305*245*98	2.39	510*320*324	14.35	6
140059623	LED floodlight-E II 100W-4000-GY-GP	305*245*98	2.39	510*320*324	14.35	6
140059624	LED floodlight-E II 100W-6000-GY-GP	305*245*98	2.39	510*320*324	14.35	6

Dimensional Drawing



Model	L (mm)	W (mm)	H (mm)	X (mm)
LED FL-E 30W	150	120	83	44
LED FL-E 50W	200	140	99	60
LED FL-E 70W	250	180	120	60
LED FL-E 100W	280	220	135	80

Photometric Data



40°+80°(30W/50W/70W/100W)

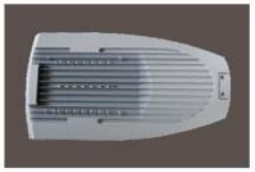
VOLUX

SBDD-LED-400B









Configuration Data:

Number of LEDs	LED Current	Power Consumpt	Nominal Initial Flux*
32	700mA	75W	7500lm
48	350mA	50W	5500lm
	530mA	80W	8400lm
	700mA	100W	10000lm
64	350mA	65W	7150lm
	530mA	100W	11000lm
	700mA	--	--

*CCT is Cool White @ 25℃

Application: Street

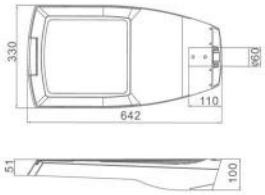
Main Features:

Luminaire Efficiency is more than 100 lm/Wattage
Modern streamline die cast aluminum case.
Closure screen in flat tempered clear or frosted glass.
Unique optical design creates consistent distribution and scalability.
Integrated surge protection device.
CE certification.

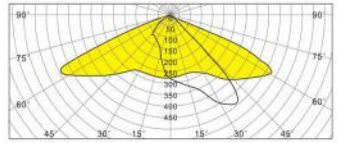
Technical Data:

IP66 protection degree.
Insulation class: I
Power supply: 120-277V (50/60Hz)
LED current: 350/530/700mA
Power Factor: > 0.95
Working Ambient: -40℃ to +55℃
Life Span: >50,000 hrs.
CRI: Ra ≥70
CCT: Warm White (3000 – 3700K), Neutral White (3700 – 5000K) and Cool White (5000 – 6500K)
Net Weight (Max. Wattage): 8kg

Product Dimensions(mm)

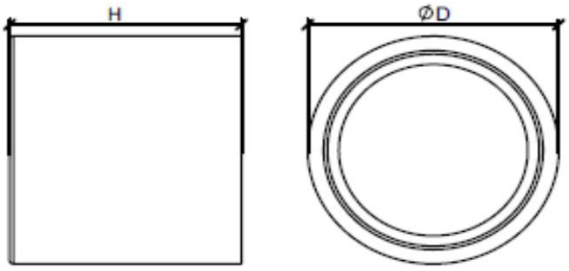


Polar Diagram



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No. 65, Jalan PJS 11/7, Bandar Sunway, 46150 Selangor Darul Ehsan, Malaysia.
Tel : +603 5636 4348 Fax : +603 5636 4352
email: malaysia@davislighting.com website: www.davislighting.com





Model	Height (H)	Diameter (D)
DVS-AL-SRDL-8-xK	130 mm	200 mm

Dimensions : 130 X 200mm (H x D)

Project Name :

Brand	: DAVIS	**Model**	: DVS-SRDL-8"-30W	**Code**	:

Description : 30W LED SURFACE MOUNTED ROUND DOWNLIGHT FITTING WITH OPAL DIFFUSER, LED MODULE & LED DRIVER

Specifications

Material	: Die Cast Aluminium
Finishing	: Matt White Finished
Input Voltage	: 220 - 240V
Colour Temperature	: 4000K
Lumen	: 2850lm
Power Consumption	: 30W
Colour Randering	: 80 Ra
Power Factor	: 0.90
Operating Temperature	: -20°C to 50°C
Beam Angle	: 80 Degree
IP Rating	: IP20
Life Span	: 30,000 hours
LED Driver	: External Driver

DA235 - 13 W



The DA235 series white trim downlight is built robust with an aluminium die-cast body and is available with a beam angle of 90 degrees. The unit provides a soft, tender light and its simple and elegant appearance will blend seamlessly with any décor.

FEATURES

- » IP54 protection from below ceiling, IP20 from above
- » Enhanced performance
- » Suits GreenStar, IPART and BCA compliant designs
- » Die-cast aluminium heatsink
- » Aust. approved LED dimmable driver 5 - 100%
  (for details refer to Control / Dimmer data sheet)
- » 13 W ± 5% maximum system watts
- » High performance LEDs, up to 50,000 hr
- » EMC compliant to 300 MHz
- » Operational voltage 176 to 264 VAC
- » Overload / short circuit protection
- » High power factor > 0.95
- » 1.5 m supply flex and 2-pin plug
- » Quick connect LED head
- » Ceiling penetration of 49 mm
- » Lumen output: 835 lm (3000 K)
  909 lm (4000 K)

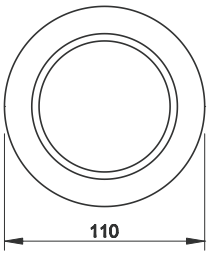
MODELS

DA235-3KD-xx 3000 K
DA235-4KD-xx 4000 K

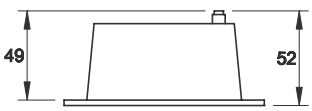
xx denotes finish colour: 01 = white
02 = silver
03 = black

Other colours available on request

DIMENSIONS



Hole cutout
90 mm



APPLICATION

Domestic
- » Kitchens
- » Bathrooms
- » Laundries
- » Undercover areas
- » Soffits, under eaves

Commercial
- » Storage areas
- » Toilets
- » Undercover areas, eaves
- » Shops, malls
- » Soffits, under eaves

Industrial
- » Task lighting
- » Toilets
- » Amenities

Manufactured under ISO 9001:2008 to standards AS/NZS60598.1
AS/NZS60598.2.1
AS/NZS60598.2.2
AS/NZS CISPR 15

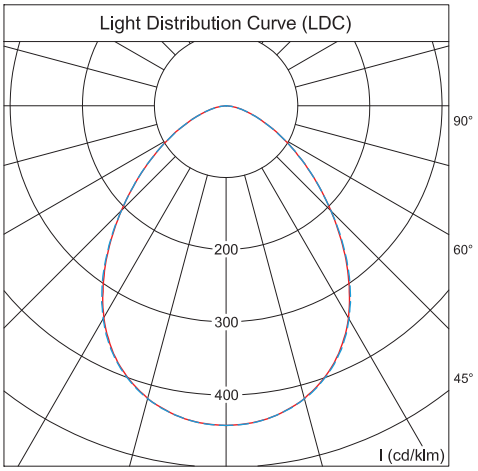
Lighting Council AUSTRALIA MEMBER 2014

LED DOWNLIGHT

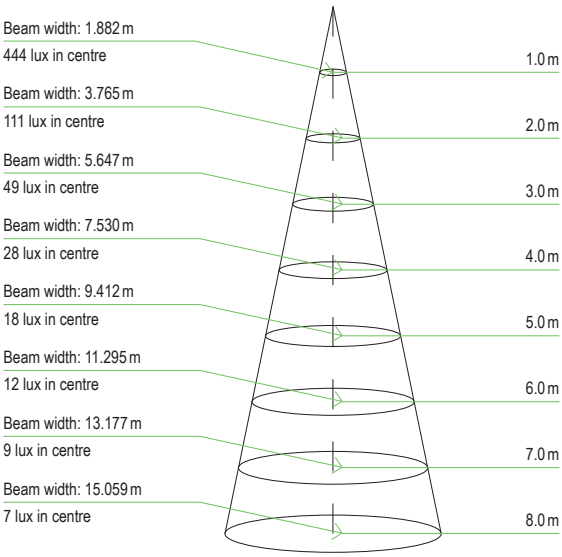
LED DOWNLIGHT

LIGHTING DATA

DA235-3KD

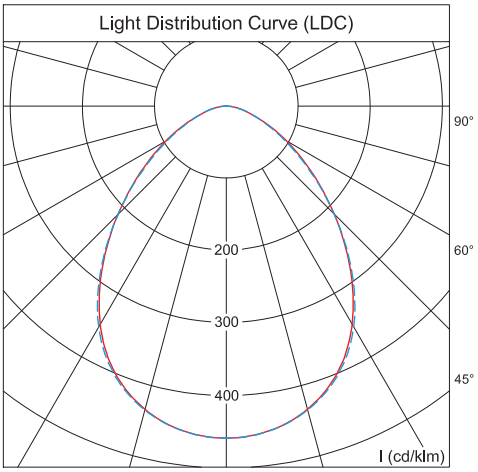


Utilisation Table (TM5)											DA235 3KD.IES
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	59	67	73	77	83	87	89	93	95
70	30	20	53	62	68	72	78	83	86	90	92
70	10	20	49	57	64	68	75	79	82	87	90
50	50	20	58	66	71	75	80	84	86	89	91
50	30	20	52	61	66	71	76	80	83	87	89
50	10	20	48	57	63	67	73	77	80	84	87
30	50	20	56	64	69	73	78	81	83	86	88
30	30	20	52	60	65	69	75	78	81	84	86
30	10	20	48	56	62	66	72	76	78	82	84
0	0	0	46	54	60	64	69	72	75	78	80
BZ-class			3	3	3	3	3	3	3	3	3
			SHRnom : 1.25			SHRmax : 1.430					

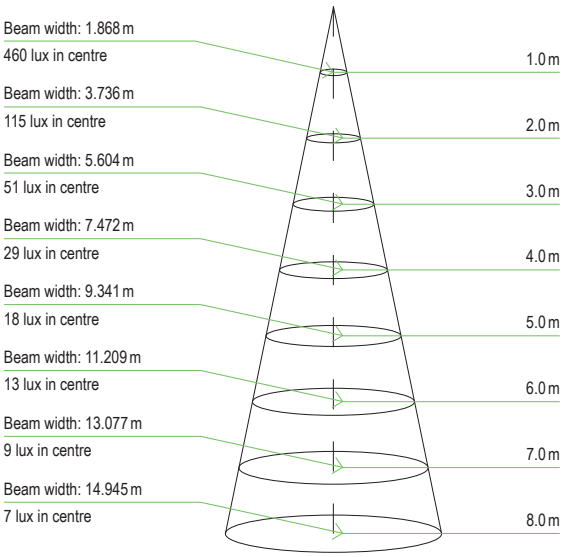


Average Beam Half - Angle = 43°

DA235-4KD



Utilisation Table (TM5)											DA235 4KD.IES
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	61	70	76	80	85	89	93	95	97
70	30	20	55	64	70	74	81	85	88	92	95
70	10	20	50	59	66	70	77	82	85	89	92
50	50	20	59	68	73	77	83	86	89	92	94
50	30	20	54	63	69	73	79	83	85	89	91
50	10	20	50	59	65	69	75	80	83	87	90
30	50	20	58	66	71	75	80	83	86	88	90
30	30	20	53	62	67	71	77	81	83	86	88
30	10	20	49	58	64	68	75	78	81	85	87
0	0	0	48	56	62	66	71	75	77	81	83
BZ-class			2	3	3	3	3	2	3	3	3
			SHRnom : 1.25			SHRmax : 1.406					



Average Beam Half - Angle = 43°

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SALES OFFICES (all states): 1300 851 001
E-mail: australia@davislighting.com
Website: www.davislighting.com

DAVIS LIGHTING "When your business depends on light."

WPL



Davis WPL our energy efficient LED range of IP65 protection weatherproof luminaire suitable for surface or pendant mounting. The polycarbonate body is constructed to ensure reliability. It is SELV compliant with 50,000 hours life span thus reduced need for maintenance and saves costs. Standard accessories such as the stainless steel diffuser retaining clips and stainless steel mounting brackets are provided ensuring no compromise to the ingress protection.

FEATURES

- » Energy efficient IP65 protection weatherproof
- » Long life LED up to 50,000hrs by maintaining >70% flux in accordance to LM80 standards
- » Polycarbonate body, opal diffuser, & Stainless steel clips
- » SELV compliant
- » EMC compliant to 300Mhz
- » Maintenance free
- » Suitable for surface or pendant mount

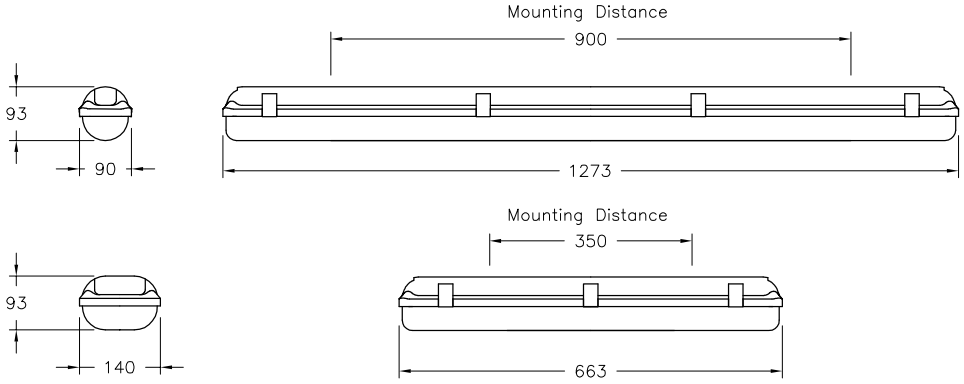
MODELS

- » WPLS210-3K
- » WPLS210-4K
- » WPLS210-6K
- » WPLT220-3K
- » WPLT220-4K
- » WPLT220-6K
- » WPLS420-3K
- » WPLS420-4K
- » WPLS420-6K
- » WPLT440-3K
- » WPLT440-4K
- » WPLT440-6K

APPLICATIONS

- » Suitable for indoor or outdoor general use
- » Car Parks
- » Corridors
- » Factories & warehouses

DIMENSIONS



Manufactured under ISO 9001:2008 to standards IEC 60598.1
IEC 60598.2.1
IEC CISPR15

SELV · ECOSmart · 5 - 100% · IP65 · INDOOR · OUTDOOR

DAVIS Lighting "When your business depends on light."

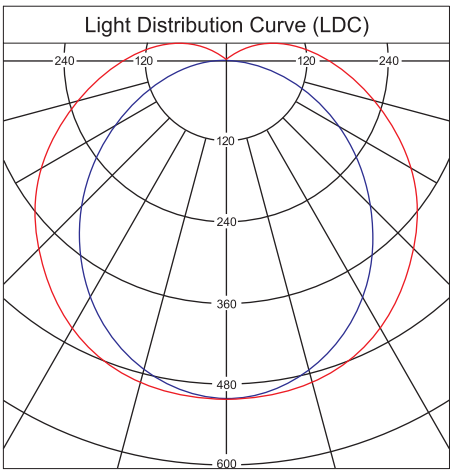
LED WEATHERPROOF (IP65)

030915

LED WEATHERPROOF (IP65)

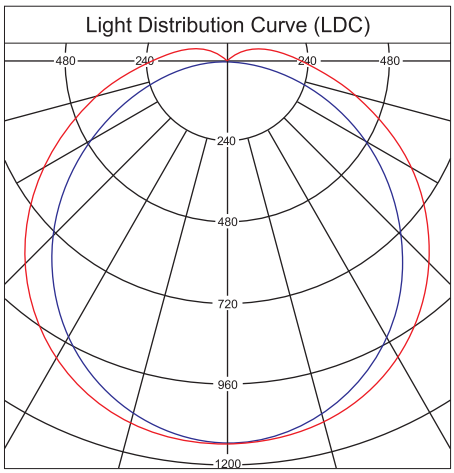
LIGHTING DATA

WPLS420



Utilisation Table (TM5)			WPLS420-P13111803.IES								
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	53	61	68	73	80	85	88	93	96
70	30	20	45	52	60	65	73	79	83	88	92
70	10	20	39	46	54	59	67	73	78	84	88
50	50	20	50	57	64	69	75	80	83	87	90
50	30	20	43	50	57	62	69	75	78	83	87
50	10	20	38	45	52	57	65	70	74	80	84
30	50	20	48	54	61	65	71	75	78	82	85
30	30	20	42	48	55	60	66	71	74	79	82
30	10	20	37	44	50	55	62	67	71	76	79
0	0	0	34	40	46	51	57	61	65	69	73
BZ-class			5	5	5	5	5	5	5	6	6
SHRnom : 1.50 SHRmax : 1.69											

WPLT440



Utilisation Table (TM5)			WPLT440-P13093002.IES								
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	55	63	71	76	83	88	91	96	99
70	30	20	48	56	63	68	76	82	86	91	95
70	10	20	42	50	57	63	71	77	81	87	91
50	50	20	53	61	67	72	79	83	86	91	93
50	30	20	46	54	61	66	73	78	82	87	90
50	10	20	41	49	56	61	68	74	78	83	87
30	50	20	51	58	64	69	75	79	82	86	88
30	30	20	45	52	59	63	70	75	78	83	86
30	10	20	41	47	54	59	66	71	75	80	83
0	0	0	38	44	51	55	62	66	70	74	77
BZ-class			5	5	5	5	5	5	5	5	5
SHRnom : 1.50 SHRmax : 1.64											

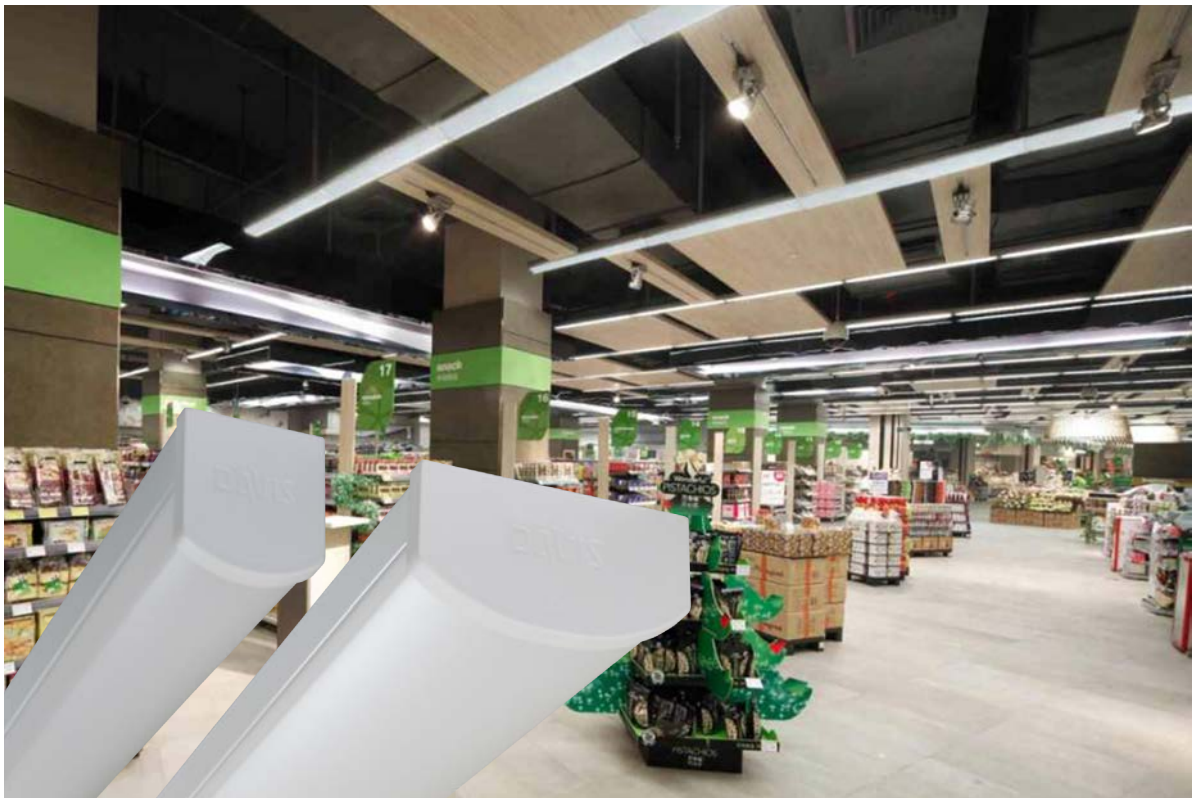
SPECIFICATIONS

Model	WPLS210	WPLS420	WPLT220	WPLT440
Size	663 x 90 x 93	1273 x 90 x 93	663 x 140 x 93	1273 x 140 x93
Base material	Polycarbonate			
Diffuser material	Polycarbonate Opal			
Gear Tray	Mild steel 0.5-0.7mm			
Input Voltage (V)	198-264			
Mains Frequency (Hz)	50/60			
Nominal power (W)	10	20	20	38
Driver type	Constant current			
Output Current (mA)	700			
Power Factor	>0.9			
Nominal system flux (lm)	>1000	>1900	>1900	>3800
CCT (K)	3000/4000/6500			
CRI	>80			
Mounting	Surface / Pendant			
Beam Angle (°)	>100			
Average Life (hrs)	35,000			
Max ambient temp (°C)	45			
IP Rating	IP65			
Standards	IEC60598-1, IEC60598-2.1, IEC CISPR15			

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ASCELLA

10 - 35 W



Ascella is all things to all installations.

This multi-purpose LED luminaire is suitable for domestic and many commercial applications, providing optimum lighting levels (up to 3700 lm) and minimal running costs. Both slim- and wide- body models are available in a number of power and colour temperture variations, and all units feature a PMMA opalised diffuser. Ascella is designed for surface mounting and offers quick and easy installation, not to mention near-zero maintenance. Ascella also features end cap knockouts for in-line mounting, or end-to-end mounting allowing for continuous ceiling runs without the eyesore of exposed conduit.



FEATURES

» Slim- and wide- body models
» PMMA opalised diffuser
» Chassis and accessory metal surfaces treated & degreased, finished in a white polyester-epoxy powder-coat and baked for unprecedented protection and the highest quality finish
» 30,000 hr LEDs
» Energy efficient electronic control gear
» Surface mounting
» Knockouts for in-line mounting
» Quick and easy installation

APPLICATIONS

» Domestic areas
» Hotels / motels
» Offices
» Commercial interiors
» Showrooms, galleries
» Boardrooms
» Schools

OPTIONS

» Dimmable versions
» High output 50,000 hr LEDs
» Single-point emergency
(Note: options are indent only)

LED BATTEN

Manufactured under ISO 9001:2008 to standards AS/NZS60598.1
AS/NZS60598.2.1
AS/NZS CISPR 15

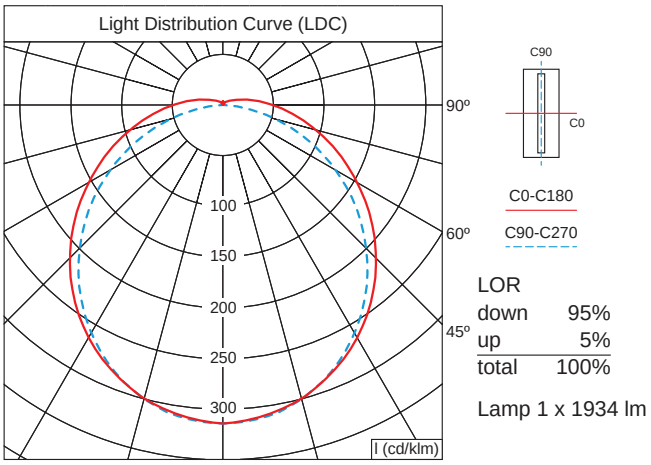
Lighting Council AUSTRALIA MEMBER 2015

IP20 INDOOR

LED BATTEN

LIGHTING DATA

ACW420TBD



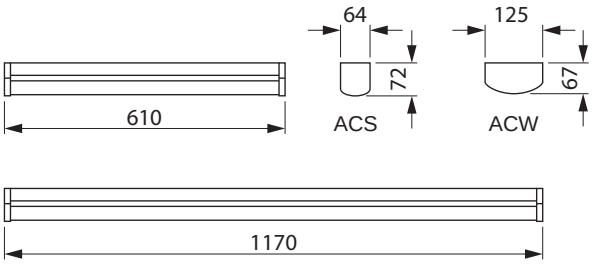
LOR

down	95%
up	5%
total	100%

Lamp 1 x 1934 lm

Utilisation Table (TM5)											ACW420TBD.IES
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	57	65	72	77	84	89	92	97	100
70	30	20	49	57	64	70	78	83	87	92	96
70	10	20	43	51	59	64	72	78	82	88	93
50	50	20	55	62	69	74	80	85	88	92	95
50	30	20	48	55	62	67	75	80	83	88	92
50	10	20	43	50	57	62	70	75	79	85	89
30	50	20	53	60	66	70	77	81	84	88	90
30	30	20	47	54	60	65	72	77	80	84	88
30	10	20	42	49	56	61	68	73	77	82	85
0	0	0	39	46	53	57	64	68	72	76	79
BZ-class			5	5	5	5	5	5	5	5	5
			SHRnom : 1.50				SHRmax : 1.583				

DIMENSIONS





SPECIFICATIONS

Model	ACS210TBD	ACS220TBD	ACS420TBD	ACS435TBD	ACW210TBD	ACW220TBD	ACW420TBD	ACW435TBD
Length	610 mm	610 mm	1170 mm	1170 mm	610 mm	610 mm	1170 mm	1170 mm
Body Material	Mild steel, white powdercoat							
Diffuser Material	PMMA Opalised							
Input Voltage	220-240 VAC 50 / 60 Hz							
Nominal Power	10 W	20 W	20 W	35 W	10 W	20 W	20 W	35 W
Nominal System Flux	> 900 lm	> 1600 lm	> 2000 lm	> 3700 lm	> 850 lm	> 1600 lm	> 1900 lm	> 3700 lm
Efficacy	90 lm / W	80 lm / W	100 lm / W	106 lm / W	85 lm / W	80 lm / W	95 lm / W	106 lm / W
Power Factor	> 0.70	> 0.90			> 0.70	> 0.90		
Colour Temperature	3000 K / 4000 K / 6500 K							
CRI	> 80							
Ta	> 35	30	36	31	> 35			
Average Life	30,000 hrs							
Mounting	Surface							
IP Rating	IP20							

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DAVIS LIGHTING "When your business depends on light."

PB series



This multi-purpose luminaire is suitable for domestic, commercial and light industrial applications, providing optimum lighting levels at the lowest cost. Davis' ever popular Project Series of wide-body batten luminaires takes another leap forward with new and improved models, ideal for covering J-box cable entry and cable ducting. The PB series comes in two lengths, four power ratings and is available in either 3000 K, 4000 K or 6500 K, providing a wealth of combinations that will benefit any installation. PB utilises a high-performance, high-efficacy, long-life energy saving light source and is virtually maintenance-free; even more reasons to enjoy the PB Advantage.





FEATURES

- Enhanced performance
- White powdercoated mild steel body
- Opalised polycarbonate diffuser
- Long life 50,000 hr LEDs
- Colour temp: 3000 K, 4000 K, 6500 K
- Output 1000 to 4000 lm
- Operating range 220-240 VAC
- Constant current driver
- Quick and easy installation
- Suitable for surface or pendant mount

APPLICATIONS

- Retail shops
- Storage areas
- Kitchens, canteens
- Walk-in wardrobes
- Corridor and entrance areas
- Undercover carparks, workshops

LED BATTEN

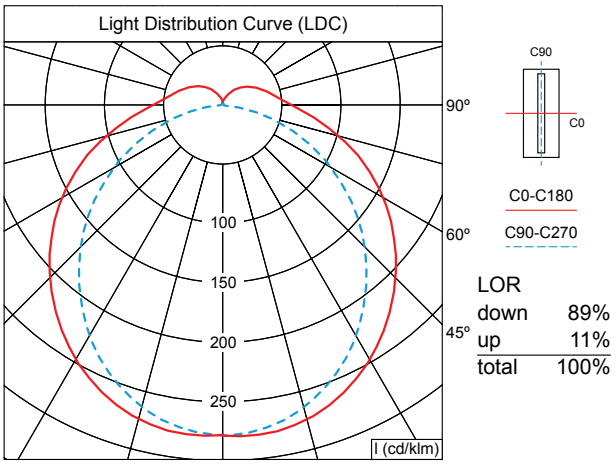
Manufactured under ISO 9001:2008 to standards IEC/AS/NZS 60598.1
IEC/AS/NZS 60598.2.1
IEC/AS/NZS CISPR 15

Lighting Council AUSTRALIA MEMBER

IP20 INDOOR

LED BATTEN

LIGHTING DATA



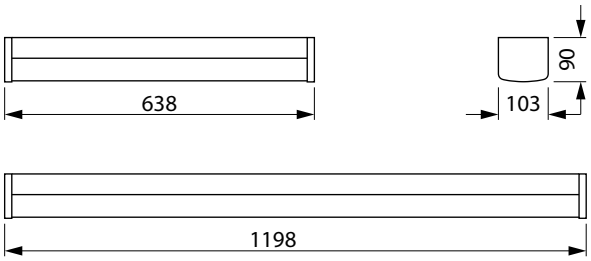
PBD435DLS4K

Utilisation Table (TM5)											PBD435DLS4K.IES
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	56	64	72	77	84	89	92	97	100
70	30	20	49	56	64	69	77	83	87	92	96
70	10	20	43	50	58	64	72	78	82	88	93
50	50	20	54	62	69	74	80	85	88	93	96
50	30	20	47	55	62	67	75	80	84	89	92
50	10	20	42	50	57	62	70	75	79	85	89
30	50	20	53	60	66	71	77	81	84	88	91
30	30	20	47	54	60	65	72	77	80	85	88
30	10	20	42	49	56	61	68	73	77	82	86
0	0	0	39	46	53	57	64	69	72	77	80
BZ-class			5	5	5	5	5	5	5	5	5
			SHRnom : 1.50				SHRmax : 1.585				

SPECIFICATIONS

Model	PBD210DLS4K	PBD220DLS4K	PBD420DLS4K	PBD435DLS4K
Format	Diffused			
	PBW210DLS4K	PBW220DLS4K	PBW420DLS4K	PBW435DLS4K
Format	Wire Guard			
Length	638 mm	638 mm	1198 mm	1198 mm
Supply Voltage	220-240 VAC 50 / 60 Hz			
Power (nom.)	10 W	20 W	20 W	35 W
Output (nom.)	1000 lm	2100 lm	2450 lm	4050 lm
Efficacy	100 lm / W	105 lm / W	122 lm / W	115 lm / W
Power Factor	0.90			
CCT	3000 K / 4000 K / 6500 K			
CRI	>80			
Average LED Life	50,000 hrs			
Weight	1.38 kg	2.30 kg	1.38 kg	2.30 kg

DIMENSIONS





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POLLUX



Davis Pollux series are designed for simplicity, yet elegant with high efficacy and energy efficiency. It provides up to 4 times longer life than the conventional fluorescent fixture and requires minimum maintenance cost. It's carefully controlled powder coating process ensures durability and protection. Ideal to illuminate specific areas such as T-bar recessed indoor applications, classrooms or offices with good glare control for visual comfort.

FEATURES

- » T-bar recess mounted LED luminaire
- » Energy saving & high performance LED light source
- » Long life LED up to 50,000hrs by maintaining >70% flux in accordance to LM80 standards
- » Slim design with low profile casing 40mm
- » SELV compliant
- » EMC compliant to 300Mhz
- » Insert-proof lamp compartment
- » Anti-glare control

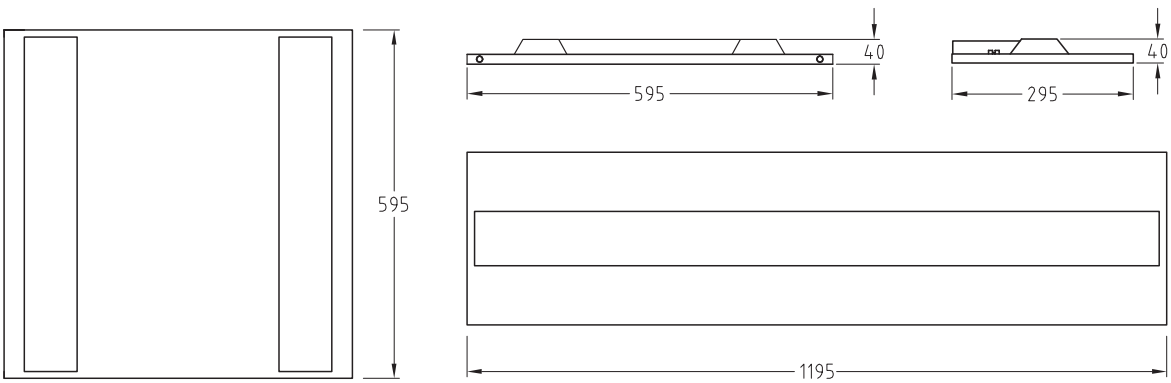
MODELS

- » PL440-3K
- » PL440-4K
- » PL440-6K
- » PLW240-3K
- » PLW240-4K
- » PLW240-6K

APPLICATIONS

- » Suitable for indoor general use
- » Commercial Building
- » Offices
- » Healthcare

DIMENSIONS



LED RECESSED DIFFUSED LUMINAIRE

Manufactured under ISO 9001:2008 to standards IEC 60598.1
IEC 60598.2.1
IEC 60598.2.2
IEC CISPR15

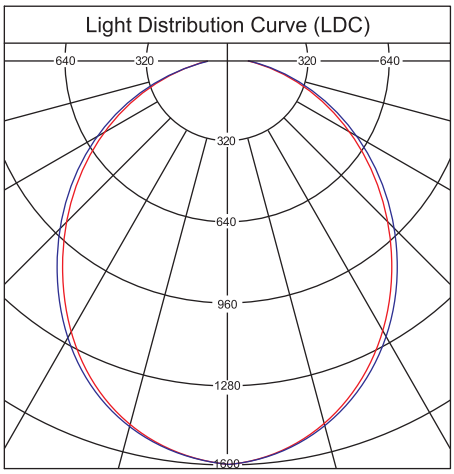
SELV IP20 INDOOR

030915

LED RECESSED DIFFUSED LUMINAIRE

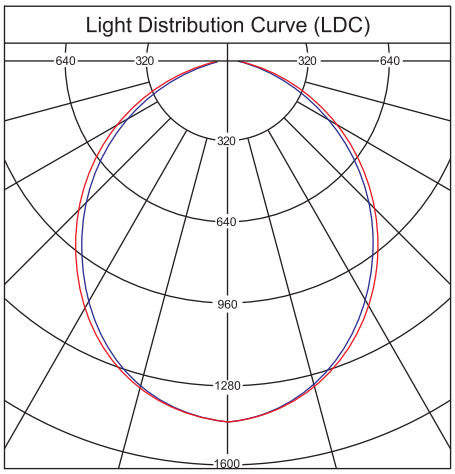
LIGHTING DATA

PL440



Utilisation Table (TM5)			PL440-P14031701.IES								
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	59	70	77	82	89	94	98	102	105
70	30	20	52	62	70	75	83	89	93	98	101
70	10	20	46	57	64	70	78	84	89	94	98
50	50	20	58	68	74	79	86	91	94	98	101
50	30	20	51	61	68	74	81	86	90	95	98
50	10	20	46	56	63	69	77	82	86	92	95
30	50	20	56	66	72	77	83	87	90	94	97
30	30	20	50	60	67	72	79	84	87	92	94
30	10	20	46	55	63	68	75	80	84	89	92
0	0	0	43	53	60	65	72	77	80	85	88
BZ-class			4	4	4	4	4	4	4	4	4
SHRnom : 1.25 SHRmax : 1.478											

PLW240

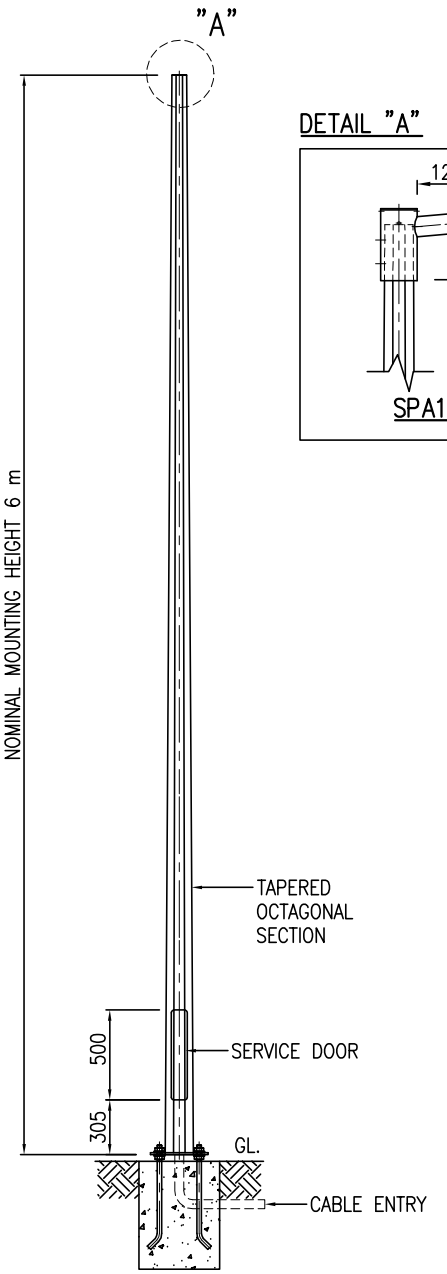


Utilisation Table (TM5)			PLW240-P14021303.IES								
Reflectances			Room Index								
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	64	72	79	84	91	95	99	103	105
70	30	20	56	64	72	77	85	90	94	99	102
70	10	20	51	59	67	72	80	86	90	95	99
50	50	20	62	70	77	81	88	92	95	99	101
50	30	20	56	63	71	76	83	87	91	96	98
50	10	20	51	58	66	71	79	84	88	93	96
30	50	20	61	68	74	79	85	89	91	95	97
30	30	20	55	62	69	74	81	85	88	92	95
30	10	20	51	58	65	70	77	82	85	90	93
0	0	0	48	55	62	67	74	78	81	86	88
BZ-class			3	4	4	4	4	4	4	4	4
SHRnom : 1.50 SHRmax : 1.503											

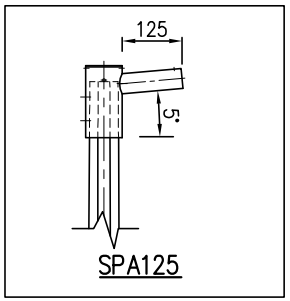
SPECIFICATIONS

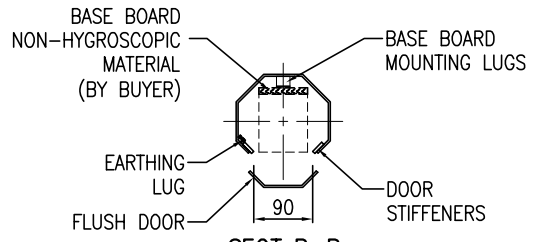
Model	PL440	PLW240
Size	1200X300	600X600
Casing material	mild steel 0.5-0.7mm	
Coating	polyester-epoxy powder	
Finish	White	
Diffuser	PMMA Diffused	
Input Voltage (V)	AC198-264	
Mains Frequency (Hz)	50/60	
Nominal power (W)	38	
Driver type	Constant current	
Output current (mA)	700	
Power Factor	0.9	
Nominal system flux (lm)	>3900	>3500
CCT (K)	3000/4000/6500	
CRI (K)	>80	
Mounting	Recessed only	
Beam Angle (°)	>90	
Average Life (hrs)	35,000	
Max ambient temp (°C)	45	
IP Rating	IP20	
Standards	IEC60598-1, IEC60598-2.1, IEC60598-2.2, IEC CISPR15	

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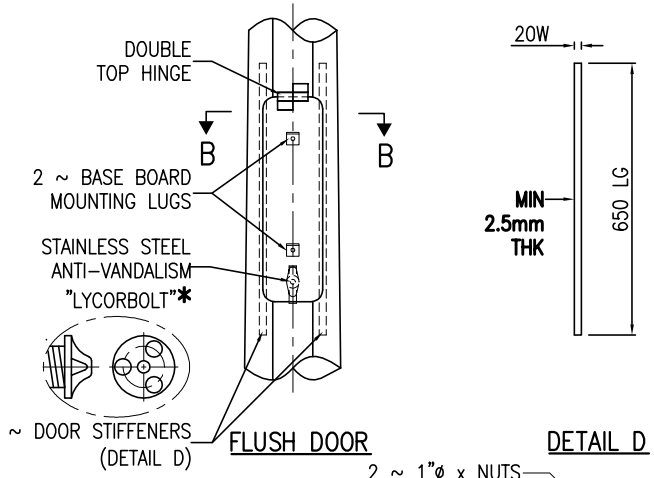


DETAIL "A"



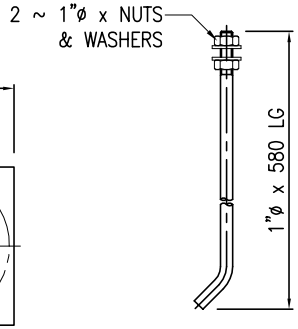


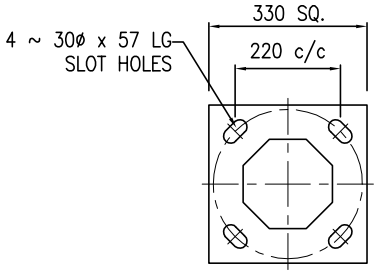
SECT B-B



FLUSH DOOR

DETAIL D





BASE FLANGE

RAG BOLT (H58R2A)

TECHNICAL SPECIFICATIONS

1) DESIGN CONDITIONS
   - 1.1 BASIC WIND SPEED : **35** m/s (BS 5649) SUPERSEDED BY BS EN 40-3-1
   - 1.2 10 MINUTES MEAN WIND VELOCITY : **20.6** m/s (BS EN 40-3-1) EQUIVALENT TO BS 5649 3-SEC GUST BASIC WIND SPEED OF **35** m/s
   - 1.3 UNIT LUMINAIRE WEIGHT : **12** kg
   - 1.4 UNIT LUMINAIRE SAIL AREA : **0.12** m²
2) STANDARDS
   - 2.1 POLE DESIGN : BS EN 40-3-1 & BS EN 40-3-3 EN 12767 CLASS 0
   - 2.2 MATERIAL : BS EN 10025 S275JR
   - 2.3 WELDING (ELECTRIC ARC WELDING) : BS EN 1011-2
   - 2.4 GALVANIZING (**10 YEARS** WARRANTY) : BS EN ISO 1461 / BS 729
3) TESTING PROCEDURES : DIMENSIONAL VERIFICATION, GALVANIZING THICKNESS, MATERIAL STRENGTH & THICKNESS
4) QUALITY CONTROL PROCEDURES : THE SUPPLIER / MANUFACTURER AND GALVANIZER SHALL BE ISO 9001 : 2008 ACCREDITED

MANUFACTURER'S COMPLIANCE

1) LOCALLY MANUFACTURED PRODUCTS : -MANUFACTURER'S DECLARATION THAT POLE SECTIONS AND COMPONENTS ARE "MADE IN MALAYSIA" IN COMPLIANCE TO MOF "SURAT PEKELILING PERBENDAHARAAN BIL.7 TAHUN 2002". -HOT ROLLED STEEL COIL WITH LOCAL STEEL MILL CERTIFICATES.
2) MANUFACTURING AND HOT DIP GALVANIZING : -PREFERED IN-HOUSE MANUFACTURING WITH HOT DIP GALVANIZING PROCESSES.
3) PROVIDE COMPULSORY TESTING AT MANUFACTURER'S FACTORY : -TYPE TEST TO BS EN 40-3-2 -GALVANIZING TEST -MATERIAL TEST -WELDING TEST BY DYE PENETRANT
4) CERTIFICATION : -JKR / ISO / SIRIM
5) REGISTRATION : -MITI / IKRAM / MOF / CIDB
6) TRACK RECORD : -EVIDENCE OF MIN. 10 YEARS MANUFACTURING & SUPPLY TRACK RECORDS.
7) PE ENDORSEMENT : -PE ENDORSEMENT MANDATORY FOR ALL POLE DESIGN CALCULATIONS & DRAWINGS FOR SUBMISSION.
8) DESIGN CALCULATION : -DESIGN CALCULATIONS SHALL BE VERIFIED BY HAND CALCULATION, VALIDATED, REVIEWED AND APPROVED.
9) CERTIFICATE OF WARRANTY -10 YEARS FOR HOT DIP GALVANIZING (WARRANTY IS APPLICABLE TO PRODUCTS USED IN MALAYSIA ONLY) : -10 YEARS PERIOD FROM DATE OF DELIVERY SUBJECT TO BS 5493 ENVIRONMENTAL CONDITIONS.

* UTILITY INNOVATION APPLICATION NO : UI 2012001805

CUSTOMER APPROVED DRAWING FOR MANUFACTURE

(Co. stamp, sign & date)

REV	DETAILS	BY	CHD	DATE

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PRELIMINARY DRAWING FOR TENDER PURPOSES ONLY

PROJECTION

ALL DIMS ARE SUBJECT TO MANUFACTURING TOLERANCES

CLIENT : KEJURUTERAAN BROADWAY

PROJECT:

DRAWN : NSJ | CHD : | DATE: 05.04.17

LYSAGHT MARKETING SDN BHD
CO. NO.: 102382-M

TITLE : **6m RV LIGHTING COLUMN (FLANGED TYPE) c/w SPA125**

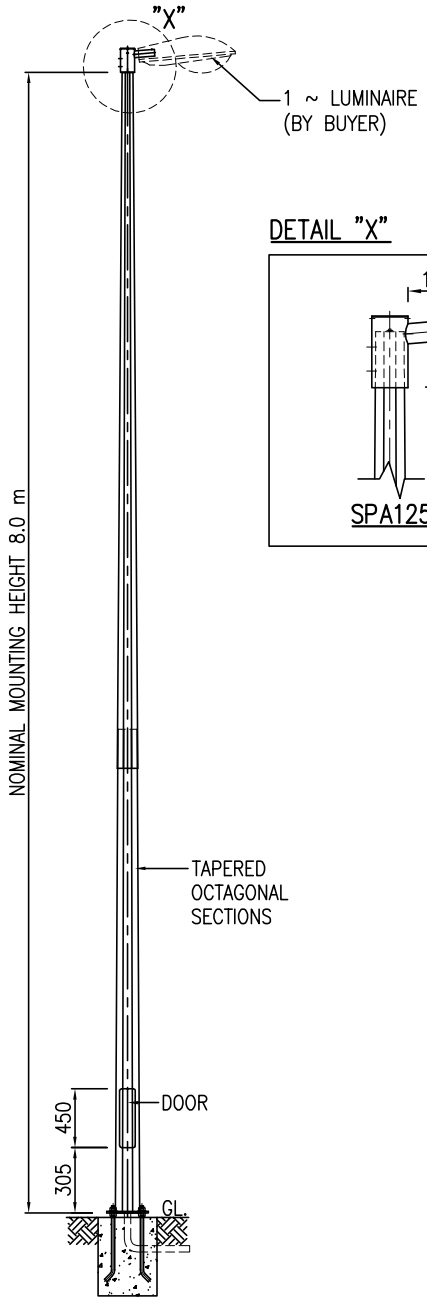
SCALE : 1 : 40 | SHEET 1 of 1 | REV

DWG./REF. NO. RV060FA-089-1

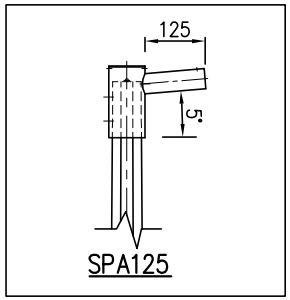
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DIMENSIONS IN mm UNLESS STATED

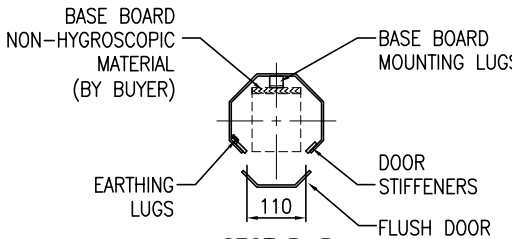
SHEET SIZE A4



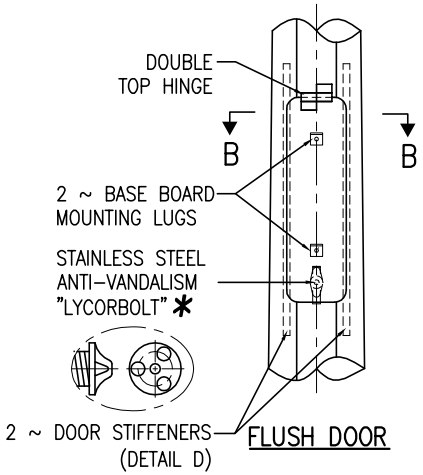
DETAIL "X"



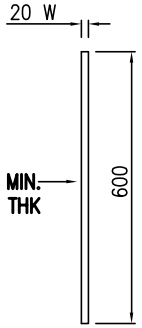
SPA125



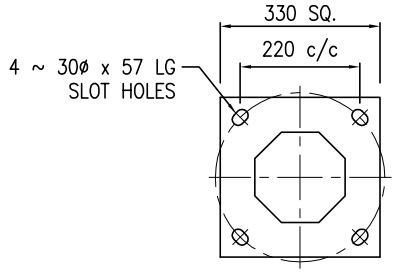
SECT B-B



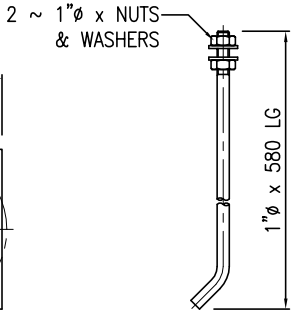
FLUSH DOOR



DETAIL D



BASE FLANGE



RAG BOLT
(H58R2A)

TECHNICAL SPECIFICATIONS

1) **DESIGN CONDITIONS**
   - 1.1 BASIC WIND SPEED : **35** m/s (BS 5649) SUPERSEDED BY BS EN 40-3-1
   - 1.2 10 MINUTES MEAN WIND VELOCITY : **20.6** m/s (BS EN 40-3-1) EQUIVALENT TO BS 5649 3-SEC GUST BASIC WIND SPEED OF **35** m/s
   - 1.4 UNIT SAIL AREA OF LUMINAIRES : **0.12 m²**
   - 1.5 TOTAL MASS OF LUMINAIRES : **12 KG**
2) **STANDARDS**
   - 2.1 POLE DESIGN : BS EN 40-3-1 & BS EN 40-3-3 EN 12767 CLASS 0
   - 2.2 MATERIAL : BS EN 10025 S275JR
   - 2.3 WELDING (ELECTRIC ARC WELDING) : BS EN 1011-2
   - 2.4 GALVANIZING (**10 YEARS** WARRANTY) : BS EN ISO 1461 / BS 729
3) **TESTING PROCEDURES** : DIMENSIONAL VERIFICATION, GALVANIZING THICKNESS, MATERIAL STRENGTH & THICKNESS TYPE TEST: BS EN 40-3-2
4) **QUALITY CONTROL PROCEDURES** : THE SUPPLIER / MANUFACTURER AND GALVANIZER SHALL BE ISO 9001 : 2008 ACCREDITED

MANUFACTURER'S COMPLIANCE

1) **LOCALLY MANUFACTURED PRODUCTS** : -MANUFACTURER'S DECLARATION THAT POLE SECTIONS AND COMPONENTS ARE "MADE IN MALAYSIA" IN COMPLIANCE TO MOF "SURAT PEKELILING PERBENDAHARAAN BIL.7 TAHUN 2002".
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   -GALVANIZING TEST
   -MATERIAL TEST
   -WELDING TEST BY DYE PENETRANT
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✱ **UTILITY INNOVATION APPLICATION NO : UI 2012001805**

CUSTOMER APPROVED DRAWING
FOR MANUFACTURE

(Co. stamp, sign & date)

REV	DETAILS	BY	CHD	DATE

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PRELIMINARY DRAWING FOR TENDER PURPOSES ONLY

PROJECTION

ALL DIMS ARE SUBJECT TO MANUFACTURING TOLERANCES

CLIENT : KEJURUTERAAN BROADWAY

PROJECT:

DRAWN : NSJ | CHD | DATE: 05.04.17

LYSAGHT MARKETING SDN BHD
CO. NO.: 102382-M

TITLE : *8 m RV LIGHTING COLUMN (FLANGED TYPE) c/w SPA125*

SCALE : 1 : 55 | SHEET 1 of 1 | REV

DWG./REF. NO. RV080FA -124 -1

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DIMENSIONS IN mm UNLESS STATED

SHEET SIZE A4



Siren Tone Activation

RS485 Interface

Introduction

Emergency Paging Panel is an essential tool for firemen during emergency, allowing direct paging to all zones and bypassing any active BGM or paging in progress.

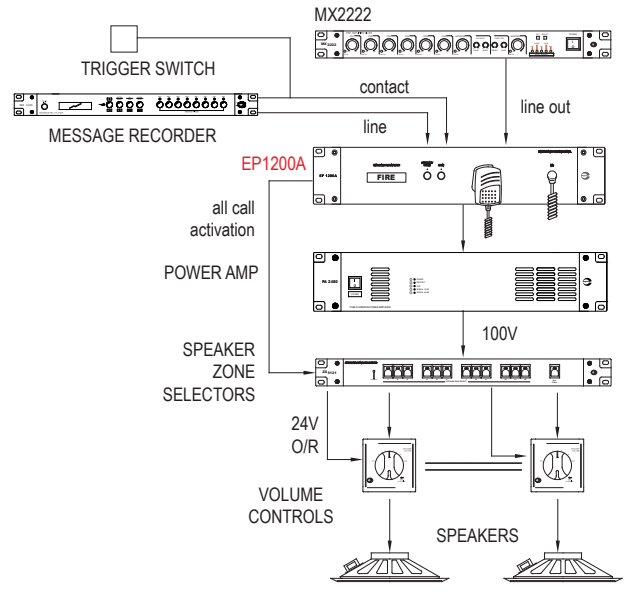
EP1200A is enhanced with communication port, enabling the unit to be used with iPX5151 IP Client for a LAN based setup. This shall allow simultaneous emergency paging or siren activation for entire multiple sub racks available in the system.

Features

- Built in siren tone generator (constant signal)
- Visual FIRE indicator
- External voice message activation
- Dual mode siren tone activation
- Dry contact when paging mic is activated
- Priority paging via front panel microphone, bypassing all other audio sources
- Output level controls for siren and message / paging microphone

Application Schematic

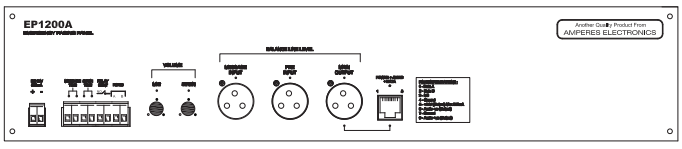
Application in conventional system



Technical Specifications

Power requirement	24V DC
Power consumption	3.5W
MICROPHONE	
Mic sensitivity	-72 dB Omni directional
Impedance	600 Ohm
Frequency response	300 ~ 8 KHz
SIREN	
Siren frequency	Continuous at 8 KHz
Siren duration	Continuous when activated
Siren activation	Front test switch / remote contact
Input channel	Pre-amplifier output, message recorder
Output level	Balanced line out (1.2V)
Priority sequence	Paging mic - siren - message - pre amp in
Indicators	Front FIRE with backlight illumination
Dimension (WxHxD)	482 x 88 x 180 mm
Weight	3.0 kg

Rear View:



Packing information

Qty per carton	: 1 unit
W x H x D	: 560 x 165 x 295 mm
Weight	: 3.6 kg



Priority Mute

Dual Output

Phatom Power

Introduction

This compact 1 hu pre-amplifier mixer features 6 mic, 4 BGM sources, chime and external line inputs and is suitable for any application, such as meeting room, lecture theatre, hall of prayer and definitely commercial fixed PA installation.

It dual output feature can be used for uninterrupted paging setup, ie. BGM and paging announcement. Adjustable priority muting level is available for paging announcement to override BGM and other lower priority sources. Adjusting it to minimum and the unit shall work like any other mixing unit and it comes with 12V phantom power supply for mic input 1 to 4.

Features

- 12 inputs of mic, BGM sources, ext.chime and mixer link
- Expandable to form more channels for larger setup
- Auto mic muting with adjustable mixing level for mic Ch.1, 2, ext.chime and mixer link
- Priority muting with disable option for normal mixing mode
- Switchable phantom power for mic channel 1 to 4
- Dual output ; mixed line and BGM output for uninterrupted paging setup
- Independently adjustable BGM output level with balanced line
- Built in daisy chain source selector with last selection memory
- Bass and treble tone control
- AC and DC operation for uninterrupted operation during power failure

Application Schematic

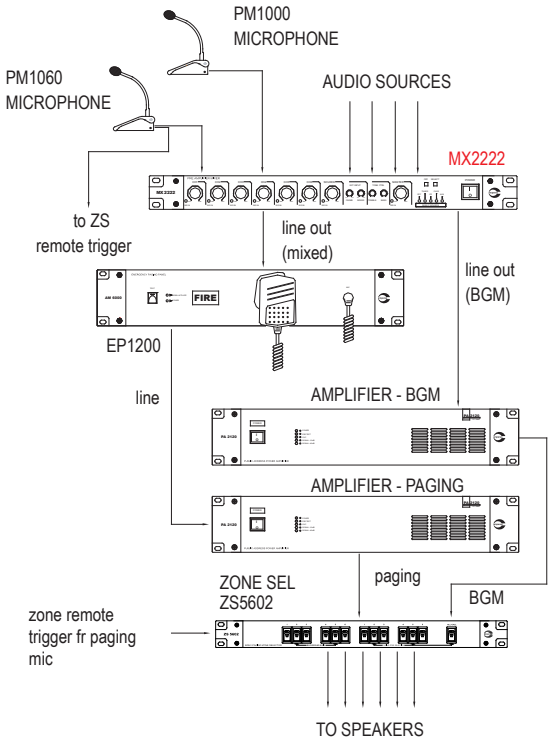
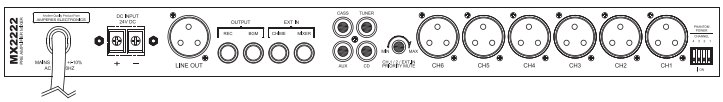


Illustration for uninterrupted paging system.

Technical Specification

Operating voltage	230 / 240V ac or 24V DC
Power consumption	2.4W on 240V ac / 100 mA on 24V DC
Input channels	6 x mic ; 4 x BGM ; ext chime in ; mixer link
Input impedance	Mic : 600 Ohm BGM : 47 K Ohm unbalanced Chime input : 10 K Ohm unbalanced Mixer link : 600 Ohm balanced
Sensitivity(1.2 mVrms output)	Line : 530 mVrms Mic : 2.5 mVrms
Output level	1.2V XLR balanced (mixed output) 1.0V phone jack balanced (BGM output)
Output impedance	600 Ohm balanced
Controls	Mic channel ; chime ; mixer input Master mixed ; BGM ; Bass and treble controls
Phantom power	12V DC switchable at mic 1 to 4
Frequency response	175 - 15 KHz (+/- 3 dB at 1 KHz) with low cut
S/N ratio	> 60 dB at 1 KHz
Dimensions (WxHxD)	482 x 44 x 180 mm
Weight	2.5 kg

Rear View



Packing information
Qty per carton : 1 unit
W x H x D : 560 x 95 x 295 mm
Weight : 3.1 kg

amperes

120W 100V | **PA2120**
240W 100V | **PA2240**
360W 100V | **PA2360**
480W 100V | **PA2480**



Introduction

PA2000 Series of amplifiers had been a reliable workhorse for years and had been refined to perform more efficiently. It is available with power ratings of 120W to 480W 100V line, in 2 HU height for space saving.

Various protection features are included with the objective of providing trouble free operation for years to come.

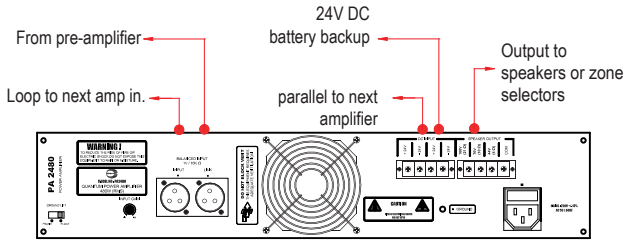
Packing information
Qty per carton : 1 unit
W x H x D : PA2120 / PA2240 / PA2360 / PA2480
: 550 x 180 x 465 mm

Weight : PA2120 - 13.4 kg
PA2240 - 14.6 kg
PA2360 - 17.4 kg
PA2480 - 19.4 kg

Features

- Available in various ratings ; from 120W to 480W 70 or 100V line
- 4 Ohm speaker connection available with 25V output
- Thermal protection by muting input signal (typically 85 deg at heat sink)
- Momentary short circuit protection
- Temperature dependent dual speed cooling fan
- Balanced input signal with gain control and selectable grounding option
- AC and DC operation for uninterrupted operation during power failure

Application Schematic



Technical Specifications

	PA2120	PA2240	PA2360	PA2480
Power requirement	220 / 240V ac or 24V DC back up supply			
Power consumption (240V ac)	280VA (1.3A)	420VA (1.75A)	560VA (2.3A)	700VA (3.0A)
Current consumption (24V DC)	8A	14.5A	19A	24A
Standby current (24V DC)	0.2A	0.25A	0.3A	0.32A
Input signal	1V / 10K Ohm; balanced via XLR female			
Input gain controls	-40 to 4 dBu			
Rated output (100V, RMS)	120W	240W	360W	480W
4 Ohm output voltage	22V	31V	38V	43.8V
Output impedance (max load)	83 Ohm	42 Ohm	27 Ohm	20 Ohm
Frequency response	70Hz - 15 KHz @ 1KHz +/-3 dB			
S/N ratio	>70 dB @ 1 KHz, 1V			
THD + N	<0.18 %			
Protections	Thermal, Short circuit, Overload, Fuse			
Cut off temperature	75 Deg C			
Cooling system	Auto temperature controlled fan speed			
Indications	LED : Power, Signal level			
Dimensions (W x H x D)	482 x 88 x 335 mm			
Net Weight	12 kg	13.3 kg	16.2 kg	18.2 kg

IMPROVED



Introduction

AX3800 offers great flexibility and simplicity for amplifier fault changeover setup. With the precise circuit design, amplifier fault detection period is greatly reduced to initiate timely changeover to standby unit. The internal pilot tone generation at 20KHz is set at optimum interval to avoid unnecessary loading to amplifiers.

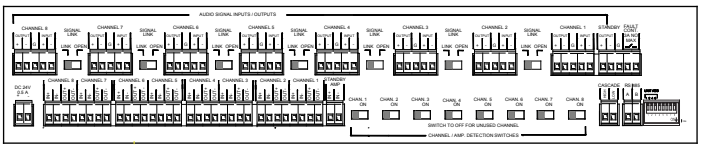
Changeover shall occur at both input and output of amplifiers, making it suitable for application in a matrix system. Priority and single changeover ensures overloading of standby amplifier is avoided, thus providing a reliable and uninterrupted system at most times.

Simplified Cabling

Pilot Tone Generator

Shorter Fault Detection

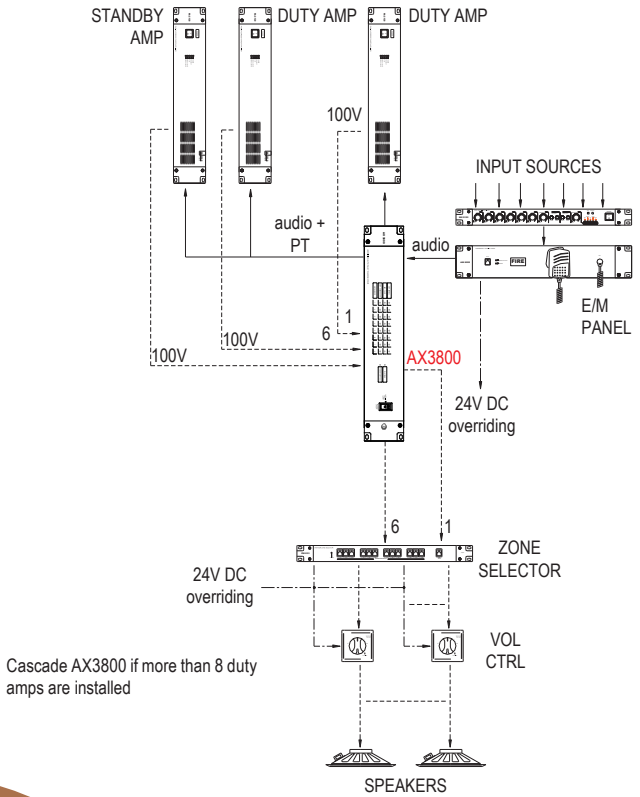
Rear View:



Features

- Cater for 8 duty and 1 standby
- Expandable for 1 standby to cater for more than 8 duty amps.
- Built in Pilot Tone generator, transmit at intervals and senses at sequence to protect amplifiers
- Overloading protection by allowing only a single take over
- Prioritised changeover which higher numbered amplifier shall be preferred for take over if more than two units are down
- Shorter fault detection time from 7 to 15 seconds
- Changeover at input and output section simultaneously ; suitable for matrix system installations
- Input link switch ; making connection of sources easier
- Channel isolation switch for unused or un-monitored channel
- Individual channel status indicators ; normal, fault and changeover

Application Schematic



Technical Specifications

Operating voltage	24V DC ; 1A
Power consumption	6.8 W
Input signal	8 Ch balanced line signal
Input impedance	10 K Ohm
Audio output gain	Unity
Pilot tone interval	8 seconds / channel
Pilot tone frequency	20 KHz (+/- 5%)
Detection line	70 / 100 V line
Detection level	50 V rms min
Failure detection time	7 - 15 seconds
Failure recovery time	20 seconds max
Zone load rating	500W / 100V line max
Status indication LED	Normal ; Fault ; Changeover
Changeover alert	Buzzer with switch
Changeover section	Input and output simultaneously
Dimensions (WxHXD)	482 x 88 x 180 mm
Weight	2.85 kg

Packing information
Qty per carton : 1 unit
W x H x D : 560 x 165 x 295 mm
Weight : 3.6 kg



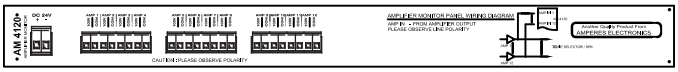
Introduction

AM4120 shall be used to monitor amplifier outputs of 70 / 100V line at the rack which is equipped with level meter, amplifier output LED and speaker for audio monitoring. It can also be used as a tool to calibrate sound output level of each amplifier from the rack.

Features

- 12 inputs for 70 / 100V line amplifier outputs
- Dual mode monitoring with continuous signal indicator
- Audio monitoring with volume control

Rear View:



Technical Specifications

Operating voltage	24V DC via PS9400 PSU
Power consumption	50 mW
Amplifier inputs	12 : 70 / 100V line
Monitoring mode	Audio : 1W speaker with 5 presets Visual : segment LED level meter LED for all channels
Dimensions (WxHxD)	482 x 44 x 180 mm
Weight	2.1 kg

Packing information

Qty per carton	: 1 unit
W x H x D	: 560 x 95 x 295 mm
Weight	: 2.8 kg

AS4000 | Amplifier Surveillance Module



AS4000 is used to monitor the status of 70 / 100V line power amplifiers which do not have built in detection module. Every amplifier shall employ one AS4000 and the dry contact output from the unit shall then be connected to Amperes AX700. Repeating this link shall then form an automatic amplifier fault changeover / surveillance system.

Technical Specifications

Operating voltage	24V DC via PS9400 PSU
Power consumption	200 mW nominal
Input impedance	10 K balanced
Output impedance	600 Ohm balanced
Max audio input	0.75V
Max audio output	1.2V
Transmit interval	10 seconds
Detection delay	20 seconds
Recovery time	30 seconds
Frequency response	20 - 20 KHz
Detection output	NO and NC dry contact
Dimensions (WxHxD)	120 x 96 x 28 mm
Weight	330 gms

Features

- Interval Pilot Tone injection ; reduces strain to amplifiers
- Works independently with or without availability of audio signal
- Low distortion to original audio signal
- Status monitoring via LED ; Pilot Tone and amplifier fault
- Compatible with most 70 / 100V line amplifiers in the market

24 DC Automatic Battery Charger

amperes

NEW



RS485 | Remote | Battery Protection

Features

- Constant DC voltage charging for 24V battery bank
- 4A initial charging current with reducing rate over charging time
- Built in surge protection and resetable fuse
- Output short circuit protection
- Thermal protection against overheating
- Auto low battery disconnection with LCD indication
- Battery reversed polarity protection
- Rear mains switch to avoid unnecessary switching off the unit
- RS485 communication for remote monitoring via PMX II software

Rear View:



Introduction

Meet the all new next generation of innovative Battery Charger, which has been engineered to meet the requirement of installers and users alike. It is compact in 1 HU height, built with the latest technology for efficient charging, controls and monitoring purpose.

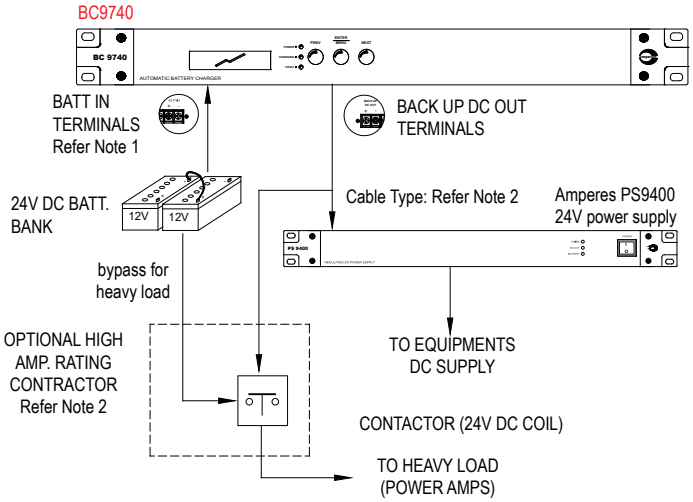
Driven by powerful ARM processor, it works to protect against misconnections, prolonging battery life with its battery monitoring feature and communicates to provide human interaction. RS485 data port is available for external monitoring via PMX II Software and can be readily linked up to LAN through iPX5500 Com Box.

Amperes invites you to experience this innovative product which we had meticulously developed for the convenience of the valued users.

Technical Specifications

Input voltage	220 / 240V ac
Charging voltage	28.8V dc
Charging current	4A; (max 5A)
Idle power consumption	1.3W
Protections	25A resettable fuse at battery back up output Low battery auto disconnection, reverse polarity, standby protection
Indications	AC mains, short circuit and low battery
Displays	Charging current Charging voltage Battery voltage Output current Battery reverse polarity
Communication	RS485 out; link to Amperes PMX II LAN via iPX5500 comm. box for remote monitoring
E/M back up Amp rating	25A max (Use external contactor / relay if required)
Terminals	Battery input , EM load
Dimensions (WxHxD)	482 x 44 x 180 mm
Weight	2.62 kg

Application Schematic



Packing information
Qty per carton : 1 unit
W x H x D : 560 x 95 x 295 mm
Weight : 3.2 kg

From contemporary to classic design, Amperes offers choices for the installation needs. The variants are in three different designs and available in various ratings, ranging from 5 watts to 150 watts 100V line.

They are suitable for 4 wire system installation with built in emergency overriding relay and overriding LED indicator.

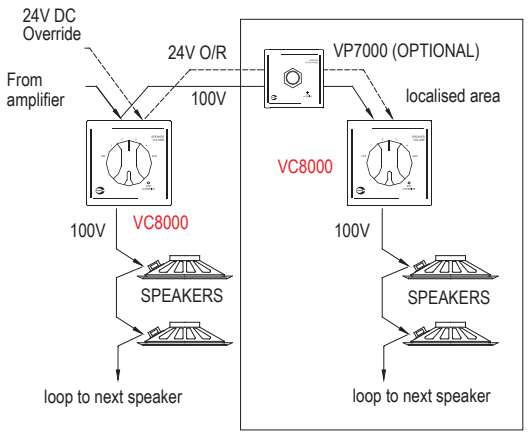
Features

- Suitable for 4 wire system : 2 for 100V line , 2 for 24V DC overriding signal
- Built in overriding relay to allow emergency signal to bypass volume attenuation
- Overriding LED indicator whenever EM paging is activated
- 5 preset attenuation with OFF
- Large cable terminal block for ease of termination

Technical Specifications

Power rating	Refer to variants
Overriding voltage	24V DC
Overriding current	15 mA per channel
Attenuation	6 steps incl. OFF
Attenuation / step	6 dB / step
Attenuation method	VC7005 / 7010 / 8010 - Resistive Others - Auto transformer
Colour	White
Size (W x H x D)	VC7000 / 8000 - 86 x 86 x 40 mm VC7000A - 70 x 120 x 40 mm
Weight	VC7805 / 7005 / 7010 - 100 gms VC7030 / 7050 - 248 gms VC7100 / 7150 - 382 gms VC8010 - 250 gms VC8030 - 254 gms VC8050 - 264 gms VC8100 - 269 gms
Optional item :	
Conceal enclosure	77 x 77 x 60 mm
Surface enclosure	85 x 85 x 60 mm

Application Schematic



4 wire system installation

NOTE :
Wall concealed installation shall require back enclosure with depth of min 50 mm from finishing surface for models with auto transformer. Normal electrical back enclosure shall suffice for installation using resistive volume controllers. ie. VC7005 / 7010 / 8010



VC7000 - 5 - 150W 100V (86 x 86 mm)



VC7000A - 5 - 100W 100V (70 x 120 mm)

For 70 x 120 faceplate series:
Vertical and Horizontal version available



VC8000 - 5 - 100W 100V (86 x 86 mm)

Variants :

VC8000 SERIES (86 X 86 mm)

VC8010 :	10W 100V Line Resistive
VC8030 :	30W 100V Line Auto Trans
VC8050 :	50W 100V Line Auto Trans
VC8100 :	100W 100V Line Auto Trans

VC7000 SERIES (86 x 86 mm)

VC7810 :	10W 8 OHM Resistive
VC7005 :	5W 100V Line Resistive
VC7010 :	10W 100V Line Resistive
VC7030 :	30W 100V Line Auto Trans
VC7050 :	50W 100V Line Auto Trans
VC7100 :	100W 100V Line Auto Trans
VC7150 :	150W 100V Line Auto Trans

VC7000A SERIES (70 X 120 mm)

VC7010A :	10W 100V Line Resistive
VC7030A :	30W 100V Line Auto Trans
VC7050A :	50W 100V Line Auto Trans
VC7100A :	100W 100V Line Auto Trans

CS510 / CS610 : DUAL CONE CEILING SPEAKER W ABS ENCLOSURE

Available in 5" and 6" of driver size complete with matching transformer of three tapping ; 1, 3 or 6W. Back enclosure are supplied as integral part of the speakers made from quality ABS plastic. Installation is made easy with its screw mounting mechanism.

Packing information
CS510A : 850 (W) x 385 (H) x 240 (D) mm
: 15 kg
: 20 uts per carton

CS610A : 685 (W) x 475 (H) x 340 (D) mm
: 19.6 kg
: 18 uts per carton



CS510A - 5" 6W 100V Line
CS610A - 6" 6W 100V Line



CS606 - 6" 6W 100V Line

CS515 : DUAL CONE CEILING SPEAKER W ABS ENCLOSURE

CS515 is a general purpose 5" 6W 100V line ceiling speakers which comes complete with ABS honeycomb grille and back enclosure. It is suitable for BGM and Paging application and suitable for rust prove environment.

Packing information
CS515 : 850 (W) x 385 (H) x 240 (D) mm
: 15 kg
: 20 uts per carton



NEW

CS515 - 5" 6W 100V Line

CS606 : DUAL CONE CEILING SPEAKER W METAL ENCLOSURE

Available in 6" dual cone speaker with back metal enclosure, grill and baffle and multi tap matching transformer of 1.5, 3 and 6W 100V line. This model shall be suitable for installations that demand fire resistant version of dome.

Packing information
CS606 : 420 (W) x 220 (H) x 345 (D) mm
: 6.5 kg
: 6 uts per carton

CS343 : WEATHERPROOF CEILING SPEAKER

CS343 is driven by a 4" dual cone speaker with built in matching transformer of dual taps of 3 and 6W 100V line.

Made of quality ABS enclosure and aluminum grille, it is suitable for high humidity areas, such as bathrooms and salty environment. Though compact in size, it delivers satisfactory sound reproduction with high SPL level, good for listening pleasure as well as paging clarity.

Packing information
CS343 : 550 (W) x 180 (H) x 465 (D) mm
: 9.5 kg
: 9 uts per carton



CS343 - 4" 6W 100V Line

Technical Specifications

	CS510	CS610	CS606	CS515	CS343
SPEAKER					
Power rating	6W 100V line nominal (max 10W)				
Diameter	5" (125 mm)	6" (150 mm)		5" (125 mm)	4" (100 mm)
Cone type	Dual cone				
Impedance (Ohm)	8				
Freq response (+/- 5dB)	150 ~ 19 KHz	120 ~ 19 KHz	150 ~ 16 KHz	150 ~ 17 KHz	150 - 18 KHz
SPL @ 1W / m (+/- 3dB) 1 KHz	93 dB	92 dB	91 dB	92 dB	90 dB
Magnet weight	3 oz	5.3 oz	2 oz	3 oz	
TRANSFORMER					
Tapping (100V line)	1 / 3 / 6W		1.5 / 3 / 6W		3 / 6W
Primary impedance (Ohm)	10 K / 3.3 K / 1.6 K		6.7 K / 3.3 K / 1.6 K	10 K / 3.67 K / 1.7 K	3.3K / 1.67 K
Secondary impedance (Ohm)	8				
PHYSICAL					
Grille / enclosure	White metal / ABS white		White metal	ABS Plastic	Aluminum / ABS
Cutting hole dim	140 mm	175 mm	165 mm	145 mm	120 mm
Overall size (dia x height)	177 x 130 mm	230 x 102 mm	200 x 100 mm	175 x 95 mm	140 x 130 mm
Weight	715 g	785 g	950 g	600 g	900 g
Colour	White				

SURFACE MOUNT SPEAKER

It is constructed with high quality ABS plastic with 4" dual cone speaker driver and multi tapping matching transformer of 1 / 3 / 6 and 10W 100 V line. Suitable for wall and ceiling installation with optional tilt mounting bracket. Available in white colour.

Packing information
BS410 : 550 (W) x 220 (H) x 430 (D) mm
: 12 kg
: 12 uts per carton



BS410 - 4" 10W 100V



DV410 - 4" 6W 100V

SURFACE MOUNT SPEAKER

A classic yet favourite model which is suitable for installations in small enclosed areas such as staircase, office, etc. Available in white colour with multi tap matching transformer of 1 / 3 / and 6W 100V line, fit for vertical or horizontal installations.

Packing information
DV410 : 590 (W) x 400 (H) x 305 (D) mm
: 15.4 kg
: 18 uts per carton

SURFACE MOUNT SPEAKER

Wall mount speaker are suitable for any type of sound reproduction, for both paging and background music. Available in white colour with high effeciency driver and line transformers.

Packing information
BS410 : 550 (W) x 220 (H) x 430 (D) mm
: 12 kg
: 12 uts per carton

NEW



BS506 - 5" 6W 100V

Technical Specifications

	BS410	DV410	BS506
SPEAKER			
Power rating	10W 100V	6W 100V	6W 100V
Diameter	4"		5"
Cone type	Dual Cone		
Impedance (Ohm)	4	8	8
Freq response (+/- 5dB)	100 ~ 16 KHz	100 ~ 18 KHz	100 ~ 15 KHz
SPL @ 1W / m (+/- 3dB) 1 KHz	92 dB	90 dB	93 dB
Magnet weight	7.5 oz	3.0 oz	3 oz
TRANSFORMER			
Tapping (100V line)	1 / 3 / 6 / 10W	1 / 3 / 6W	1 / 3 / 6W
Primary impedance (Ohm)	10 K / 3.3 K / 1.6 K /1K	10 K / 3.3 K / 1.6 K	10 K / 3.3 K / 1.6 K
Secondary impedance (Ohm)	4	8	8
PHYSICAL			
Grille / enclosure	ABS with metal grille		ABS
Overall size (WxHxD)	185 x 205 x 90 mm	195 x 215 105 mm	172 x 195 x 105 mm
Weight	1.1 kg	0.75 kg	
Colour	White		



HS815 8" 15W 100V LINE
HS830 12" 30W 100V LINE

HS815 & HS830 : HORN SPEAKER WITH ROUND FLARE

Both models are constructed using rounded aluminum flare of 8" (HS815) and 12" (HS830) with multiple power selection via rotary switch. Suitable for schools, mosques, car parks, factories at indoor or under shade installations and that requires omni direction sound broadcast.

Packing information
HS815 : 695 (W) x 480 (H) x 520 (D) mm
: 23 kg
: 12 uts per carton

HS830 : 665 (W) x 665 (H) x 355 (D) mm
: 10.6 kg
: 4 uts per carton

HS880 20" 80W 100V LINE



HS880 : HIGH POWER HORN SPEAKER

Constructed using rounded aluminum flare of 20" (HS880) with multiple power selection. It is suitable for schools, mosques, fencing perimeters etc, which requires loud and clear broadcast.

Packing information
HS880 : 585 (W) x 390 (H) x 560 (D) mm
: 6.2 kg
: 1 unit per box



HS820 6" X 8" 15W 100V LINE
IP65

HS820 : HORN SPEAKER WITH RECT. FLARE

Constructed with high impact ABS flares rectangular shape to suit installation sites where pattern of broadcast shall be controlled, such as low level car parks, corridors, etc. Suitable for indoor or outdoor sites with IP65 rating.

Packing information
HS820 : 550 (W) x 180 (H) x 465 (D) mm
: 14.2 kg
: 8 uts per carton

Technical Specifications

	HS815	HS830	HS880	HS820
Power rating	15W 100V	30W 100V	80W 100V	15W 100V
Power tapping (W)	1 / 3 / 5 / 10 / 15	3 / 5 / 10 / 15 / 30	20 / 40 / 60 / 80	1.9 / 3.8 / 7.5 / 15
Primary Impedance (Ohm)	670 1 K 2 K 3.3 K 10 K	330 670 1 K 2 K 3.3 K	500 250 160 125 -	5.26 K 2.63 K 1.33 K 667 -
Secondary impedance (Ohm)	8		16	8
Frequency response (+/-5 dB) @ 1KHz, 1W	350 ~ 7 KHz	300 ~ 10 KHz	160 ~ 6 KHz	250 ~ 8 KHz
SPL (1W / m @ 1 KHz)	103 dB	105 dB	110 dB	105 dB
Flare material	Aluminum			ABS
Flare dimension	8" round	12" round	20" round	160 x 220 mm
Driver enclosure	ABS		Aluminum Diecast	ABS
Overall size (dia x height)	210 x 240 mm	310 x 325 mm	504 x 335 mm	222(W) x 162(H) x 232(D) mm
Weight	1.55 kg	1.85 kg	3.35 kg	1.5 kg
Colour	Beige			White

PM1000 | Dekstop Paging Microphone
PM1060 | 6 Ch Dekstop Paging Microphone
PM1120 | 12 Ch Dekstop Paging Microphone

Introduction

PM1000 analogue series are available in three variants and had been serving many installations faithfully since its creation. They are available as simple paging mic with chime to those with 6 or 12 zone selections. They are most suitable for simple and small size installations of less than 12 zones in total.

Features

- Condenser gooseneck microphone with illuminated ring
- Pre and post announcement 4 tone chime
- Adjustable chime and mic volume with balance mic / line output level
- Output level selection to mic or line signal to suit the input type of the pre-amplifier mixer
- Dry contact available when mic is active (PM1000 only)
- 6 or 12 zone selection for PM1060 and PM1120

Technical Specifications

	PM1000	PM1060	PM1120
Power requirement	24V DC adaptor	24V DC via D9 conn.	
Power consumption	50 mA	150 mA	150 mA
Zone selection	ALL CALL	6 and 12 zones w ALL CALL	
Microphone	Condenser microphone cardioid		
Output impedance	600 Ohm		
Output level	1.2 V (line output) / balanced mic (775 mV)		
Output dry contact	3 A normally open		
Output controls	Chime and mic level		
Audio connection	1/4 " stereo phone jack		
Switching connection	2W connector	D15 connector	
Operating distance	300 m (recommended)		
Chime	4 tone up and 4 tone down		
Indicators	Mic ring, zone switch, ALL CALL		
Frequency response	100 ~ 12 KHz (+/- 3dB ; 0 dB out)		
S/N ratio	> 60 dB		
Gooseneck mic length	400 mm		
Dimensions (WxHxD)	150 x 62 x 186 mm (excluding mic)		
Weight	800 gms	800 gms	850 gms



PM1000

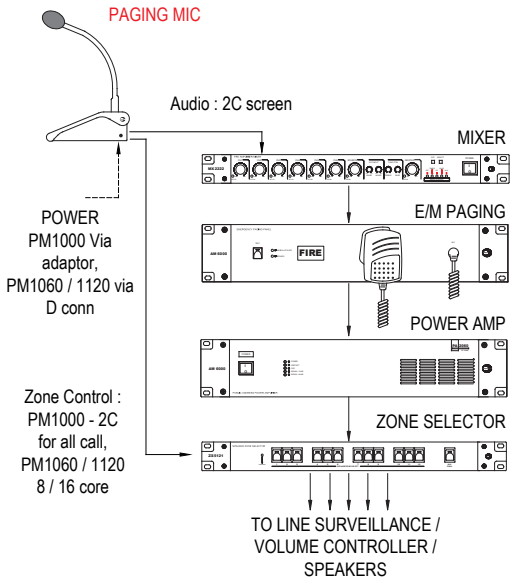


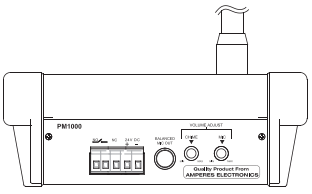
PM1060



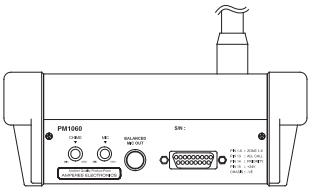
PM1120

Application Schematic





Rear View Of PM1000



Rear View Of PM1060 / PM1120

Packing information

Qty per carton	: 1 unit
W x H x D	: 512 x 83 x 288 mm
Weight	: PM 1000 - 1.5 kg (incl adaptor)
	: PM 1060 - 1.15 kg
	: PM 1120 - 1.2 kg



SQ9715

Features

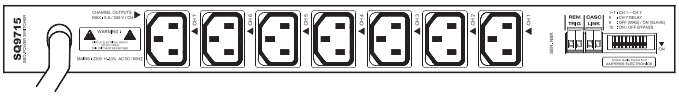
- 7 channel with 6A per channel; total load of 15A with surge protection
- Cascade 2 units to form 14 channel setup
- ON / OFF sequential switching
- Remote switching port via external noiseless contact
- AC output via IEC connectors with channel isolation via DIP switch
- Ch. 7 with delay Off option for 2 min ; suitable for video projector connection
- Lock mode to avoid incidental switching

Introduction

SQ9715 is suitable for applications in PA, sound and AV system in which it manages the powering sequence of every equipment in orderly manner. It works to provide a some degree of protection to the lifespan of the equipment as random powering may cause irreversible damage.

It has internal surge protection to kill harmful incoming power spikes. An important tool that works to safely powering up your equipment with a touch of a button.

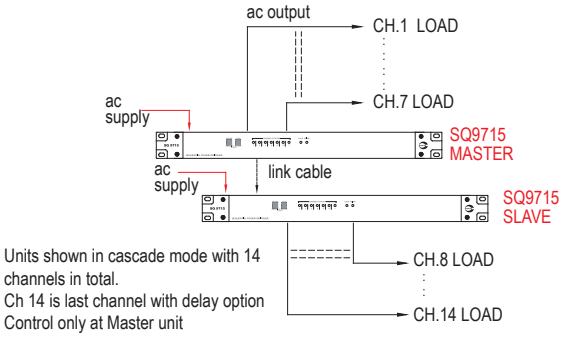
Rear View:



Technical Specifications

Operating voltage	230 / 240V ac
Power consumption	50 mW (without load)
Output voltage	230 / 240V ac
Max load / channel	6A
Max total load	15A
Output connection	IEC female socket
Max cascade	2 uts : total 14 channels
Surge protection	L-N, L-E, N-E.
Clamping voltage	870V ac
Turn on sequence	Step 1 to 7 incremental
Turn off sequence	Step 7 to 1 decremental
Step timing	2 seconds
Delay off option	Channel 7 via DIP switch
Delay off timer	2 minutes
Switch lock	Via front switch
Indicators	AC mains, Ch. on, Lock
Dimensions (WxHxD)	482 x 44 x 180 mm
Weight	2.7 kg excl. accessories

Application Schematic



Units shown in cascade mode with 14 channels in total.
Ch 14 is last channel with delay option
Control only at Master unit

Packing information
Qty per carton : 1 unit
W x H x D : 560 x 95 x 295 mm
Weight : 3.3 kg

Regulated 24V DC Power Supply | PS9400



IMPROVED

Technical Specifications

Input ac voltage	220 ~ 240V ac
Output voltage	24V +/- 1%
Rating	4A nominal ; max 4.5A
No load consumption	50 mW
Efficiency	83%
Indicators	AC mains, battery input, DC output
Protections	Built in surge protection Short circuit Overload (105% ~ 150%) Over voltage (115% ~ 135%)
Output DC protection	Manual reset circuit breaker
Terminals	Batt input and load ; barrier connector
Dimensions (WxHxD)	482 x 44 x 180 mm
Weight	2.6 kg

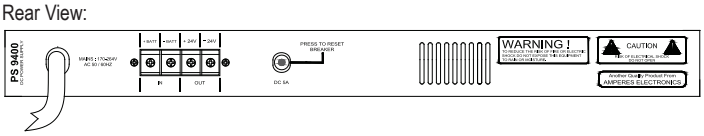
Packing information
Qty per carton : 1 unit
W x H x D : 560 x 95 x 295 mm
Weight : 3.3 kg

PS9400 is a rack mounted 24V DC regulated power pack designed uniquely for PA installations. It comes with built in changeover relay which shall be connected to back up 24V DC to allow continuous and uninterrupted supply to the whole installation whenever the mains failed.

Features

- 4V DC 4A output highly regulated switching power supply
- Manual reset output circuit breaker protection
- Built in surge and short circuit protection
- Back up battery overriding relay

Rear View:



ZS5062 | 6 Ch Speaker Zone Selector
ZS5122 | 12 Ch Speaker Zone Selector

NEW

RS485 | Fail Safe | Remote Monitor

Features

- Available in 6 and 12 zones ; expandable to 192 zones
- Fail safe zone trigger during power or unit failure
- Remote zone triggering via analogue and RS485 data
- Zone monitoring via PMX II software
- Local paging overriding bypassing BGM
- Flexible amplifier to zone configuration

Introduction

These next generation of zone selectors are introduced to meet the new demands for a fail safe equipment. They are available in 6 and 12 zones and expandable to larger configurations.

ZS5602 / 5122 may look and function similarly with other zone selectors but they have several distinctive features for safety, operation and monitoring. All zone contacts shall automatically closed during power failure or damage to the unit, which is vital to continuous emergency broadcast. RS485 communication port is available for remote triggering or monitoring via PMX software.

ZS5062
6 Ch Speaker Zone Selector



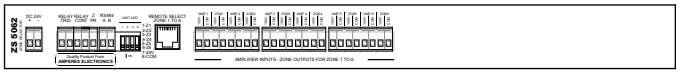
ZS5122
12 Ch Speaker Zone Selector



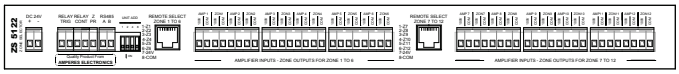
Technical Specifications

	ZS5062	ZS5122
Operating voltage	24V DC via PS9400 adaptor	
Power consumption (idle)	3.29W	6.25W
Power consumption (All Call)	0.72W	0.96W
Current consumption (idle)	0.14A	0.26A
Current consumption (All Call)	0.03A	0.04A
Max load / channel	500W at 100V line	
Number of zones	6	12
Amplifier inputs	6	12
Zone selection	Front panel switch and remote	
Cascade limitation	16	
Remote triggering	-ve triggered (common ground)	
Indicators	Individual zone switch, Priority	
Data communication	RS485 19.2 kbps baud rate	
Switching mode	Individual, All Call Local zone selection bypassed when remote trigger is activated	
Dimensions (W x H x D)	482 x 44 x 180 mm	
Weight	1.85 kg	2 kg

Rear View ZS5062:



Rear View ZS5122:



Packing information
Carton : 560 (W) x 95 (H) x 295 (D) mm
Weight : ZS5602 : 2.5 kg
: ZS5122 : 2.7 kg
Qty : 1 unit / carton

4.0 Warranty Certificate & Authorities letter

ABLECON POWER SYSTEM SDN BHD (932164-P)
5 Jalan Pemberita U1/49, Temasya Industrial Park, Glenmarie
40150 Shah Alam, Selangor Darul Ehsan
Tel: 603-55694990 Fax: 603-55694090
E-mail: sales.ablecon@gmail.com

ABLECON
POWER SYSTEM

Our Ref. : APS/L150/17

Date : 21th December 2017

Kejuruteraan Broadway Sdn bhd
No 29 Jalan Jintan
Taman Supreme
Cheras, Kuala Lumpur

Dear Sir / Madam,

PROJECT : Lot 7316 Jalan Klang Banting RHB Trustees
PRODUCT : Schneider Electric 11KV Switchgear (Model: HWX-C & RMU SM6)
OWNER : RHB TRUSTEES BERHAD (AXIS REAL ESTATE INVESTMENT TRUST (Co no. 573019-U)
LESSEE : NESTLE PRODUCTS SDN BHD (Company NO. 45228-H)

ABLECON POWER SYSTEM SDN BHD ("the supplier") hereby undertake to provide warranty the equipments supplied to the project mention above to be free of defects in workmanship and material for a period of **12 months** from Date of Delivery.

Our standard terms and conditions apply in this warranty.

It shall be an essential condition in the warranty, that the Buyer promptly brings to the Company's attention of any defect complained of and satisfactory proof of its existence thereof, and demonstrates to the satisfaction of the Company that the equipment has been properly installed within the time stipulated, maintained and operated within its rated design characteristics.

Thank you.

Yours truly,
*For **ABLECON POWER SYSTEM SDN BHD***

.....
Vincent Loi

DAVEX (MALAYSIA) SDN BHD (114942-X)
Head Office
65, Jalan PJS 11/7, Bandar Sunway,
47500 Subang Jaya, Selangor, Malaysia.
tel : +603 5636 4348
fax : +603 5636 4352
email : malaysia@davislighting.com

Penang Branch
Plot 32, Lorong Perusahaan Maju 8,
Bukit Tengah Industrial Park, Phase IV,
13600 Seberang Prai, Pulau Pinang, Malaysia.
tel : +604 507 0293 / 0580
fax : +604 507 0968
email : malaysia@davislighting.com
url : www.davislighting.com

Our ref: Sijangkang//LKP/Warranty/18/01

4th January 2018

RHB Trustees Berhad
(As Trustee for Axis Real Estate Investment Trust)
3rd Floor, Plaza OSK, Jalan Ampang,
50450 Kuala Lumpur.

Or

Nestle Products Sdn Bhd
22-1, 22nd Floor, Menara Surian,
No. 1, Jln PJU 7/3,
Mutiara Damansara,
47810 Petaling Jaya, Selangor Darul Ehsan.

Dear Sir / Madam:

RE: NDC SIJANGKANG
- WARRANTY ON DAVIS LED FIXTURE

A. Warranty Period

Purchaser receives the warranty for the applicable period as described in below:

Product	Warranty Period
DAVIS Led Fixture	18 months

B. Special Conditions

- The warranty period starts from 1st February 2018.
- The warranty period is based on burning behavior of maximum 4745 hours per year; and switching cycles in accordance with IEC norms ;
- Product is used in accordance with Davis product specifications and application guidelines;
- This warranty excludes actual removal and reinstallation activities and/or costs.
- The warranty is not applicable to:
  - Product that has been subjected to misuse, accident, shipping or other physical damage, improper installation, abnormal operation or handling, neglect, inundation, fire, water or other liquid intrusion; or

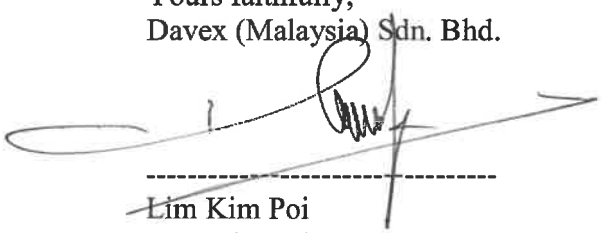
- Product that has been damaged due to repair, alteration, or modification by anyone not authorized by Davis Lighting; or
- Product which defect or problem is caused by its use with non-Davis products or accessories; or
- Product which warranty / quality stickers, product serial number or electronic serial number has been removed, altered or rendered illegible; or
- Product returned without valid proof of purchase or which proof of purchase has been altered or is illegible; or
- Force Majeure;
- Labor costs for (de)-installation of the Products are not covered under this warranty.

The liability, if any, of Davex or Davex' representatives for damages whether arising from breach of the terms of any quotation, breach of contract, warranty, negligence, indemnity, strict liability or otherwise, with respect to the products is limited to an amount not to exceed the price of the Product giving rise to the liability.

Davex and Davex' representatives shall in no event be liable to the customer for any special, indirect, incidental or consequential damages or cover, or loss of data, profit, revenue or use, in connection with or arising out of this warranty or any resulting agreement, or the functioning or the customer's use of, or inability to use Products, including (embedded) software, or for any liability of the customer to any third party with respect thereto.

Thank you.

Yours faithfully,
Davex (Malaysia) Sdn. Bhd.



Lim Kim Poi
Managing Director

MALAYSIA TRANSFORMER

CERTIFIED TO ISO 9001:2008
CERT NO. : AR 1298

CERTIFIED TO ISO 14001:2004
CERT NO. : ER 0762

CERTIFIED TO OHSAS 18001:2007
CERT NO. : SR 0622

Our Ref : MTM/KEJBROADWAY/NESTLE/17/12/002

23rd October 2017

NESTLE PRODUCTS SDN BHD
(Company No. 45229-H)
22-1, 22nd Floor, Menara Surian,
No. 1, Jalan PJU 7/3,
Mutiara Damansara,
47810 Petaling Jaya,
Selangor Darul Ehsan.

Dear Sir,

2 units of 1250kVA 11/0.433kV (T4/17/12506 & T4/17/12507)
- Warranty Letter

The above matter refers.

Please be informed that our warranty is 18 months from date of delivery or 12 months from date of commissioning, whichever is earlier subject to manufacturing defects in work-manship or parts, as warranted by OEM only, excluding normal wear and tear (such as damage or discoloration) and improper handling or use of transformer, and missing of parts).

Should you need further clarification, please contact En. Mohd Zaim Mohd Zakaria (Manager, Sales & Marketing) at 019-2424814 or email at zaim@mtm.com.my.

Thank you.

Yours faithfully,

Azhar Alias
General Manager
Sales & Marketing

Cc : Kejuruteraan Broad-Way Sdn Bhd
29, Jalan Jintan, Taman Supreme,
56100 Cheras,
Kuala Lumpur.

MALAYSIA TRANSFORMER

CERTIFIED TO ISO 9001:2008
CERT NO. : AR 1298

CERTIFIED TO ISO 14001:2004
CERT NO. : ER 0762

CERTIFIED TO OHSAS 18001:2007
CERT NO. : SR 0622

Our Ref : MTM/KEJBROADWAY/RHB/17/12/001

23rd October 2017

RHB TRUSTEES BERHAD
(AS TRUSTEE FOR AXIS REAL ESTATE INVESTMENT TRUST)
Company No. 573019-U
3rd Floor, Menara Surian,
No. 1, Jalan PJU 7/3,
Mutiara Damansara,
47810 Petaling Jaya,
Selangor Darul Ehsan.

Dear Sir,

2 units of 1250kVA 11/0.433kV (T4/17/12506 & T4/17/12507)
- Warranty Letter

The above matter refers.

Please be informed that our warranty is 18 months from date of delivery or 12 months from date of commissioning, whichever is earlier subject to manufacturing defects in work-manship or parts, as warranted by OEM only, excluding normal wear and tear (such as damage or discoloration) and improper handling or use of transformer, and missing of parts).

Should you need further clarification, please contact En. Mohd Zaim Mohd Zakaria (Manager, Sales & Marketing) at 019-2424814 or email at zaim@mtm.com.my.

Thank you.

Yours faithfully,

Azhar Alias
General Manager
Sales & Marketing

Cc : Kejuruteraan Broad-Way Sdn Bhd
29, Jalan Jintan, Taman Supreme,
56100 Cheras,
Kuala Lumpur.

SMBE | Fuji Electric
Innovating Energy Technology

Our ref : *smbe001/broad-way/axisrealestate/18*

29 January 2018

KEJURUTERAAN BROAD-WAY SDN BHD
No 29, Jalan Jintan, Taman Supreme,
56100 Wilayah Persekutuan,
Kuala Lumpur

Dear Sir,
CADANGAN PEMBANGUNAN MEMBINA GUDANG DI ATAS LOT 7316 (PT3609) JALAN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR UNTUK TETUAN RHB TRUSTEES BERHAD-AXIS REAL ESTATE
Subject: Warranty For 'Fuji SMBE Brighten' Main Switchboard, Essential Main Switchboard, AMF Panel,Sub-switchboard & Metering panel

This is to certify that the Switchboard for the above-mentioned project shall be covered by 18 months warranty starting from the date of 29 January 2018 granted from Consultant.

Our standard clause where the warranty does not apply are :

Replacement and / or repairs resulting from normal wear & tear or damages caused by improper handling / operation or insufficient maintenance as recommended.

Please do not hesitate to contact us for any further clarification.

Thank you.

Yours faithfully,

For and on behalf of
Fuji SMBE Brighten Sdn Bhd

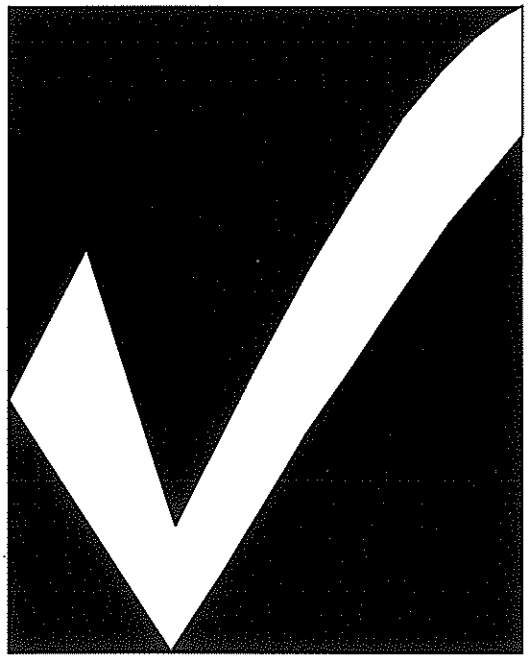


Ahmad Faiz bin Mat Nor
Project Division

Warranty Certificate

We hereby certify that the product detailed is covered by Powertrade Energy Sdn Bhd under our Standard Warranty for a period of twelve months from the date of commissioning or eighteen months from the date of despatch, whichever is earlier, in accordance with our Conditions of Sale.

SCANPaC™
Generators



SCANPaC MODEL : SP 350 DW

ENGINE : DAEWOO 6DWD-430

SERIAL NUMBER : 16DWD0061

ALTERNATOR : MECC ALTE ECO 40-1S/4

SERIAL NUMBER : H047309

CUSTOMER : KEJURUTERAAN BROAD-WAY SDN BHD

For and behalf of

POWERTRADE ENERGY SDN BHD (630219-K)
Formerly Known As Powermech Energy Sdn Bhd

No 1, Jalan TP 7/5, Taman Perindustrian UEP,
47500 Subang Jaya, Selangor Darul Ehsan, MALAYSIA,
Tel : 603-5614 3688 Fax : 603-5614 1268

Http : www.powertadeenergy.com
E-mail : ykchai@powertradeenergy.com

Despatch Date : 6th October 2017

萬里工程有限公司 (Co. No. 53799-X)
Kejuruteraan Broad-Way Sdn. Bhd.
GST No. 000325517312

AJA REGISTRARS ISO 9001:2008 UKAS MANAGEMENT SYSTEMS 0059
Certificate Number: AJA09/13866

KBSB/016/18/CKA/jw

16 January 2018

Han Yang Consultancy Sdn Bhd
No. 19, Lorong Desa Pauh 1
Taman Desa Pauh
13700 Perai
Penang

Attn: Ir C K Lim

Dear Sir

RE: CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI:- FASA 1 1-GUDANG 1 TINGKAT (120M x 360M) DENGAN PEJABAT/BLOK SOSIAL 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBHG. TANAH DI BAWAH SEK. 200 KTN UNTUK KOLAM TAKUNGAN (2.414 EKAR) DIATAS LOT 7316 (PT 3609), JALAN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR UNTUK TETUAN RHB TRUSTEES BERHAD (As Trustee for Axis Real Estate Investment Trust)
- Electrical Services
- Power Supply Energised & Voltages Distribution

With reference to the above and further to the HT meter installed and power energised on 17-12-2017 (Sunday) which was updated on whatapps group discussion, we wish to inform that the power supply are distributed as below for your kind attention.

1. 11KV TNB supply shall be 11KV;
2. LV Supply for RYB 3 phase shall be 430V;

Single Phase Supply for	RN	244V
	YN	
	BN	

The transfomer tap changes is at Tap 2. Rotation is clockwise.

We trust the above is in order and should you required any further information or clarification please do not hesitate to contact the undersigned.

Yours faithfully
KEJURUTERAAN BROAD-WAY SDN BHD

Chan Keng Ann

.....
Project Engineer

c.c RHB Trustees Bhd - Mr E L Lin
AME Construction Sdn Bhd - Mr Raymond Chia
Kooi Keat Architect - Ar Ooi

萬里工程有限公司 (Co. No. 53799-X)
Kejuruteraan Broad-Way Sdn. Bhd.
GST No. 000325517312

AJA REGISTRARS ISO 9001:2008 UKAS MANAGEMENT SYSTEMS 0059
Certificate Number: AJA09/13866

KBSB/018/18/CKA/jw

16 January 2018

Han Yang Consultancy Sdn Bhd
No. 19, Lorong Desa Pauh 1
Taman Desa Pauh
13700 Perai
Penang

Attn: Ir C K Lim

Dear Sir

RE: CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI:- FASA 1 1-GUDANG 1 TINGKAT (120M x 360M) DENGAN PEJABAT/BLOK SOSIAL 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBHG. TANAH DI BAWAH SEK. 200 KTN UNTUK KOLAM TAKUNGAN (2.414 EKAR) DIATAS LOT 7316 (PT 3609), JALAN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR UNTUK TETUAN RHB TRUSTEES BERHAD (As Trustee for Axis Real Estate Investment Trust)
- Electrical Services
- 'Surat Sokongan Bagi Sijil Pematuhan Dan Penyiapan'

With reference to the above, enclosed please find the original letter from TNB ref. TNB(B)/SELA//BAN/2385 dated 4-1-2018 which is self-explanatory for your kind attention.

We trust the above is in order and should you required any further information or clarification please do not hesitate to contact the undersigned.

Thank you.

Yours faithfully
KEJURUTERAAN BROAD-WAY SDN BHD

Chan Keng Ann

.....
Project Engineer

encls

c.c RHB Trustees Bhd - Mr E L Lin
AME Construction Sdn Bhd - Mr Raymond Chia
Kooi Keat Architect - Ar Ooi

No. Siri: 004777/2018

Suruhanjaya Tenaga
Energy Commission

BORANG B
(Peraturan 3)

AKTA BEKALAN ELEKTRIK 1990

PERAKUAN PENDAFTARAN

PEPASANGAN NO : ST(TKL)P/S/SGR/07196

Suruhanjaya dengan ini memperakui menurut seksyen 21 Akta Bekalan Elektrik 1990 bahawa pepasangan **AXIS MEGA DISTRIBUTION CENTRE** di **LOT 7316, (PT 3609), PERSIARAN SIJANGKANG UTAMA TAMAN INDUSTRI SIJANGKANG UTAMA 42500 , TELOK PANGLIMA GARANG SELANGOR** harta kepunyaan **RHB TRUSTEES BERHAD** telah memenuhi kehendak-kehendak Akta itu dan Peraturan-Peraturan yang dibuat di bawahnya.

Suruhanjaya memperakui bahawa pepasangan yang tersebut di atas telah didaftarkan dan Perakuan Pendaftaran ini adalah sah selama 1 tahun* dari tarikh dikeluarkan yang dinyatakan di bawah.

Fi (RM)	:	**2,200.00**
Aggregat kuasa yang dipasang	:	**11.0 kV / 2125 kW**
Tarikh dikeluarkan	:	**04/05/2018**
Tempat	:	**PETALING JAYA**

Ir. MD RASDI BIN ABDULLAH
Pengarah Kawasan
Suruhanjaya Tenaga
Kawasan Selangor & WP (KL & Putrajaya)

Suruhanjaya Tenaga

*Tidak kurang daripada satu tahun dan tidak lebih daripada 5 tahun.

ALFA
Noise Control
Sdn • Bhd
(480208-K)

QUALITY SYSTEM SIRIM CERTIFIED TO ISO 9001:2008 CER. NO.: AR 4984
QUALITY SYSTEM SIRIM CERTIFIED TO ISO 9001:2008 CER. NO.: MY-AR 4984

Ruj. Kami : ANC/DECL 695/06/18

Tarikh : 07hb Jun 2018

Pengarah
Jabatan Alam Sekitar Negeri Selangor Cawangan Sepang,
Kementerian Sumber Asli Dan Alam Sekitar
B28-1 & B28-2, Jalan 7,
Bandar Baru Bangi Salak Tinggi,
433900 Sepang, Selangor.

Tuan,

Lampiran Borang Peristiharan Bertulis (Written Declaration Form)
Pengesahan Pemasangan Alat Pembakaran Bahanapi Janakuasa
Untuk Tetuan : RHB TRUSTEES BERHAD

Merujuk kepada surat pemberitahuan bertulis rujukan tuan Spg(B)91/110/621/079 Jld. 16 (12) Bertarikh 20 April 2018 adalah berkaitan.

Bersama-sama ini dikembalikan borang Peristiharan Bertulis dan Lukisan Sebagaimana Binaan yang menunjukkan mana-mana kerja atau struktur bagi setiap pemasangan, ditandatangani oleh Jurutera Professional bagi mereka bentuk dan menyelia sistem kawalan pencemaran udara.

Sekian, terima kasih.

Yang benar,
ALFA NOISE CONTROL SDN BHD

.....
MOHAMAD RUSLI BIN ISHAK
Executive Engineer

No. 22, Jalan Industri USJ 1/5, Taman Perindustrian USJ 1, 47600 Subang Jaya, Selangor D. E.
Tel: 603-8081 4869 / 4892 / 8197 / 8021 6317 Fax: 603-8081 6793 E-mail: alfanoisecontrol@gmail.com Website: www.alfanoise.com

AKUAN BERTULIS MENGENAI REKA BENTUK DAN PEMBINAAN SISTEM KAWALAN PENCEMARAN UDARA
[Peraturan 7(5)]

WRITTEN DECLARATION ON DESIGN AND CONSTRUCTION OF AIR POLLUTION CONTROL SYSTEM
[Regulation 7(5)]

Nama premis : **RHB TRUSTEES BERHAD**
Name of premise :
Alamat premis : **Di Atas Lot 7316 (PT 3609), Jalan Klang- Banting, Mukim Telok Panglima Garang,**
Address of premise : **Daerah Kuala Langat, Selangor Darul Ehsan.**

No. rujukan JAS (jika berkenaan): **Spg (B) 91/110/621/079 Jld. 16(12) Bertarikh 20 April 2018**
Refer*ence number (if applicable) :*

No. telefon : 03-9280 8799 ...No. Faks : 03-9280 8796
T*elephone number :* *Fax number :*

Kami seperti nama di bawah, dengan ini mengaku bahawa sistem kawalan pencemaran udara yang telah direka bentuk dan dibina telah mematuhi keperluoan dan spesifikasi minimum sebagaimana digariskan dalam Dokumen Panduan Alat Pembakaran Bahanapi dan Sistem Kawalan Pencemaran Udara yang ditetapkan oleh Ketua Pengarah Kualiti Alam Sekeliling.

We the undersigned hereby declare that the air pollution control system has been designed and constructed in strict compliance with the minimum requirements and specifications as outlined in the Guidance Document For Fuel Burning Equipments And Air Pollution Control Systems as specified by the Director General of Environmental Quality.

A. Tandatangan Pemunya atau Penghuni Premis :
Signature of the Owner or Occupier of Premise:

.....

(Pemunya atau penghuni premis)
(Owner or occupier of premise)

RHB TRUSTEES BERHAD (573019-U)
(as trustee for AXIS REIT)
Level 11, Tower Three,
RHB Centre, Jalan Tun Razak,
50400 Kuala Lumpur, Malaysia.
Tel: +603-9280 5933 Fax: +603-9280 5934

No. Kad Pengenalan : TONY CHIENG SIONG UNG (NRIC NO.: 730508-13-5227)
Identity Card Number:
Jawatan : Director
Designation
No. Telefon Bimbit : - E-mel : rhbt.reits@rhbgroup.com
H/p. No. *E-mail*
Tarikh : 15 MAY 2018
Date:

B. Tandatangan Jurutera Profesional :
Professional Engineer's Signature :

1. Jurutera yang bertanggungjawab untuk reka bentuk sistem kawalan
Engineer responsible for design of the control system

JURUTERA PROFESIONAL
DENGAN PERAKUAN AMALAN
ELEKTRIKAL
Ir. CHAN KAM BOON
C11796
MALAYSIA

.....

(Cop Rasmi & Tandatangan)
(Official Stamp & Signature)

Nama : **CHAN KAM BOON**
Name
No. Kad Pengenalan : **430718-08-5737**
Identity Card Number:
No. Telefon Bimbit : ..... E-mel : **pesbchan@gmail.com**
H/p. No. *E-mail*
*Disiplin : Kimia / Alam Sekitar / Lain-lain (sila nyatakan)
**Discipline : Chemical / Environmental / Others (please specify)*

No. Pendaftaran L.J.M : **C11796**
B.E.M Registration Number :
Tarikh :
Date:

2. Jurutera yang bertanggungjawab untuk reka bentuk komponen-komponen mekanikal
Engineer responsible for design of mechanical components

.....

(Cop Rasmi & Tandatangan)
(Official Stamp & Signature)

Nama : .....
Name
No. Kad Pengenalan : .....
Identity Card Number:
No. Telefon Bimbit : ..... E-mel : .....
H/p. No. *E-mail*
*Disiplin : Kimia / Alam Sekitar / Lain-lain (sila nyatakan)
**Discipline : Chemical / Environmental / Others (please specify)*

.....
No. Pendaftaran L.J.M : .....
B.E.M Registration Number :
Tarikh : .....
Date:

3. Jurutera yang bertanggungjawab untuk reka bentuk struktur
Engineer responsible for structural design

.....

(Cop Rasmi & Tandatangan)
(Official Stamp & Signature)

Nama : .....
Name
No. Kad Pengenalan : .....
Identity Card Number:
No. Telefon Bimbit : ..... E-mel : .....
H/p. No. *E-mail*
*Disiplin : Kimia / Alam Sekitar / Lain-lain (sila nyatakan)
**Discipline : Chemical / Environmental / Others (please specify)*

.....
No. Pendaftaran L.J.M : .....
B.E.M Registration Number :
Tarikh : .....
Date:

4. Jurutera yang bertanggungjawab untuk reka bentuk komponen-komponen elektrikal dan elektronik
Engineer responsible for design of electrical and electronic components

.....

(Cop Rasmi & Tandatangan)
(Official Stamp & Signature)

Nama : .....
Name
No. Kad Pengenalan : .....
Identity Card Number:
No. Telefon Bimbit : ..... E-mel : .....
H/p. No. *E-mail*
*Disiplin : Kimia / Alam Sekitar / Lain-lain (sila nyatakan)
**Discipline : Chemical / Environmental / Others (please specify)*

.....
No. Pendaftaran L.J.M : .....
B.E.M Registration Number :
Tarikh : .....
Date:

Nota : JAS bermaksud Jabatan Alam Sekitar, Malaysia
LJM bermaksud Lembaga Jurutera Malaysia

Note:* *DOE stands for Department of Environment, Malaysia
BEM stands for Board of Engineers, Malaysia

* Potong mana yang tidak berkenaan
* *Delete whichever is not applicable*

JABATAN ALAM SEKITAR NEGERI SELANGOR
CAWANGAN SEPANG
B28-1 & B28-2, JALAN 7
BANDAR BARU SALAK TINGGI
43900 SEPANG, SELANGOR
TEL : 03-87061332 FAX : 03-87061336

BILIK KAWALAN : 03-87061340
LAMAN WEB : http://www.doe.gov.my
EMAIL : selangor@doe.gov.my

PENGIKTIRAFAN MS ISO 9001:2008 NO. SIJIL : AR 5141

Ruj. Tuan :

Ruj. Kami : Spg(B) 91/110/621/079 Jld. 16(12)

Tarikh : 20 April 2018

Pengurus
RHB Trusteers Berhad
Level 11, Tower One
RHB Centre, Jalan Tun Razak
50400 KUALA LUMPUR

Tuan,

PEMBERITAHUAN BERTULIS DI BAWAH PERATURAN 5, PERATURAN-PERATURAN KUALITI ALAM SEKELILING (UDARA BERSIH) 2014

Pemasangan Satu (1) Unit Janakuasa Tunggu Sedia Di Atas Lot 7316 (PT 3609), Jalan Klang-Banting, Mukim telok Panglima Garang, Daerah Kuala Langat, Selangor Darul Ehsan

Saya adalah dengan hormatnya diarah merujuk kepada perkara tersebut di atas.

2. Dimaklumkan bahawa Jabatan ini telah menerima dokumen pemberitahuan bertulis bagi cadangan projek di atas yang disediakan oleh perunding tuan, Alfa Noise Control Sdn. Bhd. melalui surat rujukan DOE8131/03/18 bertarikh 27 Mac 2018.

3. Sehubungan itu, Jabatan ini mengambil maklum dokumen pemberitahuan bertulis bagi mematuhi Peraturan 5, Peraturan-Peraturan Kualiti Alam Sekeliling (Udara Bersih) 2014 bagi pemasangan janakuasa tunggu sedia. Butiran peralatan adalah seperti di bawah :

Bil.	Jenis Peralatan	Keupayaan	Lukisan Kejuruteraan	Jurutera Profesional
1	1 unit janakuasa (tunggu sedia)	350 kVA	ANC9763/04/17	Ir. Chan Kam Boon (Elektrikal: C11796)
2	Electrical Installation – Site Plan, Location Plan & Key Plan, Electrical Manhole & Ducting Layout	-	KBSB-SEL-16424-ALL	Ir. Chan Kam Boon (Elektrikal: C11796)

(Sila catatkan rujukan Jabatan ini apabila berhubung)

4. Oleh yang demikian, adalah menjadi tanggungjawab tuan untuk mematuhi perkara-perkara berikut :

4.1 Kehendak di bawah Peraturan 7(2) iaitu tuan hendaklah melantik jurutera profesional untuk merekabentuk dan menyelia kerja-kerja pemasangan janakuasa tunggu sedia berkenaan ;

4.2 Kehendak di bawah Peraturan 7(3) iaitu tuan hendaklah mengendali dan menyenggara janakuasa tunggu sedia tersebut mengikut amalan kejuruteraan yang menyeluruh dan memastikan bahawa setiap komponen sistem kawalan pencemaran udara berfungsi dengan baik ; dan

4.3 Kehendak di bawah Peraturan 7(5) dan 7(6) iaitu mengemukakan borang Perisytiharan Bertulis dan Lukisan Sebagaimana Binaan yang menunjukkan kedudukan mana-mana kerja atau struktur yang menjadi sebahagian daripada alat kawalan kepada Ketua Pengarah Kualiti Alam Sekeliling tidak lewat daripada tiga puluh (30) hari dari tarikh permulaan operasi janakuasa tunggu sedia tersebut.

5. Kerjasama dan sokongan pihak tuan dalam memulihara kualiti alam sekitar ke arah pembangunan lestari amatlah dihargai.

Sekian.

"BERKHIDMAT UNTUK NEGARA"

"PEMULIHARAAN ALAM SEKITAR TANGGUNGJAWAB BERSAMA"

Saya yang menurut perintah,

(MOHD ASRI BIN RAMLI)
Ketua Cawangan
Jabatan Alam Sekitar Negeri Selangor
Cawangan Sepang

s.k

Alfa Noise Control Sdn. Bhd.
No.22, Jalan Industri USJ 1/5
Taman Perindustrian USJ 1
47600 Subang Jaya
SELANGOR

TENAGA NASIONAL

Tenaga Nasional Berhad (200866-W)
No. 129, Jalan Bangsar, 59200 Kuala Lumpur.

Tel: +6 03 2296 5566
Fax: +6 03 2283 3686
www.tnb.com.my

Rujukan Kami : TNB(B)/SELA/BAN/2385
Ruj. Tuan : HYC-16424/TNB/013(MT)
Tarikh : 4 Januari 2018.

Han Yang Consultancy Sdn Bhd.
No. 19, Lorong Desa Pauh 1,
Taman Desa Pauh,
13700 Perai, Penang.

Tuan,

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :
FASA 1
- GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT/BLOK SOSIAL 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DI BAWAH SEKSYEN 200 KTN UNTUK KOLAM TAKUNGAN (2.414 EKAR) DI ATAS LOT 7316 (PT 3609), JALAN KLANG-BANTING, MUKIM TELOK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN UNTUK TETUAN RHB TRUSTEES BERHAD (AS TRUSTEE FOR AXIS REAL ESTATE INVESTMENT TRUST).
Per : ~ Surat Sokongan Bagi Sijil Pematuhan Dan Penyiapan (CCC) ~

Dengan segala hormatnya perkara di atas adalah di rujuk.

2. Untuk makluman tuan, pihak TNB tidak mempunyai sebarang halangan untuk sokongan bagi sijil layak menduduki bagi pembangunan di atas.

Sekian, terima kasih.

" BETTER . BRIGHTER"

" TNB MENGAMALKAN DASAR TIADA HADIAH ."

(Hasni Farhana Bt. Hamzah)
Engineer (Supply Planning 11kV-Subzone Banting/Sepang),
Jabatan Distribution Network,
Bahagian Pembahagian, TNB.

kum/kp/cf/servis/CF - Created on 4.1.18

萬里工程有限公司 (Co. No. 53799-X)
Kejuruteraan Broad-Way Sdn. Bhd.
GST No. 000325517312

AJA REGISTRARS ISO 9001:2008 UKAS MANAGEMENT SYSTEMS 0059
Certificate Number: AJA09/13866

KBSB/018/18/CKA/jw

16 January 2018

RHB Trustees Berhad
Suite 6.04, Penthouse
Wisma Academy
4A, Jalan 19/1
46300 Petaling Jaya

Attn: Mr Lin Eng Lee

Dear Sir

RE: CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI:- FASA 1 1-GUDANG 1 TINGKAT (120M x 360M) DENGAN PEJABAT/BLOK SOSIAL 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBHG. TANAH DI BAWAH SEK. 200 KTN UNTUK KOLAM TAKUNGAN (2.414 EKAR) DIATAS LOT 7316 (PT 3609), JALAN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR UNTUK TETUAN RHB TRUSTEES BERHAD (As Trustee for Axis Real Estate Investment Trust)
- Electrical Services
- 'Pengesahan Kelulusan Siap Infrastruktur Telekomunikasi'

With reference to the above, enclosed please find the original letter of acceptance from Telekom Malaysia ref. ( )4415A/TPG/2015/20 dated 12-1-2018 for your kind attention.

Kindly acknowledge receipt of the above by signing and returning the duplicate copy of this letter for our record.

Thank you.

Yours faithfully
KEJURUTERAAN BROAD-WAY SDN BHD

Chan Keng Ann
.....
Project Engineer

encls

c.c AME Construction Sdn Bhd - Mr Raymond Chia
Kooi Keat Architect - Ar Ooi
Han Yang Consultancy Sdn Bhd - Ir C K Lim

Ruj. Kami: ( ) 4415A/TPG/2015/20
Ruj. Tuan: 1/15(RHB)EBC-14/myh
Tarikh: 19 hb Januari 2018

RHB TRUSTEES BERHAD
6th FLOOR, PLAZA OSK,
JALAN AMPANG
50450 KUALA LUMPUR

PROJEK	:	***CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI:*** ***1) FASA 1 – GUDANG 1 TINGKAT (148 X 400M) DENGAN PEJABAT 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK*** ***2) FASA 2 - GUDANG 1 TINGKAT (150 X 310M) DENGAN PEJABAT 2 TINGKAT***
HARTANAH/TAPAK PROJEK	:	***DI ATAS LOT 7316 (P.T.3609), JALAN KLANG BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN***
PEMILIK/PEMAJU	:	***TETUAN RHB TRUSTEES BERHAD***

Per: Pengesahan Kelulusan Siap Infrastruktur Telekomunikasi

Dengan segala hormatnya saya merujuk kepada perkara tersebut di atas.

2. Sukacita dimaklumkan bahawa infrastruktur telekomunikasi bagi projek tersebut di atas telah siap disempurnakan mengikut pelan dan spesifikasi teknikal yang teleh diluluskan oleh pihak TM sebelum ini. Bersama-sama ini turut dilampirkan salinan Sijil Penerimaan untuk rujukan pihak tuan.

3. Adalah diingatkan bahawa kelulusan ini adalah tertakluk kepada terma-terma dan syarat-syarat yang dinyatakan di dalam surat-surat kami bertarikh ***14hb Nov 2016*** *Rujukan:* ***4415A/TPG/2015/20***

4. Pihak kami ingin menarik perhatian tuan kepada Para 2 (d & e) Surat tersebut dimana pemaju/pemilik bersetuju tidak mengenakan sebarang fi atau caj keatas TM untuk penempatan segala peralatan-peralatan telekomunikasi bagi perkhidmatan telekomunikasi yang diberikan oleh TM kepada pelanggan-pelanggannya di bangunan berkenaan sepanjang tempoh perkhidmatan tersebut disediakan. Sila rujuk kepada salinan surat Perakuan Persetujuan terma dan syarat yang telah ditandatangani oleh pihak tuan.

5. Walau apapun yang dinyatakan di atas, TM adalah tidak terikat untuk memberikan sebarang perkhidmatan telekomunikasi setelah kerja-kerja pembangunan siap dilaksanakan

6. Sekiranya di masa hadapan pihak TM memberi perkhidmatan telekomunikasi melalui infrastruktur telekomunikasi yang telah disiapkan, laluan tersebut haruslah muktamad. Sekiranya terdapat kerja-kerja pengalihan setelah infrastruktur TM dibangunkan, pihak TM tidak akan menanggung kos untuk melaksanakan kerja-kerja tersebut.

Telekom Malaysia Berhad (128740 - P)
Access Selangor Barat
Network Development Central. IT & Network Technology
Tingkat 1, Wisma TM Shah Alam, Persiaran Damai, Seksyen 11, 40000 Shah Alam Selangor Darul Ehsan, Malaysia.
Tel: 603 5518 8731 / 34 / 74 Fax: 603 5518 8788 / 603 5518 8799 www.tm.com.my

7. Sekiranya pihak tuan memerlukan sebarang penjelasan berkaitan dengan perkara tersebut di atas, sila hubungi kami di talian 55188735.

Dengan ini pihak kami tiada apa-apa halangan sebagai sokongan pihak tuan untuk mendapatkan Sijil Kebenaran Menduduki Bangunan (COF) dari Majlis tempatan yang berkaitan

Sekian, terima kasih.

Yang benar,

MOHD FAIRUZ BIN HISHAM
AGM
ACCESS SELANGOR BARAT
SEKSYEN 11, SHAH ALAM

CERTIFICATE OF ACCEPTANCE

Ruj Kami : 4415A/TPG/2015/20
Ruj.Tuan : ETCAN/TELEKOM/SA/1311/17

Tarikh: 4hb Jan 2018

SIJIL PENERIMAAN

PENERIMAAN KERJA-KERJA EXTERNAL SAHAJA

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI:
1) FASA 1 – GUDANG 1 TINGKAT (148 X 400M) DENGAN PEJABAT 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK
2) FASA 2 - GUDANG 1 TINGKAT (150 X 310M) DENGAN PEJABAT 2 TINGKAT
DI ATAS LOT 7316 (P.T.3609), JALAN KLANG BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN TETUAN RHB TRUSTEES BERHAD

NAMA KONTRAKTOR : **ET CAN SDN BHD**

RUJUKAN LESEN PKK : **0120170511-WP188241**

TARIKH PEMERIKSAAN : **21hb November 2017**

Kerja-kerja yang disiapkan telah dibuat pemeriksaan dan disahkan mengikut spesifikasi SKMM dan MTSFB dan diberi kelulusan.

Pihak tuan bertanggungjawab sepenuhnya untuk memperbaiki sebarang kerosakan dalam tempoh jaminan.

PEMERIKSA
Muhammad Zulhelmi
Pem Pegawai Teknik
Access Network Development
Shah Alam

DISEMAK
Mohd Hisam B Abu Amal
Pengurus
Access Network Development
Shah Alam

DILULUSKAN
Mohd Fairuz B Hisham
AGM
Access Network Development
Shah Alam

5.0 Test report/user acceptance test

Schneider Electric

FACTORY ROUTINE TEST CERTIFICATE - RING MAN UNIT (RM6)

Customer Company Name: ALBECON (SITJANG BANG) | Project ID: E4010 17120

Model No: NE D101 | ☑ NE ☐ RE ☐ DE

Serial No: SB-2017-W25-4-00HS | Voltage: 12 kV | kA: 21 | Sec: 3

Insulation Resistance Test Volts : 5 kV | AC High Voltage Test Volts : kV

Load Break Switch/ 630 A | Fuse Switch/ A | Breaker/ A

ONE MINUTE DIELECTRIC TEST

Pressure Test Ser no : H-2694 | Calibration Due Date : 20/6/2018

Insulation Resistance Serial No : W0381107 | Calibration Due Date : 4/6/2018

Phase Tested	Injected Voltage	I.R. MEG. OHMS (Before)	Leakage Current (mA) During HV Test	I.R.MEG.OHMS (After)	Fct 1	Fct 2	Fct 3	Fct 4
R-YBE	28KVAC	200000	2.4	200000	ON	ON	ON	ON
Y-RBE	28KVAC	200000	2.4	200000				
B-RYE	28KVAC	200000	2.4	200000				
Contact Fct 1,2	32KVAC	200000	0.6	200000				
Contact Fct 3	32KVAC	200000	0.4	200000				

CONTACT RESISTANCE - MICRO OHMS

Contact Resistance Test Ser No: 1010 38682 | Calibration Due Date: 3/11/2017

		Range	R	Y	B	Remarks
Earth Switch "ON"	Fct 1	234 <= 300	150.6	92.7	180.9	
	Fct 2		97.1	98.0	96.1	
	Fct 3		158.5	143.2	151.8	
	Fct 4		116.5	90.9	105.0	
Main Switch "ON"	Fct 1 & Fct 2	298 <= 350	185.6	181.4	176.9	
	Fct 2 & Fct 3		194.4	187.0	185.6	
	Fct 3 & Fct 4		196.1	181'8	178.3	

MOTORIZATION

Without ☑

Operations at Un, min -15%, max +10%

On fct " I " at Un -15% O/C Closing Time, Opening Time < = 6s

On fct " D "/at Un -15% O/C Winding Time < = 12s

	Serial No	Un	U min	U max
Fct 1	999-172521-5100721 FB 741	24VDC	✓	✓
Fct 2	1M1726117	24VDC	✓	✓
Fct 3	999-172521-5100721 FB 742	24VDC	✓	✓
Fct 4	1M1783096	24VDC	✓	✓

OPENING COIL

Without ☑

Test Voltage	AC	+ 10 %		Test Voltage	DC	+ 10 %	
		- 15 %				- 30 %	

	Serial No	U min	U max
Fct2	1785024	✓	✓
Fct4	1785024	✓	✓

CIRCUIT BREAKER RELAY

VIP 30,VIP 35, VIP 300 TYPE

	Type of Relay	Gauge	Type of Phase Core	Type of Earth Core	Serial No
Fct 2	SEPAM SERIES 10 B M1A	200/1A	200/1A	200/1A	2117000105
Fct 4	SEPAM SERIES 10 B M1A	200/1A	200/1A	200/1A	2117000114

SHORT CIRCUIT INDICATOR

Without ✓

Integrated Alpha E, Alpha M

	Type	Adjust Current	Serial No.
Fct 1			
Fct 3			

Check all the parts	YES	NO	N/A	REMARKS
C.T's S/N for Short Circuit Indicator			✓	RYB
Gas Leak Check (Bushings/ Earth Bowl)	✓			
L/B switch-Hight bet MV Bushing (R,Y,B) gland plate >300mm	✓			
Mechanical Interlocks Checked (Cable Box Door)	✓			
Mechanical Interlocks Checked (Earth Switch)	✓			
Mimic Front Panel Check	✓			
Operation Mechanism Check	✓			
Pressure Gauge Check	✓			
Rating Plate Check (Voltage/ Amps/kA)	✓			
Stud Fitted for 11kV ≤ 100A		✓		
Voltage Indicator Light Check (fct 1, fct 2, fct 3, fct 4)	✓			Type: 1.35kV/ 4.5kV 45%
Voltage Indicators Checked (No Light)	✓			0.72kV/ 2.4kV 10% Nominal
RM6 2IQ/IQI & 3I/III Function		✓		Diam.: 1145mm(H)x1185mm(L)x670mm(W)
RM6 2I2Q/ QIQI & 3IQ/IIQI Function	✓			Diam.: 1145mm(H)x1617mm(L)x670mm(W)

Remarks: FAT

Tested By Full Name: MOHD AZMIL BIN ABDUL RAHMAN

I/C No.: 870825-08-5589

DATE: 25/8/2017

Tested/Company Stamp: (No. Syarikat 387042-V) ENGINEERING SERVICES SDN. BHD.

	Signature	Printer Name
SEM's Engineer		
Witness By:	BAGUS SYAHPUTRA	Chan Keng Ann
DATE	25/8/2017	25/8/2017

Rate Facility Mgmt SB

K'bro-adway S.B.

PROJECT

CADANGAN PEMBAGUNAN MEMBINA GUDANG MERANGKUMI:-

1. *FASA 1 – GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2 TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200 KTN UNTUK KOLAM TAKUNGAN (2.414 EKAR)*

DIATAS LOT 7316 (P.T.3609) JALAN KLANG – BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.

UNTUK TETUAN: RHB TRUSTEES BERHAD (AS TRUSTEE FOR AXIS REAL ESTATE INVESTMENT TRUST)

OWNER

RHB TRUSTEES BERHAD
LEVEL 11, TOWER ONE,
RHB CENTRE, JALAN TUN RAZAK,
50400 KUALA LUMPUR.

M & E CONSULTANT

HAN YANG CONSULTANCY SDN BHD
12-B, MEDAN ANGSANA 2,
11500 BANDAR BARU AYER HITAM,
PULAU PINANG.

ELECTRICAL CONTRACTOR

KEJURUTERAAN BROAD-WAY SDN BHD
NO. 29, JALAN JINTAN,
TAMAN SUPREME-CHERAS,
56100 KUALA LUMPUR.

GENSET SUPPLIER

SPECTRUM POWER SYSTEM SDN BHD
NO. 3 JALAN TP 7/5, TAMAN PERINDUSTIRAN UEP,
47500 SUBANG JAYA, SELANGOR DARUL EHSAN, MALAYSIA.
TEL : 03-5614 3688 FAX : 03-5614 1268

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2.0	SETTING UP SITE INSPECTION	5
3.0	MANUAL CONTROL TEST	6
4.0	ENGINE PROTECTION TEST	7
5.0	FACTORY LOAD TESTING	8

1.0 VISUAL INSPECTION

1.0 OBJECTIVE

1.1 To ensure the generator set is in good condition without any physical damages.

1.2 To verify that all major components are fitted to the generator set.

2.0 TOOLS / TESTING EQUIPMENT

2.1 No specific tools required.

3.0 SET UP

3.1 No special setting up is required.

4.0 VERIFICATION PROCEDURE

4.1 To verify the diesel engine make, model and serial number.

4.2 To verify the A.C alternator make, model and serial number.

4.3 To verify all ancillary equipment are fitted to the generator set.

4.4 To verify that there is no physical damage on the generator set.

5.0 TEST RECORD

5.1 To record data CSD: 0001-1 and 0001-2.

VISUAL INSPECTION RECORD CSD0001-1

1) General Condition of Generator		**Check**	**Remarks**
1.1	Any physical damage	✓	OK
1.2	Loose Component/connection	✓	OK
1.3	Loose bolt / nut	✓	OK
1.4	Loose hoses / crip	✓	OK
1.5	Loose beltings	✓	OK
1.6	Others	–	–

2) Major Components of Generator		**Check**	**Remarks**
2.1	Radiator	✓	OK
2.2	Turbo Charger	✓	OK
2.3	Starter Motor 24V	✓	OK
2.4	Charging Alternator 24V	✓	OK
2.5	Fuel Injection Pump	✓	OK
2.6	Skid Base	✓	OK
2.7	Flexible Fuel Lines	✓	OK
2.8	Air Restriction Indicator	✓	OK
2.9	Air Cleaner	✓	OK
2.10	Oil Filter	✓	OK
2.11	Fuel Filter	✓	OK
2.12	Fan belt	✓	OK
2.13	Alternator belt	✓	OK
2.14	Others		

VISUAL INSPECTION RECORD CSD0001-2

3) Record of Generator Set Data			
3.1	Genset Model	:	SP 350 DW
3.2	Generator Rating	:	350kVA
3.3	Engine make	:	DAEWOO
3.4	Engine Model	:	6DWD-430
3.5	Engine Serial No	:	16DWD0061
3.6	Alternator make	:	MECC ALTE
3.7	Alternator Model	:	ECO 40-1S/4A
3.8	Alternator Serial No	:	H047309
3.9	Enclosure Standard	:	IP23
3.10	Volt / Speed / Hz / PF	:	230/400 / 1500RPM / 50 Hz / 0.8P.F
3.11	Generator Dimension (mm)	:	
3.12	Others		-

4) All ancillary fitted to Generator		Check	Remarks
4.1	Automatic Voltage Regulator	/	
4.2	Others - INTELLITE AMF 20	/	

Checked by : Spectrum Power System
Signature :
Name : DINAN
Date : 17/8/17

Witnessed by : Han Yang Consultancy
Signature :
Name : CK Wan
Date : 17/8/17

Witnessed by : RHB Trustees Berhad
Signature :
Name : [illegible]
Date : 10/8/2017

Witnessed by : Kej. Broad-Way S/B
Signature :
Name : Chan Keng Ann
Date : 17/8/2017

Witnessed by : Baljit Singh
Signature :
Name : Baljit Singh
Date : 17/08/2017

2.0 SETTING UP INSPECTION

1.0 OBJECTIVE

1.1 To make sure the Genset is properly set up for subsequent testing.

1.2 To make sure there is sufficient diesel fuel for the testing.

2.0 SETTING UP

The following is setting up as an internal preparation for the actual inspection. Detailed procedures shall be in accordance to Powertrade Energy's standard procedures.

3.1 Move the generator to the Test Cell using the overhead crane/forklift in the factory

3.2 Position the generator, couple the exhaust outlet with the flexible hose

3.3 Fill up the radiator with clean water and check that the engine oil is at the maximum level.

3.4 Connect the power cables from the generator to the load banks.

3.5 Connect the fuel supply and return line accordingly.

3.6 Tightening all loose clamps, wires and hoses.

3.7 Connect the battery to the starter motor.

3.0 INSPECTION PROCEDURE

The following inspection shall be carried out jointly with the client and the engineer: -

4.1 To verify the exhaust is firmly clamped to the flexible hose.

4.2 To verify the radiator is filled with water and the engine oil to the correct level.

4.3 To verify all the cables are properly connected.

4.4 To verify the fuel supply system is connected.

4.5 To verify the polarity of the battery to the starter motor is correct.

4.6 To verify all mechanical parts are tightened.

4.7 To verify there is no fuel oil or water leaks from the diesel generator.

4.0 TEST RECORD

5.1 Result / finding in according to the above procedure shall be recorded in test record refer CSD NO: 0002-1

	Setting up Inspection of generator set.	Checks	Remarks
1.1	Exhaust flexible	✓	ok
1.2	Radiator Water is filled	✓	ok
1.3	Engine oil is filled	✓	ok
1.4	Fuel supply system connected	✓	ok
1.5	Polarity of the battery/connection	✓	ok
1.6	All cables are properly connected	✓	ok
1.7	All mechanical parts tightened	✓	ok
1.8	All hoses clamps tightened	✓	ok
1.9	Any fuel oil or water leaks	✓	ok
1.10	AC/DC Wiring connection / tightened	✓	ok
1.11	Others	–	–

1.9 as per Visual Inspection at 110% load for 1 hours, note leakages engine and alternator grease leak. (Sign).

17/8/17

3.0 MANUAL CONTROL TEST

1.0 OBJECTIVE

1.1 To ensure the generator set can be controlled manually.

2.0 TOOLS / TESTING EQUIPMENT

2.1 No tools are required for manual test.

3.0 SETTING UP

3.1 No special setting up is required.

4.0 TESTING PROCEDURE

4.1 Manual start and stop the generator set 2 - 3 times.

4.2 Simulation fault shutdown and reset 2 - 3 times.

5.0 TEST RECORD

5.1 Result / finding in accordance to the above procedure shall be recorded in the test record. Refer CSD No: 0003-1

MANUAL CONTROL TEST RECORD CSD 0003-1

	Manual Control Test	Check	Remarks
1.1	Manual start and stop	/	ok
1.2	Emergency Stop Button	/	ok
1.3	Manual reset	/	ok

Tested by : Spectrum Power System

Signature :

Name : AIMAN

Date : 17/8/17

Witnessed by : Han Yang Consultancy

Signature :

Name : CIKLAN

Date : 17/8/17

Witnessed by : RHB Trustees Berhad

Signature :

Name : KRISHNAN

Date : 17/8/2017

Witnessed by : Kej. Broad-Way S/B

Signature :

Name : Chan Keng Ann

Date : 17/8/2017

Witnessed by : BALJIT SINGH

Signature :

Name : BALJIT SINGH

Date : 17/8/2017

4.0 ENGINE PROTECTION TEST (FUNCTIONAL TEST)

1.0 OBJECTIVE

1.1 To ensure the protection devices are functioning and interconnected properly with Auto Mains Failure board.

2.0 TESTING PROCEDURE

3.1 Low oil pressure tripping

3.2 High water temperature tripping

3.0 TEST RECORD

4.1 Result / finding in accordance to the above procedure shall be recorded in test record. Refer CSD No : 0004-1.

PROTECTION TEST RECORD CSD 0004-1

Protection Testing Procedure		Check	Remarks
1.1	Low oil pressure trip		CIRCUIT TEST WITH AMF
1.2	High water temperature trip		S/B AT SITE
1.3	LOP indication		
1.4	HWT indication		
1.5	Others		

Tested by : Spectrum Power System

Signature :

Name : SUNAN

Date : 17/8/17

Witnessed by : Han Yang Consultancy

Signature :

Name : CK Wu

Date : 17/8/17

Witnessed by : RHB Trustees Berhad

Signature :

Name : KRISHNAN

Date : 17/8/2017

Witnessed by : Kej. Broad-Way S/B

Signature :

Name : Chan Keng Ann

Date : 17/8/17

Witnessed by : BALJIT SINGH

Signature :

Name : BALJIT SINGH

Date : 17/8/2017

5.0. FACTORY LOAD TESTING

1.0 OBJECTIVE

1.1 To ensure the generator set is able to deliver the designed load.

2.0 TOOLS / TESTING EQUIPMENT

2.1 1.0 P.F Load bank.
2.2 Voltmeter.
2.3 Ammeter
2.4 Kilowatt Meter.
2.5 Frequency Meter
2.6 Clamp Meter Tester

3.0 SETTING UP

This setting up procedure can be carried out as an internal preparation for actual testing: -

3.1 Start up the generator and let it warm up for 5 minutes at free load.
3.2 Check and rectify any excessive vibration and noise due to loose connection.
3.3 Shut down the generator and tidy up for actual testing.

4.0 TESTING PROCEDURE

4.1 Start up the generator and let it warm up for 5 minutes at no load. Detailed procedures shall be in accordance to Spectrum Power System's standard test procedures.

4.2 Start the **350KVA** test in accordance to the following steps and duration: -

25%	15 mins
50%	15 mins
75%	15 mins
100%	30 mins
110%	60 mins

4.3 Record the following data's at every 15 minutes interval.

- Time for testing.
- Load in Kilowatt.
- % of load
- Line to line Voltage.
- Phase current.
- Engine water temperature.
- Engine oil pressure.
- Engine speed
- Generator frequency

4.4 Remove the load and allow the generator to run for 10 minutes and shut down.

5.0 TEST RECORD

5.1 Result / finding in accordance to the above procedure shall be recorded in test record refer CSD No : 0005-1.

GENERATOR LOAD AND ACCEPTANCE TEST RECORD CSD 0005-1

Time	Duration (min)	Load			Engine Water Temp (°C)	Oil Pressure (bar)	Speed (rpm)	Frequency (Hz)	Voltage (V)			Ampere		
		KW	%	P.F					RY L1-L2	YB L2-L3	BR L1-L3	R	Y	B
1430 1435	0	0	0	1.0	62	7.1	1503	50.0	420	419	416	–	–	–
1445 1430	15	70	25	1.0	68	6.8	1503	50.0	420	419	416	98	98	99
1500 1445	15	140	50	1.0	70	6.5	1503	50.0	420	419	417	195	196	196
1515 1500	15	210	75	1.0	71	6.3	1506	50.1	419	419	416	291	290	292
1530 1515	15	280	100	1.0	81	4.3	1500	50.0	418	418	415	394	395	394
1545 1530	15	280	100	1.0	83	4.3	1500	50.1	419	418	415	394	395	394
1606 1545	15	308	110	1.0	87	4.1	1503	50.1	419	417	415	430	431	430
1615 1600	15	308	110	1.0	89	3.9	1503	50.1	419	417	415	430	431	430
1630 1615	15	308	110	1.0	89	3.9	1512	50.2	418	416	415	430	431	431
1645 1630	15	308	110	1.0	86	4.1	1515	50.5	418	418	416	431	432	430

Tested by : Spectrum Power System

Signature :

Name : AZNAN

Date : 17/8/17

Verified by : Han Yang Consultancy

Signature :

Name : CK Lim

Date : 17/8/17

Verified by : RHB Trustees Berhad

Signature :

Name :

Date : 17/8/2017

Verified by : Kej. Broad-Way S/B

Signature :

Name : Chan Keng Ann

Date : 17/8/2017

Verified by :

Signature :

Name :

Date : 17/3/2016

Malaysia Transformer Manufacturing Sdn. Bhd.
(A Subsidiary of Tenaga Nasional Berhad)

QUALITY SYSTEM SIRIM CERTIFIED TO MS ISO 9001 Registration No: AR 1298 — UKAS QUALITY MANAGEMENT 074

RE: TES/PR01/QR04

TEST RESULT

Detail of Transformer						
Customer	NDC-Sijangkang(AXIS)					
Serial No.	T4/17/12507		Date		03-Aug-17	
Power	1250 kVA		Voltage	HV:	11000 V	
				LV:	433 V	
Current	HV:	65.61 A		LV:	1666.72 A	
Phase	3		Frequency		50 Hz	
Vector	Dyn11		Spec. No.		1250-109(11/.433)	

Iron Loss Test		Voltage (V)			
		Average	RMS	Power (W)	Current (A)
	a	433.1	433.1	2008	12.300
	b	430.9	432.8	520	20.300
	c	436.1	436.9	-989	10.000
		433.4	434.3	1539	
Corrected Value, W		1536			

Copper Loss Test		Voltage, RMS (V)	Power (W)	Current (A)
	A	465.9	1960	52.47
	B	467.4	1900	52.55
	C	467.7	1940	52.45
		467.0	5800	52.49

I^2R(HV)	= 1.5 x HV rated current x HV winding resistance(ave.)			4167	
I^2R(LV)	= 1.5 x LV rated current x LV winding resistance (ave.)			3556	
K	1.174		Total I^2R (Cold)	7723	
			Corrected Voltage	583.7	
K	Temp. Constant	Corrected Power	9062	$\%Z^2$ (Cold)	28.16
	235 + 75 / 235 + T	I^2R (Cold)	7723	$\%R^2$ (Cold)	0.53
		Cold Strays	1339	$\%X^2$	27.63
		I^2R x K	9067	$\%R^2$ (75°C)	0.67
		Strays/ K	1141	$\%Z^2$ (75°C)	28.3
		Power at 75°C	10208	%Z	5.32

	Guarantee Value	Calculated Value	Tolerance	%
Iron Loss, W	1600	1536	+15%	-4.0
Copper Loss, W	10000	10208	+15%	2.1
Total Loss,W	11600	11744	+10%	1.2
Impedance, %	5.00	5.32	±10%	6.4

Tested by,	Checked by,	Witness by,
3155	MUHAMMAD AZIM ABD AZIZ MALAYSIA TRANSFORMER MFG 03 AUG 2017 TEST ENGINEER	

Malaysia Transformer Manufacturing Sdn. Bhd.
(A Subsidiary of Tenaga Nasional Berhad)

RE: TES/PR01/QR04

TEST RESULT

Detail of Transformer						
Customer	NDC-Sijangkang(AXIS)					
Serial No.	T4/17/12507		Date		03-Aug-17	
Power	1250 kVA		Voltage	HV:	11000 V	
				LV:	433 V	
Current	HV:	65.61 A		LV:	1666.72 A	
Phase	3		Frequency		50 Hz	
Vector	Dyn11		Spec. No.		1250-109(11/.433)	

Insulation Resistance (MΩ)	HV- LV	HV- Earth	LV- Earth
	2320	1330	1050

Voltage Ratio (Acceptance Value, ±0.5% from calculated value)	Tap Position	Calculated	Measured					
			AB/an	%	BC/bn	%	CA/cn	%
	1	46.20	46.22	0.04	46.22	0.04	46.22	0.04
	2	45.10	45.15	0.11	45.15	0.11	45.15	0.11
	3	44.00	44.03	0.07	44.03	0.07	44.03	0.07
	4	42.90	42.89	-0.03	42.90	0.00	42.90	0.00
	5	41.80	41.83	0.07	41.83	0.07	41.83	0.07

Winding Resistance (Ω)	T	29 °C		
HV Side		A-B	B-C	C-A
		0.647	0.643	0.646
LV Side		a-b	b-c	c-a
		0.00084	0.00085	0.00087

Separate Source Withstand Test, 60 seconds	Voltage (kV)	Current (mA)
HV to LV and Earth	28	35
LV to HV and Earth	3	10

Induced Overvoltage Test	Voltage (kV)			Current (A)		
Generator Frequency, 120 Hz	a-b	b-c	c-a	a-b	b-c	c-a
	0.866	0.861	0.864	2.121	6.534	5.495

FUJI SMBE BRIGHTEN SDN BHD (267935-X)
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81000 KULAIJAYA, JOHOR.
TEL : 07-6606029 Fax : 07-6606027

SIJIL UJIAN PAPAN SUIS
SWITCHBOARD TEST CERTIFICATE

A. Butir-butir (Particulars)

1 a) No. Sijil & Papan Suis
(Certificate & Switchboard Serial No) BSB/2508/2017

b) Rujukan Model (Model Ref.) AMF SWICTHBOARD (350KVA)

c) Voltan (Voltage) 415V d) Amp 500

e) Frequency 50HZ f) KVA 350

2 Tarik Ujian (Test Date) 20/09/2017

Nama & Alamat Pepasangan (Installed at) SIJANGKANG PROJECT
(LOT 7316 (PT3609) JLN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG,DAERAH KUALAN LANGAT)

3 Rujukan BSB (BSB Ref) BSB/2508/2017

B. Ujian-ujian (Test)

1 2500V selama 1 minit (2500V for I minute duration) GOOD (REPORT ATTACHED)

Radas/No. Alat Ujian
(Test Equipment/Instrument No.) KIKUSUI (TOS-5050) JAPAN

Dilakukan oleh Penjaga Jentera
(Carried out by Chargeman) TAN YIAP PEIOW

Sijil No. (Cert No.) PJ-T-1-B-3158-1996 Sekatan (Restriction) AO

Nama Jurutrera Elektrik Kompoeten/Penyelia Hadir
(Name of Competen Engineer/Supervisor Present) NIL

Stesen (Station) NIL

2 Ujian Penebatan (1000V) untuk Pendawaian & Polong-Bar GOOD
Ke bingkai logam (Insulation Test to wiring & busbar to Earth Frame)
INSULATION TEST REPORT ATTACHED

No. Alat Pengujian (Test Instrument No.) KYORITSU (3005A) JAPAN

Dilakuan oleh : PW 4 Sijil No.
(Carried out by) TAN YIAP PEIOW (Cert No.) PW-T-4-B-0235-1996

C. Cop Pembuat & Tandatangan
(Manufacturer's Seal & Manager's Signature)

Fuji SMBE Brighten Sdn Bhd 267935-X

D. (Ukuran Suisbod : Menurut lukisan yang di lampirkan)
1

Ingatan : Satu salinan Sijil Ujian hendak dimajukan kepada Pejabat Pengarah. (Kawasan Suruhanjaya Tenaga)

Note : One copy of Test Certificate to be extended to the Director General Suruhanjaya Tenaga.

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SIJIL UJIAN PAPAN SUIS
SWITCHBOARD TEST CERTIFICATE

A. Butir-butir (Particulars)

1 a) No. Sijil & Papan Suis
(Certificate & Switchboard Serial No) : BSB/2507/2017

b) Rujukan Model (Model Ref.) : LV MAIN SWICTHBOARD (MSB)

c) Voltan (Voltage) : 415V d) Amp : 2000

e) Frequency : 50HZ f) KVA :

2 Tarik Ujian (Test Date) : 19/09/2017

Nama & Alamat Pepasangan (Installed at) : SIJANGKANG PROJECT
(LOT 7316 (PT3609) JLN KLANG-BANTING, MUKIM TELUK PANGLIMA GARANG,DAERAH KUALAN LANGAT)

3 Rujukan BSB (BSB Ref) : BSB/2507/2017

B. Ujian-ujian (Test)

1 2500V selama 1 minit (2500V for I minute duration) : GOOD (REPORT ATTACHED)

Radas/No. Alat Ujian
(Test Equipment/Instrument No.) : KIKUSUI (TOS-5050) JAPAN

Dilakukan oleh Penjaga Jentera
(Carried out by Chargeman) : TAN YIAP PEIOW

Sijil No. (Cert No.) : PJ-T-1-B-3158-1996 Sekatan (Restriction) : AO

Nama Jurutrera Elektrik Kompoeten/Penyelia Hadir
(Name of Competen Engineer/Supervisor Present) : NIL

Stesen (Station) : NIL

2 Ujian Penebatan (1000V) untuk Pendawaian & Polong-Bar : GOOD
Ke bingkai logam (Insulation Test to wiring & busbar to Earth Frame)
INSULATION TEST REPORT ATTACHED

No. Alat Pengujian (Test Instrument No.) : KYORITSU (3005A) JAPAN

Dilakuan oleh : PW 4 Sijil No.
(Carried out by) : TAN YIAP PEIOW (Cert No.) : PW-T-4-B-0235-1996

C. Cop Pembuat & Tandatangan
(Manufacturer's Seal & Manager's Signature)

Fuji SMBE Brighten Sdn Bhd 267935-X

D. (Ukuran Suisbod : Menurut lukisan yang di lampirkan)

1

Ingatan : Satu salinan Sijil Ujian hendak dimajukan kepada Pejabat Pengarah. (Kawasan Suruhanjaya Tenaga)

Note : One copy of Test Certificate to be extended to the Director General Suruhanjaya Tenaga.

SENDI MAHIR SDN. BHD. (333138-T)
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This laboratory is accredited by Laboratory Accreditation Scheme of Malaysia (SAMM No.082) to comply with the requirement of ISO / IEC 17025

CERTIFICATE OF CALIBRATION

Certificate No. : SM16535317

Date of Issue : 07 Sep 2016

Issued By : Sendi Mahir Sdn Bhd

Customer : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
LOT 22, JALAN AU 3/1,
57009 ULU KLANG KUALA LUMPUR

Instrument	: Transformer Turns Ratio Test Set	Calibration Date	: 07 Sep 2016
Manufacturer	: Biddle	Recalibration Date Specified By Customer	: 07 Sep 2017
Model/Type	: Three-Phase TTR	Remark : The user should be aware that any numbers of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.	
Serial No	: 12755		
Capacity	: Refer to Following Pages		
Resolution	: -	Calibration Environment Condition:	
Condition Upon Receiving	: Good in Physical Condition	Temperature	: 23.2 to 23.3 °C
		Relative Humidity	: 53 to 55 %RH
Condition Upon Returning	: Calibrated and Tested Serviceable. No adjustment done.		
Calibration Method	: In-house procedure ICPE43		
Calibration Venue	: This Instrument has been calibrated at Sendi Mahir Sdn Bhd		
Calibration Result	: The result as following page(s). The expanded uncertainties are based on an estimated confidence probability of approximately at 95% and have a coverage factor of k=2 unless stated otherwise.		

Reference Standard(s) Used :

Reference Standard Name	Serial No	Calibration Due Date	Traceable To
TRTC CALIBRATOR	E231	16 Dec 2016	NML(MY)

APPROVED FOR USE
CHECKED BY:
DATE: 30/12/16
THE CALIBRATION RESULT MET THE SPECIFIED TOLERANCE
TEST

Calibrated By: Husna

Approved Signatory: L.H. Seah

The Calibration work is outside the scope of SAMM Accreditation and has been performed in accordance with the laboratory approved procedure. The reference standard used has traceable to NATIONAL BODY or INTERNATIONAL BODY. The results of calibration performed by Sendi Mahir Sdn. Bhd. apply to the particular equipment at the time of its test. They do not indicate or imply that Sendi Mahir Sdn. Bhd. approves, recommends or endorses the manufacturers or suppliers or users of such equipment that Sendi Mahir Sdn. Bhd. in any way guarantees the equipment's performance after calibration. Test/calibrations marked "Not SAMM Accredited" in this report/certificate are not included in the SAMM Accreditation Schedule of our laboratory. Opinions and interpretations expressed herein are outside the scope of SAMM accreditation.Copyright of this certificate is owned by the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of the issuing laboratory.

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CERTIFICATE OF CALIBRATION

Certificate No. : SM16535317

Function / Test Range	Nominal Value	Test Results	Uncertainty (±)
Turn Ratio Test @ 120 V #			
Phase - A	1 turn	1.0003 turn	2.3E-03 turn ,k = 2
	10 turn	10.004 turn	2.3E-02 turn ,k = 2
	20 turn	20.011 turn	4.5E-02 turn ,k = 2
	50 turn	50.028 turn	1.1E-01 turn ,k = 2
	200 turn	200.12 turn	4.5E-01 turn ,k = 2
	800 turn	803.56 turn	1.8E+00 turn ,k = 2
	2400 turn	2409.7 turn	5.4E+00 turn ,k = 2
Phase - B	1 turn	1.0003 turn	2.3E-03 turn ,k = 2
	10 turn	10.003 turn	2.3E-02 turn ,k = 2
	20 turn	20.011 turn	4.5E-02 turn ,k = 2
	50 turn	50.023 turn	1.1E-01 turn ,k = 2
	200 turn	200.11 turn	4.5E-01 turn ,k = 2
	800 turn	802.80 turn	1.8E+00 turn ,k = 2
	2400 turn	2405.4 turn	5.4E+00 turn ,k = 2
Phase - C	1 turn	1.0003 turn	2.3E-03 turn ,k = 2
	10 turn	10.005 turn	2.3E-02 turn ,k = 2
	20 turn	20.015 turn	4.5E-02 turn ,k = 2
	50 turn	50.033 turn	1.1E-01 turn ,k = 2
	200 turn	200.18 turn	4.5E-01 turn ,k = 2
	800 turn	803.62 turn	1.8E+00 turn ,k = 2
	2400 turn	2412.7 turn	5.4E+00 turn ,k = 2

Notes : (#) Indicates are not accredited under SAMM Scope.

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MS ISO/IEC 17025
CALIBRATION
SAMM NO. 082

CERTIFICATE OF CALIBRATION

Certificate No. : SM17566109 **Date of Issue** : 27 Jan 2017

Issued By : Sendi Mahir Sdn Bhd

Customer : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
LOT 22, JALAN AU 3/1,
57009 ULU KLANG KUALA LUMPUR

Instrument : Transformer Ohmmeter
Manufacturer : Multi-Amp
Model/Type : -
Serial No : 48450
Capacity : Refer to Following Pages
Resolution : -
Condition Upon Receiving : Good in Physical Condition
Condition Upon Returning : Calibrated and Tested Serviceable.

Calibration Date : 27 Jan 2017
Recalibration Date Specified By Customer : 27 Jan 2018

Remark : The user should be aware that any numbers of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

Calibration Environment Condition:

Temperature : 23.2 to 23.3 °C
Relative Humidity : 51 to 52 %RH

Calibration Method : In-house procedure ICPE20
Calibration Venue : This Instrument has been calibrated at Sendi Mahir Sdn Bhd
Calibration Result : The result as following page(s). The expanded uncertainties are based on an estimated confidence probability of approximately at 95% and have a coverage factor of k=2 unless stated otherwise.

Reference Standard(s) Used :

Reference Standard Name	Serial No	Calibration Due Date	Traceable To
DECADE RESISTANCE BOX	E006	14 Nov 2017	NMIM(MY)
STANDARD RESISTOR	E038	25 Aug 2017	NMIM(MY)
STANDARD RESISTOR	E037	25 Aug 2017	NMIM(MY)
STANDARD RESISTOR	E088	23 Aug 2017	NMIM(MY)

APPROVED FOR USE
CHECKED BY: 1193
DATE: 14/3/17
THE CALIBRATION RESULT MET THE SPECIFIED TOLERANCE
TEST

Calibrated By: Faruq

Approved Signatory: L.H. Seah

This certificate is issued in accordance with the conditions of accreditation granted by the SAMM which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realised at the corresponding national standards laboratory. The results of calibration performed by Sendi Mahir Sdn. Bhd. apply to the particular equipment at the time of its test. They do not indicate or imply that Sendi Mahir Sdn. Bhd. approves, recommends or endorses the manufacturers or suppliers or users of such equipment that Sendi Mahir Sdn. Bhd. in any way guarantees the equipment's performance after calibration. Test/calibrations marked "Not SAMM Accredited" in this report/certificate are not included in the SAMM Accreditation Schedule of our laboratory. Opinions and interpretations expressed herein are outside the scope of SAMM accreditation. Copyright of this certificate is owned by the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of the issuing laboratory.

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Certificate No. : SM17566109

Function Test Point	Applied Value	Test Limits Max	Test Limits Min	Before Adjust	After Adjust	Uncertainty & Coverage Factor	
Resistance							
Channel 1							
2 mΩ	1 mΩ	1.005 mΩ	0.995 mΩ	1.000 mΩ	No Adj.	1.55E-03 mΩ ,k = 2	
20 mΩ	10 mΩ	10.05 mΩ	9.95 mΩ	10.01 mΩ	No Adj.	1.53E-02 mΩ ,k = 2	
200 mΩ	0.1 Ω	101.4 mΩ	100.4 mΩ	100.8 mΩ	No Adj.	1.53E-01 mΩ ,k = 2	
2 Ω	1 Ω	1.005 Ω	0.995 Ω	1.005 Ω	No Adj.	1.52E-03 Ω ,k = 2	
Channel 2							
2 mΩ	1 mΩ	1.005 mΩ	0.995 mΩ	1.055 mΩ	No Adj.	1.55E-03 mΩ ,k = 2	*
20 mΩ	10 mΩ	10.05 mΩ	9.95 mΩ	7.98 mΩ	No Adj.	1.53E-02 mΩ ,k = 2	*
200 mΩ	0.1 Ω	100.5 mΩ	99.5 mΩ	0.09 mΩ	No Adj.	1.53E-01 mΩ ,k = 2	*
2 Ω	1 Ω	1.005 Ω	0.995 Ω	0.02 Ω	No Adj.	1.52E-03 Ω ,k = 2	*

Remark : (*) Out of specification
Channel B range above 10m Ω was show reading error too high

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MS ISO/IEC 17025
CALIBRATION
SAMM NO. 002

CERTIFICATE OF CALIBRATION

Certificate No. : SM16535316 **Date of Issue** : 07 Sep 2016

Issued By : Sendi Mahir Sdn Bhd

Customer : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
LOT 22, JALAN AU 3/1,
57009 ULU KLANG KUALA LUMPUR

Instrument	:	High Voltage Insulation Tester	**Calibration Date**	: 07 Sep 2016
Manufacturer	:	Megger	**Recalibration Date Specified By Customer**	: 07 Sep 2017
Model/Type	:	MIT 520		
Serial No	:	L0431047		
Capacity	:	Refer to Following Pages		
Resolution	:	-	**Calibration Environment Condition:**	
Condition Upon Receiving	:	Good in Physical Condition	**Temperature**	: 23.1 to 23.3 °C
			Relative Humidity	: 51 to 53 %RH
Condition Upon Returning	:	Calibrated and Tested Serviceable.		

Remark : The user should be aware that any numbers of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

Calibration Method : In-house procedure ICPE 17

Calibration Venue : This Instrument has been calibrated at Sendi Mahir Sdn Bhd

Calibration Result : The result as following page(s). The expanded uncertainties are based on an estimated confidence probability of approximately at 95% and have a coverage factor of k=2 unless stated otherwise.

Reference Standard(s) Used :

Reference Standard Name	Serial No	Calibration Due Date	Traceable To
DECADE RESISTANCE BOX	E006	12 Nov 2016	NML(MY)
H.V RESISTANCE DECADE	E031	03 Mar 2017	NML(MY)
DIGITAL MULTIMETER	E203	06 Oct 2016	NML(MY)
HIGH VOLTAGE DIGITAL METER	ES131	29 May 2017	NML(MY)

APPROVED FOR USE
CHECKED BY:
DATE: 26/12/16
THE CALIBRATION RESULT MET THE SPECIFIED TOLERANCE
TEST

Calibrated By: Nabila

Approved Signatory: L.H. Seah

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Certificate No. : SM16535316

Function Test Point	Applied Value	Test Limits Max	Test Limits Min	Before Adjust	After Adjust	Uncertainty & Coverage Factor
Insulation						
250 V / 100 GΩ	10.0000 MΩ	10.50 MΩ	9.50 MΩ	9.98 MΩ	No Adj.	2.70E-02 MΩ ,k= 2
	100.0000 MΩ	105.0 MΩ	95.0 MΩ	99.7 MΩ	No Adj.	2.74E-01 MΩ ,k= 2
	1 GΩ	1050 MΩ	950 MΩ	998 MΩ	No Adj.	2.87E+00 MΩ ,k= 2
	10 GΩ	10.5 GΩ	9.5 GΩ	10.0 GΩ	No Adj.	1.62E-01 GΩ ,k= 2
	100 GΩ	105 GΩ	95 GΩ	103 GΩ	No Adj.	1.62E+00 GΩ ,k= 2
500 V / 100 GΩ	10.0000 MΩ	10.50 MΩ	9.50 MΩ	9.96 MΩ	No Adj.	2.70E-02 MΩ ,k= 2
	100.0000 MΩ	105.0 MΩ	95.0 MΩ	99.5 MΩ	No Adj.	2.74E-01 MΩ ,k= 2
	1 GΩ	1.05 GΩ	0.95 GΩ	0.99 GΩ	No Adj.	1.55E-02 GΩ ,k= 2
	10 GΩ	10.5 GΩ	9.5 GΩ	10.0 GΩ	No Adj.	1.62E-01 GΩ ,k= 2
	100 GΩ	105 GΩ	95 GΩ	102 GΩ	No Adj.	1.62E+00 GΩ ,k= 2
1000 V / 1 TΩ	100.0000 MΩ	105.0 MΩ	95.0 MΩ	99.9 MΩ	No Adj.	2.74E-01 MΩ ,k= 2
	1 GΩ	1.05 GΩ	0.95 GΩ	0.99 GΩ	No Adj.	1.55E-02 GΩ ,k= 2
	10 GΩ	10.5 GΩ	9.5 GΩ	10.1 GΩ	No Adj.	1.62E-01 GΩ ,k= 2
	100 GΩ	105 GΩ	95 GΩ	100 GΩ	No Adj.	1.62E+00 GΩ ,k= 2
2500 V / 1 TΩ	100 MΩ	105.0 MΩ	95.0 MΩ	99.2 MΩ	No Adj.	2.74E-01 MΩ ,k= 2
	1 GΩ	1050 MΩ	950 MΩ	998 MΩ	No Adj.	2.87E+00 MΩ ,k= 2
	10 GΩ	10.5 GΩ	9.5 GΩ	10.0 GΩ	No Adj.	1.62E-01 GΩ ,k= 2
	100 GΩ	105 GΩ	95 GΩ	101 GΩ	No Adj.	1.62E+00 GΩ ,k= 2
5000 V / 1 TΩ	100 MΩ	105.0 MΩ	95.0 MΩ	99.6 MΩ	No Adj.	2.74E-01 MΩ ,k= 2
	1 GΩ	1050 MΩ	950 MΩ	997 MΩ	No Adj.	2.87E+00 MΩ ,k= 2
	10 GΩ	10.5 GΩ	9.5 GΩ	10.1 GΩ	No Adj.	1.62E-01 GΩ ,k= 2
	100 GΩ	105 GΩ	95 GΩ	99 GΩ	No Adj.	1.62E+00 GΩ ,k= 2

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SAMM NO. 082

CERTIFICATE OF CALIBRATION

Certificate No. : SM16535316

Function Test Point	Instrument Reading	Test Limits		Before Adjust	After Adjust	Uncertainty & Coverage Factor
		Max	Min			
Voltage Test Level						
250 V	252 V	270.0 V	240.0 V	254.0 V	No Adj.	6.56E-01 V ,k= 2
500 V	508 V	0.542 kV	0.502 kV	0.510 kV	No Adj.	1.58E-03 kV ,k= 2
1000 V	1025 V	1.079 kV	1.018 kV	1.027 kV	No Adj.	2.72E-03 kV ,k= 2
2500 V	2557 V	2.669 kV	2.547 kV	2.559 kV	No Adj.	6.52E-02 kV ,k= 2
5000 V	5113 V	5.324 kV	5.100 kV	5.115 kV	No Adj.	1.22E-01 kV ,k= 2

Remark : (*) Out of specification.

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MS ISO/IEC 17025
CALIBRATION
SAMM NO. 082

CERTIFICATE OF CALIBRATION

Certificate No. : SM16542721 **Date of Issue** : 18 Oct 2016

Issued By : Sendi Mahir Sdn Bhd

Customer : MALAYSIA TRANSFORMER MANUFACTURING SDN BHD
LOT 22, JALAN AU 3/1,
57009 ULU KLANG KUALA LUMPUR

Instrument : Power Analyzer
Manufacturer : Yokogawa
Model/Type : PZ4000 (253752)
Serial No : 91 JA 16522
Capacity : Refer to Following Pages
Resolution : -
Condition Upon Receiving : Good in Physical Condition
Condition Upon Returning : Calibrated and Tested Serviceable.

Calibration Date : 18 Oct 2016
Recalibration Date Specified By Customer : 18 Oct 2017

Remark : The user should be aware that any numbers of factors may cause this instrument to drift out of calibration before the specified calibration interval has expired.

Calibration Environment Condition:

Temperature : 23.1 to 23.4 °C
Relative Humidity : 53 to 55 %RH

Calibration Method : In-house procedure ICPE16
Calibration Venue : This Instrument has been calibrated at Sendi Mahir Sdn Bhd
Calibration Result : The result as following page(s). The expanded uncertainties are based on an estimated confidence probability of approximately at 95% and have a coverage factor of k=2 unless stated otherwise.

Reference Standard(s) Used :

Reference Standard Name	Serial No	Calibration Due Date	Traceable To
FLUKE CALIBRATOR	E224	12 Nov 2016	NIST(USA)
AC VOLTAGE CURRENT STANDARD	E225	26 Apr 2017	NMIM(MY)

APPROVED FOR USE
CHECKED BY:
DATE: 17/11/16
THE CALIBRATION RESULT IS WITHIN THE SPECIFIED TOLERANCE
TEST

Calibrated By: Faruq

Approved Signatory: L.H. Seah

This certificate is issued in accordance with the conditions of accreditation granted by the SAMM which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realised at the corresponding national standards laboratory. The results of calibration performed by Sendi Mahir Sdn. Bhd. apply to the particular equipment at the time of its test. They do not indicate or imply that Sendi Mahir Sdn. Bhd. approves, recommends or endorses the manufacturers or suppliers or users of such equipment that Sendi Mahir Sdn. Bhd. in any way guarantees the equipment's performance after calibration. Test/calibrations marked "Not SAMM Accredited" in this report/certificate are not included in the SAMM Accreditation Schedule of our laboratory. Opinions and interpretations expressed herein are outside the scope of SAMM accreditation. Copyright of this certificate is owned by the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of the issuing laboratory.

SMSB
SENDI MAHIR SDN. BHD. (333138-T)
GST No: 001894494208
NO.6, 8 & 10, JALAN KAPAR 27/89, MEGAH INDUSTRIAL PARK,
SEKSYEN 27, 40400 SHAH ALAM, SELANGOR DARUL EHSAN, MALAYSIA.
TEL: 03-5191 7388 (HUNTING LINE), 5191 7502, 5191 7592, 5192 9481 FAX: 03-5191 0675, 5191 9716
EMAIL: enquiry@sendimahir.com ; marketing@sendimahir.com Website: www.sendimahir.com

MS ISO/IEC 17025
CALIBRATION
SAMM NO. 082

CERTIFICATE OF CALIBRATION

Certificate No. : SM16542721

Function / Test Point	Applied Value		Test Results		Measurement Uncertainty (±)		
1. DC Voltage Test							
Element -1	1000.0	V	0.99948	kV	6.3E-05	kV	, k = 2
	750.0	V	0.74932	kV	4.8E-05	kV	, k = 2
	500.0	V	0.49954	kV	3.4E-05	kV	, k = 2
	250.0	V	249.776	V	2.0E-02	V	, k = 2
	50.0	V	49.949	V	3.4E-03	V	, k = 2
Element -2	1000.0	V	0.99928	kV	6.3E-05	kV	, k = 2
	750.0	V	0.74918	kV	4.8E-05	kV	, k = 2
	500.0	V	0.49942	kV	3.4E-05	kV	, k = 2
	250.0	V	249.704	V	2.0E-02	V	, k = 2
	50.0	V	49.929	V	3.4E-03	V	, k = 2
Element -3	1000.0	V	0.99854	kV	6.3E-05	kV	, k = 2
	750.0	V	0.74880	kV	4.8E-05	kV	, k = 2
	500.0	V	0.49921	kV	3.4E-05	kV	, k = 2
	250.0	V	249.527	V	2.0E-02	V	, k = 2
	50.0	V	49.925	V	3.4E-03	V	, k = 2
2. AC Voltage Test @ 50 Hz							
Element -1	1000.0	V	0.99916	kV	5.7E-04	kV	, k = 2
	750.0	V	0.74938	kV	4.5E-04	kV	, k = 2
	500.0	V	0.49952	kV	3.4E-04	kV	, k = 2
	250.0	V	249.764	V	3.4E-02	V	, k = 2
	50.0	V	49.988	V	1.1E-02	V	, k = 2
Element -2	1000.0	V	0.99891	kV	5.7E-04	kV	, k = 2
	750.0	V	0.74911	kV	4.5E-04	kV	, k = 2
	500.0	V	0.49931	kV	3.4E-04	kV	, k = 2
	250.0	V	249.624	V	3.4E-02	V	, k = 2
	50.0	V	49.921	V	1.1E-02	V	, k = 2

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MS ISO/IEC 17025
CALIBRATION
SAMM NO. 082

CERTIFICATE OF CALIBRATION

Certificate No. : SM16542721

Function / Test Point	Applied Value	Test Results	Measurement Uncertainty (±)
2. AC Voltage @ 50 Hz Test			
Element -3	1000.0 V	0.99895 kV	5.7E-04 kV , k = 2
	750.0 V	0.74915 kV	4.5E-04 kV , k = 2
	500.0 V	0.49931 kV	3.4E-04 kV , k = 2
	250.0 V	249.622 V	3.4E-02 V , k = 2
	50.0 V	49.939 V	1.1E-02 V , k = 2
3. DC Current Test (5A)			
Element -1	5.000 A	4.6992 A	3.4E-03 A , k = 2
	3.000 A	2.82685 A	2.3E-03 A , k = 2
	1.000 A	0.94298 A	1.1E-03 A , k = 2
Element -2	5.000 A	N/A	N/A
	3.000 A	N/A	N/A
	1.000 A	N/A	N/A
Element -3	5.000 A	4.6477 A	3.4E-03 A , k = 2
	3.000 A	2.78828 A	2.3E-03 A , k = 2
	1.000 A	0.93590 A	1.1E-03 A , k = 2
4. DC Current Test (20A)			
Element -1	20.00 A	20.0152 A	2.3E-02 A , k = 2
	15.00 A	15.0008 A	1.8E-02 A , k = 2
	10.00 A	10.0115 A	1.2E-02 A , k = 2
Element -2	20.00 A	19.9989 A	2.3E-02 A , k = 2
	15.00 A	14.9986 A	1.8E-02 A , k = 2
	10.00 A	10.0000 A	1.2E-02 A , k = 2

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CALIBRATION
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Certificate No. : SM16542721

Function / Test Point	Applied Value	Test Results	Measurement Uncertainty (±)
4. DC Current Test (20A)			
Element -3	20.00 A	20.0082 A	2.3E-02 A , k = 2
	15.00 A	15.0044 A	1.8E-02 A , k = 2
	10.00 A	10.0009 A	1.2E-02 A , k = 2
5. AC Current Test @ 50 Hz (5A)			
Element -1	5.000 A	4.6937 A	4.2E-03 A , k = 2
	3.000 A	2.81490 A	3.0E-03 A , k = 2
	1.000 A	0.93810 A	1.8E-03 A , k = 2
Element -2	5.000 A	N/A	N/A
	3.000 A	N/A	N/A
	1.000 A	N/A	N/A
Element -3	5.000 A	4.6432 A	4.2E-03 A , k = 2
	3.000 A	2.78540 A	3.0E-03 A , k = 2
	1.000 A	0.92870 A	1.8E-03 A , k = 2
6. AC Current Test @ 50 Hz (20A)			
Element -1	20.00 A	19.9947 A	1.8E-02 A , k = 2
	15.00 A	14.9996 A	1.5E-02 A , k = 2
	10.00 A	9.9971 A	1.2E-02 A , k = 2
Element -2	20.00 A	19.9949 A	1.8E-02 A , k = 2
	15.00 A	14.9934 A	1.5E-02 A , k = 2
	10.00 A	9.9938 A	1.2E-02 A , k = 2

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MS ISO/IEC 17025
CALIBRATION
SAMM NO. 082

CERTIFICATE OF CALIBRATION

Certificate No. : SM16542721

Function / Test Point	Applied Value		Test Results		Measurement Uncertainty (±)		
6. AC Current Test @ 50 Hz (20A)							
Element -3	20.00	A	20.0018	A	1.8E-02	A	, k = 2
	15.00	A	14.9949	A	1.5E-02	A	, k = 2
	10.00	A	9.9946	A	1.2E-02	A	, k = 2
7. AC Power Test @ 50 Hz ##							
Element -1							
1000 V / 20 A	20.000	kW	19.9795	kW	2.3E-02	kW	, k = 2
1000 V / 15 A	15.000	kW	14.9808	kW	1.7E-02	kW	, k = 2
1000 V / 10 A	10.000	kW	9.9847	kW	1.1E-02	kW	, k = 2
Element -2							
1000 V / 20 A	20.000	kW	19.9585	kW	2.3E-02	kW	, k = 2
1000 V / 15 A	15.000	kW	14.9685	kW	1.7E-02	kW	, k = 2
1000 V / 10 A	10.000	kW	9.9782	kW	1.1E-02	kW	, k = 2
Element -3							
1000 V / 20 A	20.000	kW	19.9473	kW	2.3E-02	kW	, k = 2
1000 V / 15 A	15.000	kW	14.9580	kW	1.7E-02	kW	, k = 2
1000 V / 10 A	10.000	kW	9.9744	kW	1.1E-02	kW	, k = 2

Notes : (##) Not under Accreditation Scope.

FACTORY ACCEPTANCE TEST REPORT

PROJECT:

SIJANGKANG PROJECT

SWITCHEDBOARD NAME :

1.) **LV MAIN SWITCHBOARD (MSB)**

2.) **ESSENTIAL SWITCHBOARD (ESB)**

3.) **AMF SWITCHBOARD (350KVA)**

Fuji SMBE Brighten Sdn Bhd

ATTENDANCE RECORDS

Our Ref: : MY 2170182

Project Title : SIJANKANG PROJECT

Client : KEJURUTERAAN BROAD-WAY SDN BHD

Consultant : HAN YANG CONSULTANCY SDN BHD

Designation : LV MAIN SWITCHBOARD (MSB), ESSENTIAL SWITCHBOARD (ESB), AMF SWITCHBOARD (350KVA)

Inspection Date : 25/9/2017

Location : FUJI SMB BRIGHTEN SWITCHBOARD BUILDER FACTORY

(1) (Signature)
Name: Chan Keng Ann
Company: Kejuruteraan Broad-way Sdn. Bhd.
Date: 25/9/2017

(2) (Signature)
Name: Lim Chee Keong
Company: Han Yang Consultancy
Date: 25/9/17

(3) (Signature)
Name: MOHD AZM
Company: AXIS
Date: 25/9/2017.

(4) (Signature)
Name: Rathun Jay
Company: SMBE Brighten
Date: 25/9/2017

(5) (Signature)
Name:
Company:
Date:

(6) (Signature)
Name:
Company:
Date:

(7) (Signature)
Name:
Company:
Date:

(8) (Signature)
Name:
Company:
Date:

Fuji SMBE Brighten Sdn Bhd

FACTORY INSPECTION FEEDBACK LIST

Client : KEJURUTERAAN BROAD-WAY SDN BHD **Our Ref** : MY 2170128-3

Project Title : SIJANGKANG PROJECT

Consultant : HAN YANG CONSULTANCY SDN BHD

Inspection Date : 25/9/2017 **Time** :

Designation : LV MAIN SWITCHBOARD (MSB)

No	Client's Feedback	Action By
1	All Tested ok in good condition	

Tested by : _____ **Date:** 25/9/17

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name :	Name : Mohd Azmi
Company : K. Broad-way Sdn. Bhd.	Company :	Company : HYC	Company : AXIS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

FUJI SMBE BRIGHTEN SDN.BHD

STANDARD PROCEDURES FOR FACTORY ACCEPTANCE TEST

Client : KEJURUTERAAN BROAD-WAY SDN BHD **Our Ref** : MY 2170128-3

Project Title : SIJANGKANG PROJECT

Consultant : HAN YANG CONSULTANCY SDN BHD

Inspection Date : 25/9/2017 **Time** :

Designation : LV MAIN SWITCHBOARD (MSB)

	Yes*	No*	N/A*
1 Visual Inspection			
1.1 General arrangements of components' layout	✓		
1.2 Brands/Models of components	✓		
1.3 Dimensions of switchboards	✓		
1.4 Incoming/Outgoing feeders termination (top or bottom/cable or busduct)			✓
1.5 BAS termination compartment, if any			✓
2 Mechanical Operation			
2.1 Air circuit breakers (On/Off operation)	✓		
2.2 Molded case circuit breakers (On/Off operation)	✓		
2.3 Mechanical interlocking for feeders and coupling system	✓		
2.4 Mechanical interlocking for transfer switches (auto/manual)	✓		
3 Electrical Test			
3.1 Dielectric test and insulation test	✓		
3.2 Secondary current injection tests to verify IDMTL protection relay settings			✓
3.3 Function tests on meter instruments and electrical interlocking system	✓		
4 Others (please specify) :			

Tested by : _____ **Date:** 25/9/17

Note: Please give production one FULL week of working days for final adjustment, if required, before delivery.

☐ *Please tick ✓ on the appropriate box.*

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name : CKWan	Name : Mohd Azri
Company : K. Broadway Sdn. Bhd.	Company :	Company : HYC	Company : AXPS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

Fuji SMBE Brighten Sdn Bhd

TEST REPORT FOR INSULATION RESISTANCE LEVEL AND DIELECTRIC STRENGTH

Client	:	KEJURUTERAAN BROAD-WAY SDN BHD	**Our Ref**	:	MY 2170128-3,4
Project Title	:	SIJANGKANG PROJECT			
Consultant	:	HAN YANG CONSULTANCY SDN BHD			
Inspection Date	:	25/9/2017	**Time**	:	
Designation	:	LV MAIN SWITCHBOARD (MSB), ESSENTIAL SWITCHBOARD (ESB)			

Insulation Resistance Level Test at 500Vdc ☐ 1000Vdc ☐			**Dielectric Strength Test at 2.5KV in 60sec**			
Between Phase	**M-Ohm**		**Between Phase**	**Leakage Current (mA)**	**Results**	
	Before 2.5KV Test	**After 2.5KV Test**			**Passed**	**Failed**
R & E	274 M ohm	253 M ohm	**R & YBNE shorted**	4 mA	✓	
Y & E	303 M ohm	301 M ohm	**Y & RBNE shorted**	5 mA	✓	
B & E	583 M ohm	312 M ohm	**B & RYNE shorted**	4 mA	✓	
N & E	409 M ohm	383 M ohm	**N & RYBE shorted**	2 mA		
R & N	445 M ohm	465 M ohm				
Y & N	443 M ohm	445 M ohm				
B & N	385 M ohm	393 M ohm				
R & Y	170 M ohm	157 M ohm				
Y & B	153 M ohm	141 M ohm				
B & R	204 M ohm	202 M ohm				

** Result > 100Mohm will be indicating as 100Mohm.*
** Result > 5Mohm 'PASSED' for insulation test of in between phase, neutral & earth. (IEE regulation 713-04)*
** Result > 0.1A or 100mA 'FAILED' for dielectric strength test.*

Tested by : _____ **Date:** 25/9/17

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name :	Name : Mohd Azmi
Company : K. Broadway Sdn. Bhd.	Company :	Company : HYC	Company : Axis
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

Fuji SMBE Brighten Sdn Bhd

FACTORY INSPECTION FEEDBACK LIST

Client	:	KEJURUTERAAN BROAD-WAY SDN BHD	**Our Ref**	:	MY 2170128-4
Project Title	:	SIJANGKANG PROJECT			
Consultant	:	HAN YANG CONSULTANCY SDN BHD			
Inspection Date	:	25/9/2017	**Time**	:	
Designation	:	ESSENTIAL SWITCHBOARD (ESB)			

No	Client's Feedback	Action By
	QF-16 need fireman switch	
	Panel tested in good condition	

Tested by : _____ **Date:** 25/9/17

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name : CKLim	Name : Mohd Kasi
Company : K. Broad-way Sdn Bhd.	Company :	Company : HYC	Company : AKCS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

FUJI SMBE BRIGHTEN SDN.BHD

STANDARD PROCEDURES FOR FACTORY ACCEPTANCE TEST

Client : KEJURUTERAAN BROAD-WAY SDN BHD **Our Ref** : MY 2170128-4

Project Title : SIJANGKANG PROJECT

Consultant : HAN YANG CONSULTANCY SDN BHD

Inspection Date : 25/9/2017 **Time** :

Designation : ESSENTIAL SWITCHBOARD (ESB)

	Yes*	No*	N/A*
1 Visual Inspection			
1.1 General arrangements of components' layout	✓		
1.2 Brands/Models of components	✓		
1.3 Dimensions of switchboards	✓		
1.4 Incoming/Outgoing feeders termination (top or bottom/cable or busduct)			✓
1.5 BAS termination compartment, if any			✓
2 Mechanical Operation			
2.1 Air circuit breakers (On/Off operation)			✓
2.2 Molded case circuit breakers (On/Off operation)	✓		
2.3 Mechanical interlocking for feeders and coupling system			✓
2.4 Mechanical interlocking for transfer switches (auto/manual)			✓
3 Electrical Test			
3.1 Dielectric test and insulation test	✓		
3.2 Secondary current injection tests to verify IDMTL protection relay settings			✓
3.3 Function tests on meter instruments and electrical interlocking system			✓
4 Others (please specify) :			

Tested by : _____ **Date:** 25/9/17

Note: Please give production one FULL week of working days for final adjustment, if required, before delivery.

☐ *Please tick ✓ on the appropriate box.*

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name : CKCW	Name : Mohd Azmi
Company : K Broad-way Sdn Bhd.	Company :	Company : HYC	Company : AXIS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2019

Fuji SMBE Brighten Sdn Bhd

FACTORY INSPECTION FEEDBACK LIST

Client	:	KEJURUTERAAN BROAD-WAY SDN BHD	**Our Ref**	:	MY 2170128-5
Project Title	:	SIJANGKANG PROJECT			
Consultant	:	HAN YANG CONSULTANCY SDN BHD			
Inspection Date	:	25/9/2017	**Time**	:	
Designation	:	AMF SWITCHBOARD (350KVA)			

No	Client's Feedback	Action By
	~~Q1 - need transfer switch~~	
	Panel tested in good condition	

Tested by : _____ **Date:** 25/9/17

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name :	Name : Mohd Azmi
Company : K- Broadway Sdn. Bhd.	Company :	Company : HYC	Company : AXCS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

FUJI SMBE BRIGHTEN SDN.BHD

STANDARD PROCEDURES FOR FACTORY ACCEPTANCE TEST

Client : KEJURUTERAAN BROAD-WAY SDN BHD **Our Ref** : MY 2170128-5

Project Title : SIJANGKANG PROJECT

Consultant : HAN YANG CONSULTANCY SDN BHD

Inspection Date : 25/9/2017 **Time** :

Designation : AMF SWITCHBOARD (350KVA)

	Yes*	No*	N/A*
1 Visual Inspection			
1.1 General arrangements of components' layout	✓		
1.2 Brands/Models of components	✓		
1.3 Dimensions of switchboards	✓		
1.4 Incoming/Outgoing feeders termination (top or bottom/cable or busduct)			✓
1.5 BAS termination compartment, if any			✓
2 Mechanical Operation			
2.1 Air circuit breakers (On/Off operation)			✓
2.2 Molded case circuit breakers (On/Off operation)	✓		
2.3 Mechanical interlocking for feeders and coupling system			✓
2.4 Mechanical interlocking for transfer switches (auto/manual)			✓
3 Electrical Test			
3.1 Dielectric test and insulation test	✓		
3.2 Secondary current injection tests to verify IDMTL protection relay settings			✓
3.3 Function tests on meter instruments and electrical interlocking system	✓		
4 Others (please specify) :			

Tested by : _____ **Date:** 25/9/17

Note: Please give production one FULL week of working days for final adjustment, if required, before delivery.

☐ *Please tick ✓ on the appropriate box.*

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Kong Ann	Name :	Name : CICHAN	Name : Mohd Amri
Company : K. Broad-Way Sdn. Bhd.	Company :	Company : HYEC	Company : AXIS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

Fuji SMBE Brighten Sdn Bhd

TEST REPORT FOR INSULATION RESISTANCE LEVEL AND DIELECTRIC STRENGTH

Client	:	KEJURUTERAAN BROAD-WAY SDN BHD	**Our Ref**	:	MY 2170128-5
Project Title	:	SIJANGKANG PROJECT			
Consultant	:	HAN YANG CONSULTANCY SDN BHD			
Inspection Date	:	25/9/2017	**Time**	:	
Designation	:	AMF SWITCHBOARD (350KVA)			

Insulation Resistance Level Test at 500Vdc ☐ 1000Vdc ☑			**Dielectric Strength Test at 2.5KV in 60sec**			
Between Phase	**M-Ohm**		**Between Phase**	**Leakage Current (mA)**	**Results**	
	Before 2.5KV Test	**After 2.5KV Test**			**Passed**	**Failed**
R & E	2000 M ohm	2000 M ohm	**R & YBNE shorted**	0 mA	✓	
Y & E	2000 M ohm	2000 M ohm	**Y & RBNE shorted**	0 mA	✓	
B & E	2000 M ohm	2000 M ohm	**B & RYNE shorted**	0 mA	✓	
N & E	2000 M ohm	2000 M ohm	**N & RYBE shorted**	0 mA	✓	
R & N	2000 M ohm	2000 M ohm				
Y & N	2000 M ohm	2000 M ohm				
B & N	2000 M ohm	2000 M ohm				
R & Y	2000 M ohm	2000 M ohm				
Y & B	2000 M ohm	2000 M ohm				
B & R	2000 M ohm	2000 M ohm				

** Result > 100Mohm will be indicating as 100Mohm.*
** Result > 5Mohm 'PASSED' for insulation test of in between phase, neutral & earth. (IEE regulation 713-04)*
** Result > 0.1A or 100mA 'FAILED' for dielectric strength test.*

Tested by : _____ **Date:** 25/9/17

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name :	Name : Mohd Azmi
Company : K- Broadway Sdn Bhd	Company :	Company : HEC	Company : AKIS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

Fuji SMBE Brighten Sdn Bhd

AMF PANEL FUNCTIONAL TESTING REPORT

Client	:	KEJURUTERAAN BROAD-WAY SDN BHD	**Our Ref**	:	MY 2170128-5
Project Title	:	SIJANGKANG PROJECT			
Consultant	:	HAN YANG CONSULTANCY SDN BHD			
Inspection Date	:	25/9/2017	**Time**	:	
Designation	:	AMF SWITCHBOARD (350KVA)			

No	Terminal Check point	Passed	Failed
1	"Manual Start Mode" Test	✓	
2	"Automatic Start Mode" Test	✓	
3	Generator Fault Protection System Test		
	3a. High water temperature fault	✓	
	3b. Fuel low level fault	✓	
	3c. Over speed fault	✓	
	3d. Low oil pressure fault	✓	
	3e. Earth fault relay protection	✓	
	3f. Over current relay protection	✓	
	3g. Fail to start alarm	✓	
4	Indicated lamps & siren for fault & protection system		
	4a. Siren bell	✓	
	4b. Fault indicated lamp	✓	
	4c. Alarm mute/reset switch	✓	

**Note: Please tick ✓ on appropriate box.*

Tested by : _____ **Date:** 25/9/17

Electrical Contractor	Main Contractor	Consultant	Owner
Signature :	Signature :	Signature :	Signature :
Name : Chan Keng Ann	Name :	Name : CKLim	Name : Mohd Azmi
Company : K. Broadway Sdn. Bhd.	Company :	Company : HYC	Company : AXIS
Date : 25/9/2017	Date :	Date : 25/9/17	Date : 25/9/2017

SIRIM SST

ilac-MRA

STANDARDS MALAYSIA ACCREDITED LABORATORY

MS ISO/IEC 17025 CALIBRATION SAMM NO. 176

CERTIFICATE OF CALIBRATION

DATE OF ISSUE : 11 January 2017

CERTIFICATE NO : SST/JN/R/2017A/178

ISSUED BY : SIRIM Standards Technology Sdn. Bhd.
(Co No.:292201-P)
No.3, Jalan Teknologi 5,
Taman Teknologi Johor,
81400 Senai,
Johor Darul Takzim
Tel:+607-5989066 Fax:+607-5989077

APPROVED SIGNATORIES

Murali A/L Subramaniam

Submitted by : Fuji SMBE Brighten Sdn Bhd
3338, Jalan Pekeliling Tanjung 27,
Kawasan Perindustrian Indahpura,
81000 Kulai, Johor.
Attn:Mr. Vernon Chee Keng Seng

Job No. : JN2017-54-3
Date Received : 09/01/2017

Instrument : Digital Caliper
Manufacturer : Mitutoyo

Model No. : CD-8"CSX
Serial No. : 14203844

Instrument Condition When Received :
Physically in good condition

Instrument Condition When Returned :
1.Calibrated and test serviceable
2.Calibration due date requested by customer
3.The user should be aware that there are a number of factors that may caused this instrument to drift out of calibration before the specified calibration interval has expired.

Environmental Condition:-
Average Temperature : (20 ± 1) °C
Average Relative Humidity : (50 ± 1) %RH
Calibration Date : 11 January 2017
Requested Cal.Due Date : 11 January 2018

Calibration Method :
This instrument was calibrated using the calibration procedures No. MSD/0003 Rev. 18.0

Calibration Standard(s) Used :

Instrument Type :	Serial No. :	Cal. Due Date :	Cal. Cert. No.:	Traceability :
Caliper Checker	510172	17/10/2017	SST/SA/IR/2016J/10	SST(SA)/NML(M'SIA)

The standard instruments used in this calibration are traceable to either the National Standards maintained at the National Metrology Laboratory, SIRIM Berhad or other recognised International Standard Laboratories

Calibration Sticker No.: JN-01-178
Measurement Uncertainty : ± 0.02 mm
The uncertainty calculation is based on the ISO guide to the expression of uncertainty in measurement.
Coverage Factor k : 2

Approved Signatory
Murali A/L Subramaniam

The uncertainties are for a confidence probability of approximately 95%

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SIRIM SST

MS ISO/IEC 17025
CALIBRATION
SAMM NO. 176

CERTIFICATE OF CALIBRATION

DATE OF ISSUE: 11 January 2017 **CERTIFICATE NUMBER:** SST/JN/R/2017A/178

Instrument : Digital Caliper **Serial No.** : 14203844

CALIBRATION RESULTS

Description	Nominal Value (mm)	Errors (mm)		Max. Permissible Errors (mm)
		Before Adjustment	After Adjustment	
Range: 0 ~ 200 mm Graduation: 0.01 mm	0	0.00	N/A	± 0.02
	20	0.00	N/A	± 0.02
	50	0.00	N/A	± 0.02
	100	0.00	N/A	± 0.02
	150	0.00	N/A	± 0.03
	200	0.00	N/A	± 0.03

Note : *True Reading = Instrument Reading - Error*
Max. Permissible Errors Reference (s) : JIS-B-7507 : 1993 (Doc. Control No. : JD-01 Rev. 0.0)

Calibrated by: _____
Mokhtar Bin Ali

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the SAMM which has assessed the measurement capability of the laboratory and its traceability to recognised national standards and to the units of measurement realised at the corresponding national standards laboratory. Copyright of this certificate is owned by the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of the issuing laboratory.

SIRIM SST

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STANDARDS MALAYSIA ACCREDITED LABORATORY

MS ISO/IEC 17025 CALIBRATION SAMM NO. 176

CERTIFICATE OF CALIBRATION

DATE OF ISSUE : 01 June 2017 **CERTIFICATE NUMBER** : SST/JN/R/2017F/10

ISSUED BY : SIRIM Standards Technology Sdn. Bhd.
(Company No. 292201 - P)
Bangunan SIRIM Berhad,
No. 3, Jalan Teknologi 5, Taman Teknologi Johor,
81400 Senai, Johor Darul Takzim.
Tel. : 07-5989066 Fax. : 07-5989077

APPROVED SIGNATORIES

Gurdeep Singh A/L Gurdial Singh

Submitted by : Fuji SMBE Brighten Sdn Bhd
3338, Jalan Pekeliling Tanjung 27
Kawasan Perindustrian Indahpura
81000 Kulaijaya
Johor Darul Takzim.
(Attn. : Mr. Vernon Chee Keng Seng)

Job No. : JN2017-993-3
Date Of Received : 17 May 2017

Instrument : AC Withstanding Voltage Tester
Manufacturer : Kikusui

Model No. : TOS 5050
Serial No. : 15102941

Instrument Condition When Received: 1. Good physical condition.

Instrument Condition When Returned:
1. Calibrated and tested serviceable. No adjustment done.
2. Calibration Due Date requested by customer.
3. The User should be aware that there are factors that may caused this instruments to drift out of calibration before its specified calibration due date has expired.

Environmental Condition :-
Average Temperature : (23 ± 1) °C **Average Relative Humidity** : (55 ± 1) % RH

Calibration Date : 01 June 2017 **Requested Cal. Due Date** : 01 June 2018

Calibration Method :
This instrument was calibrated using the Calibration Procedure No. ESD / 0345 Rev. 4.0

Calibration Standard(s) Used :

Instrument Type :	Serial No. :	Cal. Due Date :	Cal. Cert. No. :	Traceability :
TDV-20ADS	13069	19 September 2017	EL 004780	NMC, S'pore
TLC-501 B	13805	07 September 2017	SST/JN/IR/2016I/4	SST (JB)/NMC, S'pore
SST-2 Time Calibrator	SJ 101	08 June 2017	SST/JN/IR/2016E/9	SST (JB)/NML,SIRIM
FLUKE 289	10970025	05 February 2018	SST/JN/IR/2017B/1	SST (JB)/NPL,UK

The standard instruments used in this calibration are traceable to either the National Standard maintained at the National Metrology Laboratory , SIRIM Berhad or other recognised International Standard Laboratories.

Calibration Sticker No : JN-06-10

Measurement Uncertainty :

1) The uncertainty calculation was based on the ISO Guide to the Expression of Uncertainty in Measurement.

2) Refer to calibration results.Coverage Factor (k) = 2

3) The test limits given are based on manufacturer's specification.

Approved Signatory

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the SAMM which has assessed the measurement capability of the laboratory and its traceability to recognised national standards and to the units of measurement realised at the corresponding national standards laboratory. Copyright of this certificate is owned by the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of the issuing laboratory.

SIRIM SST

MS ISO/IEC 17025
CALIBRATION
SAMM NO. 176

CERTIFICATE OF CALIBRATION

DATE OF ISSUE : 01 June 2017

CERTIFICATE NUMBER : SST/JN/R/2017F/10

Instrument : AC Withstanding Voltage Tester

Serial No. : 15102941

CALIBRATION RESULTS

Function / Range	Indicated Value	Test Limits	Measured Value	Measurement Uncertainty (±)
1. AC Voltage @ 50 Hz				
0 ~ 5 kV	5.00 kV	4.92 to 5.08 kV	5.007 kV	0.017 kV
	4.00 kV	3.92 to 4.08 kV	4.011 kV	0.017 kV
	3.00 kV	2.92 to 3.08 kV	3.004 kV	0.017 kV
	2.00 kV	1.92 to 2.08 kV	2.003 kV	0.017 kV
	1.00 kV	0.92 to 1.08 kV	1.004 kV	0.017 kV
0 ~ 2.5 kV	2.50 kV	2.46 to 2.54 kV	2.513 kV	0.017 kV
	2.00 kV	1.96 to 2.04 kV	2.009 kV	0.017 kV
	1.50 kV	1.46 to 1.54 kV	1.510 kV	0.017 kV
	1.00 kV	0.96 to 1.04 kV	1.005 kV	0.017 kV
	0.50 kV	0.46 to 0.54 kV	0.503 kV	0.017 kV
		Measured Value	Correction	
2. Cutoff Current	10 mA	9.83 mA	-0.17 mA	0.15 mA
	5 mA	4.97 mA	-0.03 mA	0.09 mA
	2 mA	2.01 mA	+ 0.01 mA	0.06 mA
	1 mA	1.00 mA	0.00 mA	0.02 mA
	0.5 mA	0.46 mA	-0.04 mA	0.01 mA
3. Timer				
	60 sec.	60.10 sec.	+ 0.10 sec.	0.13 sec.
	40 sec.	40.09 sec.	+ 0.09 sec.	0.13 sec.
	20 sec.	20.10 sec.	+ 0.10 sec.	0.13 sec.
	10 sec.	10.10 sec.	+ 0.10 sec.	0.13 sec.
	2 sec.	2.09 sec.	+ 0.09 sec.	0.13 sec.

Note : 1) + ve correction is to be added to the indicated value.
- ve correction is to be subtracted from the indicated value.

Calibrated by :

Mohd Saharudin B. Rahidi

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the SAMM which has assessed the measurement capability of the laboratory and its traceability to recognised national standards and to the units of measurement realised at the corresponding national standards laboratory. Copyright of this certificate is owned by the issuing laboratory and may not be reproduced other than in full except with the prior written approval of the Head of the issuing laboratory.

SIRIM SST

MS ISO/IEC 17025
CALIBRATION
SAMM NO. 176

CERTIFICATE OF CALIBRATION

DATE OF ISSUE : 16 January 2017 **CERTIFICATE NUMBER** : SST/JN/R/2017A/279

ISSUED BY : SIRIM Standards Technology Sdn. Bhd.
(Company No. 292201 - P)
Bangunan SIRIM Berhad,
No. 3, Jalan Teknologi 5, Taman Teknologi Johor,
81400 Senai, Johor Darul Takzim.
Tel. : 07-5989066 Fax. : 07-5989077

APPROVED SIGNATORIES
Gurdeep Singh A/L Gurdial Singh

Submitted by : FUJI SMBE BRIGHTEN SDN BHD
3338, Jalan Pekeliling Tanjung 27
Kawasan Perindustrian Indahpura
81000 Kulai
Johor Darul Takzim.
(Attn. : Mr. Vernon Chee Keng Seng)

Job No. : JN2017-54-8
Date Of Received : 09 January 2017

Instrument : AC Withstanding Voltage Tester
Manufacturer : Kikusui

Model No. : TOS 5050A
Serial No. : RA002477

Instrument Condition When Received: 1. Good physical condition.

Instrument Condition When Returned:
1. Calibrated and tested serviceable. No adjustment done.
2. Calibration Due Date requested by customer.
3. The User should be aware that there are factors that may caused this instruments to drift out of calibration before its specified calibration due date has expired.

Environmental Condition :-
Average Temperature : (22 ± 1) °C **Average Relative Humidity** : (54 ± 1) % RH

Calibration Date : 16 January 2017 **Requested Cal. Due Date** : 16 January 2018

Calibration Method :
This instrument was calibrated using the Calibration Procedure No. ESD / 0345 Rev. 4.0

Calibration Standard(s) Used :

Instrument Type :	Serial No. :	Cal. Due Date :	Cal. Cert. No. :	Traceability :
Vitek 4700	019317	18 April 2017	EL 004328	NMC, S'pore
TLC-501 B	13805	07 September 2017	SST/JN/IR/2016I/4	SST (JB)/NMC, S'pore
SST-2 Time Calibrator	SJ 101	08 May 2017	SST/JN/IR/2016E/9	SST (JB)/NML,SIRIM
FLUKE 289	10970025	04 February 2017	SST/JN/IR/2016B/1	SST (JB)/NPL,UK

The standard instruments used in this calibration are traceable to either the National Standard maintained at the National Metrology Laboratory , SIRIM Berhad or other recognised International Standard Laboratories.

Calibration Sticker No : JN-01-279

Measurement Uncertainty :
1) The uncertainty calculation was based on the ISO Guide to the Expression of Uncertainty in Measurement.
2) Refer to calibration results.Coverage Factor (k) = 2
3) The test limits given are based on manufacturer's specification.

Approved Signatory

The uncertainties are for a confidence probability of approximately 95%

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SIRIM SST

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STANDARDS MALAYSIA ACCREDITED LABORATORY

MS ISO/IEC 17025
CALIBRATION
SAMM NO. 176

CERTIFICATE OF CALIBRATION

DATE OF ISSUE 16 January 2017 **CERTIFICATE NUMBER** : SST/JN/R/2017A/279

Instrument AC Withstanding Voltage Tester **Serial No.** : RA002477

CALIBRATION RESULTS

Function / Range	Indicated Value	Test Limits	Measured Value	Measurement Uncertainty (±)
1. AC Voltage @ 50 Hz				
0 ~ 5 kV	5.00 kV	4.92 to 5.08 kV	5.010 kV	0.017 kV
	4.00 kV	3.92 to 4.08 kV	4.009 kV	0.017 kV
	3.00 kV	2.92 to 3.08 kV	3.000 kV	0.017 kV
	2.00 kV	1.92 to 2.08 kV	2.004 kV	0.017 kV
	1.00 kV	0.92 to 1.08 kV	1.011 kV	0.017 kV
0 ~ 2.5 kV	2.50 kV	2.46 to 2.54 kV	2.506 kV	0.017 kV
	2.00 kV	1.96 to 2.04 kV	2.006 kV	0.017 kV
	1.50 kV	1.46 to 1.54 kV	1.505 kV	0.017 kV
	1.00 kV	0.96 to 1.04 kV	0.999 kV	0.017 kV
	0.50 kV	0.46 to 0.54 kV	0.514 kV	0.017 kV
		Measured Value	Correction	
2. Cutoff Current	10 mA	10.02 mA	+ 0.02 mA	0.15 mA
	5 mA	5.01 mA	+ 0.01 mA	0.09 mA
	2 mA	2.03 mA	+ 0.02 mA	0.06 mA
	1 mA	1.04 mA	+ 0.04 mA	0.02 mA
	0.5 mA	0.49 mA	-0.01 mA	0.01 mA
3. Timer				
	30 sec.	30.05 sec.	+ 0.05 sec.	0.13 sec.
	25 sec.	25.04 sec.	+ 0.04 sec.	0.13 sec.
	20 sec.	20.03 sec.	+ 0.03 sec.	0.13 sec.
	15 sec.	15.03 sec.	+ 0.03 sec.	0.13 sec.
	10 sec.	10.03 sec.	+ 0.03 sec.	0.13 sec.
	5 sec.	5.03 sec.	+ 0.03 sec.	0.13 sec.

Note : 1) + ve correction is to be added to the indicated value.
- ve correction is to be subtracted from the indicated value.

Calibrated by :

Mohd Saharudin B. Rahidi

The uncertainties are for a confidence probability of approximately 95%

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Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/40/2018/8
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	TNB Incoming 1

C.T Details		O/C Relay Details		E/F Relay Details	
Make	BILT	Make	MIKRO	Make	MIKRO
Ratio	200/5A	Type	MK2200L	Type	MK2200L
Class	5P10	Serial Number	1359587	Serial Number	1359587
VA	15	Rated Amp.	5A	Rated Amp.	5A

TEST RESULTS :

RELAY	O/C :	28%	TM : 0.1	TEST	O/C :	1.4A	TM : 0.1
SETTING	E/F :	5%	TM : 0.1	SETTING	E/F :	0.25A	TM : 0.1

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
1.4 x 1.3	2.67	2.64	2.66	0.25 x 1.3	2.62
1.4 x 2.0	1.06	1.05	1.06	0.25 x 2.0	1.01
1.4 x 3.0	0.64	0.63	0.64	0.25 x 3.0	0.63

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
1.4	1.4	1.39	1.4	0.25	0.25

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - Y	40	1	1mA	Stable	0.25	0.1
Y - B	40	1	1mA	Stable	0.25	0.1
Y	20	0.5	0.5A	Operate	0.25	0.1

Trip Voltage	30V DC	Tripping Test	OK
COMMISSIONING	✓	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on 24/2/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: .....

Name :

Date :

Notes :

1. Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices

2. To be witnessed by the owner or person authorized by the owner of the installation.

Borang H (JPE)

Suruhanjaya Tenaga

CURRENT TRANSFORMER TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Address	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	TNB Incoming 1
Reference No :	HCY/CAL/40/2018/9

Name Plate Details : Make : BILT Type: RING Ratio : 200/5A
VA : 15 Class: 5P10 Volts:
Cycles : 50Hz Duty: Protection Relay
S/No. R: 16EP630504 Y: 16EP630505 B: 16EP630506 N:

TEST RESULTS

1.(a) Megger Tests (Megohms) using 1000V Megger

	R	Y	B	N
i) Primary Earth				
ii) Secondary /Earth	1000	1000	1000	
iii) Primary/Secondary				

(b) Pressure Test : Applied kV AC/DC min Leakage: mA

2. Magnetisation Curve-Primary Open Circuit

Secondary mA				Secondary Volts				Winding on test
R	Y	B	N	R	Y	B	N	
20	20	20		1.91	1.98	1.78		S1 S2
30	30	30		2.83	3.29	3.28		
50	50	50		6.10	6.57	6.37		C10 R C110
70	70	70		10.27	10.55	10.34		
100	100	100		17.35	17.65	17.31		C30 Y C130
300	300	300		35.01	34.55	34.69		
1000	1000	1000		38.01	37.62	37.48		C50 B C150
3000	3000	3000		42.45	42.06	41.88		
5000	5000	5000		46.21	45.89	45.62		

3. Ratio Check at Rated Burden

Primary Amps	Secondary Amps				Burden Volts			
	R	Y	B	N	R	Y	B	N
100	2.49	2.49	2.49					

COMMISSIONING	✓
RECALIBRATION	

Remark :

Tested By :

IR Tan Chee Kian
JP-T-2-B-0047-1995 (Electrical Service Engineer)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Date : 24/2/2018 Fax: 03-77859086

Witness (client) by : _____
Name :
Date :

* Note: Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

CURRENT TRANSFORMER TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Address	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	TNB Incoming 1
Reference No :	HCY/CAL/40/2018/10

Name Plate Details : Make : BILT Type: RING Ratio : 200/5A
VA : 15 Class: 1.0 Volts:
Cycles : 50Hz Duty: Ampmeter
S/No. R: 16EM622589 Y: 16EM622590 B: 16EM622591 N:

TEST RESULTS

1.(a) Megger Tests (Megohms) using 1000V Megger

	R	Y	B	N
i) Primary Earth				
ii) Secondary /Earth	1000	1000	1000	
iii) Primary/Secondary				

(b) Pressure Test : Applied kV AC/DC min Leakage: mA

2. Magnetisation Curve-Primary Open Circuit

Secondary mA				Secondary Volts				Winding
R	Y	B	N	R	Y	B	N	on test
50	50	50		2.25	1.84	2.02		S1 S2
100	100	100		6.02	4.90	5.25		
500	500	500		12.79	12.04	12.38		B10 R B110
1000	1000	1000		13.85	13.17	13.45		
3000	3000	3000		16.85	16.21	16.47		B30 Y B130
5000	5000	5000		18.88	18.21	18.45		
								B50 B B150

3. Ratio Check at Rated Burden

Primary	Secondary Amps				Burden Volts			
Amps	R	Y	B	N	R	Y	B	N
100	2.49	2.49	2.49					

Tested By :

IR Tan Chee Kian
JP-T-2-B-0047-1995 (Electrical Service Engineer)

COMMISSIONING	✓
RECALIBRATION	
Remark :	

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by : _____
Name :
Date :

Date : 24/2/2018

* Note: Protection relay and device shall be tested and calibrated at least once in every two years.

Suruhanjaya Tenaga

POTENTIAL TRANSFORMER TEST CERTIFICATE

Company Name (Electrical Services Contarctor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Address	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	TNB Incoming 1
Reference No :	HCY/CAL/40/2018/11

Nameplate Detail :

Make :
Ratio : (11KV /√3) / (110V /√3)
Hertz : 50Hz
Phase : 3 Nos Single Pole P.T

VA/Phase: 100
Duty : Voltmeter & TNB Metering
Class : 0.5

Serial No : R: A16T-1771
Y: A16T/1772
B: A16T/1777

Primary : Star With Star Pointed Earthed
Secondary : Star with star Pointed Earthed

(1) Insulation test with 1000 Volts Megger

Primary and earth :	Megohms
Secondry and earth :	Megohms
Primary and secondary :	Megohms

(2) Power Frequency Pressure Test (L.T Winding Earthed)

Applied : N/A KV for Minute on H.V Winding
Leakage : mA

(3) Nominal Ration Check - Secondary Open Circuit

Input Primary Volt	Secondary Volt Measured
A - B = 110V	a - b = 1.10V
B - C = 110V	b - c = 1.10V
C - A = 110V	c - a = 1.10V

Induced voltage test at 120 volts at secondary winding for 1.0 minute.

Leakage Current	R (mA)	Y (mA)	B (mA)
	488	473	495

Result : Passed / ~~Failed~~

Tested By :

IR Tan Chee Kian
JP-T-2-B-0047-1995 (Electrical Service Enginneer)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Date : 24/2/2018

COMMISSIONING	✓
RECALIBRATION	
Remark :	

Witness (client) by: _____
Name :
Date :

* Note: Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

PRESSURE TEST CERTIFICATE

Company Name (Electrical Services Contarctor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Address	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	TNB Incoming 1
Pressure Test On	AC Pressure Test on 1 unit VCB. Busbar. CTs and CT Chamber
Reference No :	HCY/CAL/40/2018/12

1. Meggertests (Megohms) Using 1000V Megger

Red & Earth	: 2000		Red & Yellow	2000
Yellow & Earth	: 2000		Yellow & Blue	2000
Blue & Earth	: 2000		Blue & Red	2000

Note : Phase Colour Markings : Checked/ Not checked

2. PRESSURE TEST

(a) Between ~~Red - Yellow - Blue and Earth~~/ Red and Yellow - Blue - Earth

Applied : 25 KV AC for 1 Minutes
Time Started : 12.15pm Leakage: 6 mA final

.

(b) Between ~~Yellow and Red - Blue - Earth~~/ Yellow and Red - Blue - Earth

Applied: 25 KV AC for 1 minutes
Time Started : 12.17pm Leakage: 6 mA final

(c) Between ~~Blue and Red - Yellow - Earth~~/Blue and Red - Yellow - Earth

Applied : 25 KV AC for 1 minutes
Time Started : 12.19pm Leakage: 6 mA final

(d) Test across contacts with one side earthed and VCB opened

Applied : 25 KV AC for 1 minutes
Time started: 12.22pm Leakage : 6 mA final

COMMISSIONING	✓
RECALIBRATION	

Tested By :

Remark :	

IR Tan Chee Kian
JP-T-2-B-0047-1995 (Electrical Service Enginneer)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

Date : 24/2/2018

* Note: Protection relay and device shall be tested and calibrated at least once in every two years.

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/1-24
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(SSB-1) Q1/150A TPN MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	150/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1394010
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.497sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.508

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	150	5.0	4 mA	Stable	0.5	0.5sec
Y - N	150	5.0	4 mA	Stable	0.5	0.5sec
B - N	150	5.0	3 mA	Stable	0.5	0.5sec
N - N	15	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✓	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on **4/1/2018** and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :



JR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852058, 03-77850086
Fax: 03-77859086

Witness (client) by: .....
Name :
Date :

Notes :

1. Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices

2. To be witnessed by the owner or person authorized by the owner of the installation.

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/2
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(SSB-3) Q1-150A TPN MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	150/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1470957
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.513sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.508

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	150	5.0	3 mA	Stable	0.5	0.5sec
Y - N	150	5.0	3 mA	Stable	0.5	0.5sec
B - N	150	5.0	4 mA	Stable	0.5	0.5sec
N - N	15	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✓	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on **4/1/2018** and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: .....

Name :

Date :

Notes :

1. **Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices**

2. **To be witnessed by the owner or person authorized by the owner of the installation.**

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/3
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(SSB-4) Q1-100A MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	100/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1490961
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.493sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.502

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	100	5.0	4 mA	Stable	0.5	0.5sec
Y - N	100	5.0	3 mA	Stable	0.5	0.5sec
B - N	100	5.0	3 mA	Stable	0.5	0.5sec
N - N	10	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✔	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on **4/1/2018** and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77850086

Witness (client) by: .....

Name :

Date :

Notes :

1. Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices

2. To be witnessed by the owner or person authorized by the owner of the installation.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - E / BC) Q1-15
Reference No :	HCY/CAL/04/2018/4

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489340
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.495sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.487

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____

Name :

Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/5
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - E / BC) Q1-250A TPN MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	250/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1477578
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.507sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.506

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	250	5.0	4 mA	Stable	0.5	0.5sec
Y - N	250	5.0	3 mA	Stable	0.5	0.5sec
B - N	250	5.0	3 mA	Stable	0.5	0.5sec
N - N	25	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✔	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on **4/1/2018** and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: .....
Name :
Date :

Notes :

1. **Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices**

2. **To be witnessed by the owner or person authorized by the owner of the installation.**

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - BC / 1) Q1-26
Reference No :	HCY/CAL/04/2018/6

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489336
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.484sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.491

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852083, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/7
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - BC / 1) Q1-500A TPN MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	500/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1477581
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.521sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.508

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	250	2.5	3 mA	Stable	0.5	0.5sec
Y - N	250	2.5	4 mA	Stable	0.5	0.5sec
B - N	250	2.5	4 mA	Stable	0.5	0.5sec
N - N	50	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✓	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on **4/1/2018** and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: .....
Name :
Date :

Notes :

1. **Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices**

2. **To be witnessed by the owner or person authorized by the owner of the installation.**

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - BC / 2) Q1-26
Reference No :	HCY/CAL/04/2018/8

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489341
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.487sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.492

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/9
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - BC / 2) Q1-500A TPN MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	500/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1477686
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.493sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.508

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	250	2.5	4 mA	Stable	0.5	0.5sec
Y - N	250	2.5	3 mA	Stable	0.5	0.5sec
B - N	250	2.5	4 mA	Stable	0.5	0.5sec
N - N	50	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✓	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on **4/1/2018** and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852086, 03-77850086
Fax: 03-77859086

Witness (client) by: .....
Name :
Date :

Notes :

1. **Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices**

2. **To be witnessed by the owner or person authorized by the owner of the installation.**

Borang H (JPE)

SuruhanjayaTenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-14/30A TPN MCCB Goods Hose
Reference No :	HCY/CAL/04/2018/10

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489337
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.493sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.489

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

SuruhanjayaTenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-13/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/11

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489335
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.493sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.486

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-12/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/12

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489339
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.486sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.490

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-11/20A TPN MCCB
Reference No :	HCY/CAL/04/2018/13

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489334
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.491sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.487

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____

Name :

Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-10/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/14

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489338
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.484sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.495

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-9/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/15

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489329
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.487sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.493

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852083, 03-77850086
Fax: 03-77859086

Witness (client) by: _____

Name :

Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-8/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/16

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489333
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.483

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.492

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-7/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/17

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489328
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.486sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.492

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-6/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/18

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489325
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.493sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.487

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-5/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/19

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489330
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.482sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.491

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852086, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-4/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/20

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489332
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.491sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.495

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

SuruhanjayaTenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-3/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/21

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489327
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR :	0.5A	TM : 0.5sec	TEST SETTING	ELR :	0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.483sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.490

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian
(Electrical Service Engineer JP-T-2-B-0047-1995)
HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____
Name :
Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

Suruhanjaya Tenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-2/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/22

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489331
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.487sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.494

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____

Name :

Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Borang H (JPE)

SuruhanjayaTenaga

EARTH LEAKAGE RELAY (ELR) TEST CERTIFICATE

Company Name (Electrical Services Contractor)	**HCY ENGINEERING SERVICES SDN BHD**
Registration No	**(TKL) KPE / 458444M / 2006**
Adress	**NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, BATU 6, JALAN PUCHONG, 58200 KUALA LUMPUR**

Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(DB - CP) Q1-1/30A TPN MCCB
Reference No :	HCY/CAL/04/2018/23

C.T Details		ELR Relay Details	
Make		Make	MIKRO
Ratio	Zero C.T	Type	MK301A
Class		Serial Number	1489326
VA		Rated Amp.	3.0A

TEST RESULTS :

RELAY SETTING	ELR : 0.5A	TM : 0.5sec	TEST SETTING	ELR : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

Operating Time (Second)	
Inj (A)	ELR
0.5	0.484sec

B. OPERATING CURRENT TEST

Operating Current (A)	
Setting (A)	ELR
0.5	0.492

Trip Voltage	240V AC	Tripping Test	OK	COMMISSIONING	✓
				RECALIBRATION	
			Remark :		

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby CERTIFY that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994.

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Service Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: _____

Name :

Date :

*Note : Protection relay and device shall be tested and calibrated at least once in every two years.

Suruhanjaya Tenaga

Borang H (JPE) Pin.2011

INVERSE TIME (OVERCURRENT AND EARTH FAULT) RELAY CALIBRATION CERTIFICATE

Company Name (Electrical Services Contractor)	HCY ENGINEERING SERVICES SDN BHD
Reference No :	HCY/CAL/04/2018/24
Registration No	(TKL) KPE / 458444M / 2006
Address	NO.11, JALAN 9/152, TAMAN PERINDUSTRIAN OUG, 58200 KUALA LUMPUR
Client	Kejuruteraan Broad-Way Sdn Bhd
Installation	Nestle Distribution Center Sijangkang
Circuit	(SSB - 5) Q1-100A TPN MCCB From LV MSB

C.T Details		O/C Relay Details		E/F Relay Details	
Make	MH	Make		Make	MIKRO
Ratio	100/5A	Type		Type	MK201A
Class	5P10	Serial Number		Serial Number	1477816
VA	15	Rated Amp.		Rated Amp.	2.0A

TEST RESULTS :

RELAY	O/C :	TM :	TEST	O/C :	TM :
SETTING	E/F : 10%	TM : 0.5sec	SETTING	E/F : 0.5A	TM : 0.5sec

A : OPERATING TIME TEST

OVERCURRENT				EARTH FAULT	
	Operating Time (s)				
Iinj (A)	Red phase	Yellow Phase	Blue Phase	Iinj (A)	Time (s)
				0.5 x 1.3	0.486sec
				x 2.0	
				x 3.0	

B. OPERATING CURRENT TEST

OVERCURRENT				EARTH FAULT	
Setting (A)	Operating Current (A)			Setting (A)	Operating Current (A)
	Red Phase	Yellow Phase	Blue Phase		
				0.5	0.504

C. STABILITY TEST

Phase Test	Amps. Injected		Relay Amps.	Operate / Stable	Test Setting	
	Primary (A)	Secondary (A)			Amps.	TM
R - N	100	5.0	2 mA	Stable	0.5	0.5sec
Y - N	100	5.0	2 mA	Stable	0.5	0.5sec
B - N	100	5.0	2 mA	Stable	0.5	0.5sec
N - N	10	0.5	0.5A	Operate	0.5	0.5sec

Trip Voltage	240V AC	Tripping Test	OK
COMMISSIONING	✓	RECALIBRATION	

Remark	

I, being the competent person responsible (as indicated by my signature below) for the testing and calibration of the above installation, hereby Certify that the above installation has been tested and calibrated on 4/1/2018 and is, to the best of my knowledge and belief, in accordance with the Electricity Regulations 1994

Tested and Sealed By :

IR Tan Chee Kian

(Electrical Services Engineer JP-T-2-B-0047-1995)

HCY ENGINEERING SERVICES SDN. BHD.
(Co. No. 458444-M)
No. 11, Jalan 9/152,
Taman Perindustrian OUG,
Batu 6, Jalan Puchong,
58200 Kuala Lumpur.
Tel: 03-77852088, 03-77850086
Fax: 03-77859086

Witness (client) by: .....
Name :
Date :

Notes :

1. Any protective relay and device of an installation shall be checked, tested and calibrated by a competent person at least once in every two years, or at any time as directed by the Commission. This should be done in accordance with good and safe engineering practices

2. To be witnessed by the owner or person authorized by the owner of the installation.

萬里 Broad-Way

EARTHING SYSTEM INSTALLATION

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: 8/1/2018 Location of Works to be inspected MDF ROOM
	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
1	Check Exothermic weld condition			N/A
2	Earthing conductor connection/electrode	✓		
3	Clip and saddle are provided			N/A
4	GI/PVC protective equipment	✓		
5	Earth chamber installation	✓		
6	Earth electrode installation	✓		
7	Test joint installation			N/A
8	Material type and size to specification	✓		
	individual earth resistance reading chamber 1			0.1 Ω

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chen Kang Ann Time and Date: 8/1/2018	Signature: Name: Lee Kah Woon Time and Date: 8/1/2018.	Signature: Name: Sivan Time and Date: 8/1/2018

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Zone 1
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		N/A for Meinhardt
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt			Covered by plastic
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment			Need adjustment after CCC
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		N/A for Meinhardt
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments: Adjust High Bay light alignment at safe distance above from sprinkler point and also not on racking.

* Han Yang tested the functionality on 15 November 2017.

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chan Ling Ann Time and Date: 19/1/2018 15/11/2017	Signature: Name: Time and Date:	Signature: Name: Steven Time and Date: 19/01/2018 15/11/2017

19/1/18.
Lee Kah Woon
Meinhardt EPCM. S/B.

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Zone 2
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt			Covered by plastic
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment			
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments:

* Hon Yang tested the functionality on 15 November 2017.

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chan Kuy Ann Time and Date: 19/1/2018 15/11/2017	Signature: Name: Time and Date:	Signature: Name: Sivan Time and Date: 19/01/2018 15/11/2017

19/1/18
Lee Kah Woon
Meinhardt EPCM S/B

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: 15/11/2017 Location of Works to be inspected Zone 3
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt			Covered by plastic
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment	✓		
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chen Keng Ann Time and Date: 15/11/2017	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date: 15/11/2017

Broad-Way 萬里

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Zone 4
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt			Protected by plastic
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment			Need adjustment after CCC
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chan Keng Ann Time and Date: 8/12/2017	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date: 8/12/17

萬里 Broad-Way

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Zone 5
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt			Covered by plastic
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment			Need minor adjustment
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chan Keng Ann Time and Date: 3/1/2018	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date: 3/1/18

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Office Ground Floor
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt	✓		
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment	✓		
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chen Keng Aun Time and Date: 3/1/2018	Signature: Name: Time and Date:	Signature: Name: Siva Time and Date: 3/1/18

FUNCTIONALITY TEST - ELECTRICAL

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Office 1F
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	LIGHTING			
1	Material installed as per approved submission	✓		
2	Quantity Light fitting as per shop drawing	✓		
3	Light fitting installation clean from dust, grease and dirt	✓		
4	All light fitting have proper support method	✓		
5	Location for light fitting installation as per drawing	✓		
6	Visual inspection of light fitting alignment	✓		
7	Functionality test	✓		
	SWITCH SOCKET			
1	Material installed as per approved submission	✓		
2	Quantity switch socket fitting as per shop drawing	✓		
3	Socket installation clean from dust, grease and dirt	✓		
4	Location for socket installation as per drawing	✓		
5	Visual inspection of socket alignment	✓		
6	Functionality test	✓		

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chan Kang Ann Time and Date: 31/1/2018	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date: 3/1/18

Broad-Way 萬里

FUNCTIONALITY TEST - PA

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Inspection Date & time: Location of Works to be inspected Office / Warehouse.
LIGHTING AND SWITCH SOCKET	Serial Number:

No.	DESCRIPTION	Yes	No	Remarks
	SPEAKER AND EQUIPMENT			
1	Material installed as per approved submission	✓		
2	Quantity speaker as per shop drawing	✓		
3	Speaker installation clean from dust, grease and dirt	✓		
4	All speaker have proper support method	✓		
5	Location for speaker installation as per drawing	✓		
6	Visual inspection of speaker alignment	✓		
7	Functionality test	✓		
	zoning	✓		
	paging	✓		
	player	✓		

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Chan Kong Ann Time and Date: 18/12/2017	Signature: Name: Time and Date:	Signature: Name: Siven Time and Date: 19/12/2017.

KEJURUTERAAN BROAD-WAY SDN BHD

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No:SHA002 Date:
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 1	Calibration Due Date: Panel Name:DB-1/2 *Reading '1' is equal to 200mΩ

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	INCOMING	60A	3 X 2.5mm²/1C, PVC	R Y B N	1	1 1	1 1 1 1	1 1 1 1	
	R1	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	Y1	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	B1	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	R2	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	Y2	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	B2	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	R3	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NURSHAFIQAH BT AMINUDDIN Time and Date: 11/08/17 5.10pm	checked by digital megger continuity tester Signature: Name: Time and Date:	Signature: Name: Time and Date:

11/8/17
05-10pm.

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	Y3	10A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	B3	20A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	R4	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	Y4	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	B4	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	R5	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	Y5	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	
	B5	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: JIM MUBARIQAH BT AMINUDDIN Time and Date: 11/8/17 1:10 pm	Signature: Name: Time and Date: 11/8/17 05:10pm.	Signature: Name: Time and Date:

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R6	15A	3 X 2.5mm²/1C, PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NUR SHAFIQAH BT AMINUDDIN Time and Date: 11/05/17 5.10 pm	Signature: Name: Time and Date:	Signature: Name: Time and Date:

11/5/17
05:10 pm.

KEJURUTERAAN BROAD-WAY SDN BHD

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: SHA001 Date:
Test Equipment Name / Type: Model : Location: ZONE 1	Serial Number: Calibration Due Date: Panel Name: DB -1/1 *Reading '1' is equal to 200mΩ

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	INCOMING	40A	5 x 25mm²	R Y B N	1	1 1	1 1 1	1 1 1	
	R1	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	
	Y1	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	
	B1	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	
	R2	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	
	Y2	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	
	B2	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	
	R3	10A	2 x 1C 4mm2 + 1 x 1C 2.5mm2 PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NUR SHAFIQAH @ AMINAH Time and Date: 11/08/17 5.10 pm	Digital insulation continuity tester Signature: Name: Time and Date: 11/8/17 05:10pm.	Signature: Name: Time and Date:

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	Y3	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	B3	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	R4	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	Y4	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	B4	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	R5	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	Y5	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	B5	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SIM NURSHAFIQAH BT AMINUDDIN Time and Date: 11/05/17 5:10pm	Signature: Name: Time and Date: 11/5/17 05:17~	Signature: Name: Time and Date:

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R6	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	Y6	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	B6	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	R7	10A	3 X 1C 1.5mm² PVC	R Y B			1	1	
	Y7	10A	3 X 1C 1.5mm² PVC	R Y B			1	1	
	B7	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	R8	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	Y8	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NURSHAFIQAH BT AMINUDDIN Time and Date: 11/08/17 5.10 pm	Digital insulation continuity tester Signature: Name: Time and Date: 11/8/17 5:10pm	Signature: Name: Time and Date:

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	B8	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	R9	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	Y9	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	
	B9	10A	2 x 1C 4mm² + 1 x 1C 2.5mm² PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SYAHRIL HAFIQ ALI BIN AMINUDIN Time and Date: 11/08/17 5:10 pm	Signature: Name: Time and Date: 11/8/17 5:10PM.	Signature: Name: Time and Date:

KEJURUTERAAN BROAD-WAY SDN BHD

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: SHA003 Date:
Test Equipment Name / Type: Model : Location: ZONE 1	Serial Number: Calibration Due Date: Panel Name:DB - 1/3 *Reading '1' is equal to 200mΩ

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	INCOMING	60A	5 x 25mm²	R Y B N	1	1 1	1 1	1 1	
	RYB1	2A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	
	RYB2	32A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	
	RYB3	32A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	
	RYB4	32A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	
	RYB5	20A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	
	RYB6	20A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	
	RYB7	20A	5 X 4mm²/1C, PVC	R Y B N	1	1 1	1 1	1 1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NURSHAFIQAH BT AMINUDDIN Time and Date: 11/05/17 5.10 pm	Digital insulation continuity tester Signature: Name: Time and Date: 05:10pm 11/5/17	Signature: Name: Time and Date:

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB8	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB9	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB10	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB11	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB12	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB13	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB14	20A	5 X 4mm^2/1C, PVC	R Y B N					
	RYB15	20A	5 X 4mm^2/1C, PVC	R Y B N					

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NURSHAFIQAH BT AMINUDDIN Time and Date: 11/08/17 5.10pm	Signature: Name: Time and Date: 11/8/17 05:15pm	Signature: Name: Time and Date:

KEJURUTERAAN BROAD-WAY SDN BHD

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1- GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING, MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: SHA004 Date:
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name:DB-1E *Reading '1' is equal to 200mΩ

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	DB - 1E	40A		R Y B N					
	R1 R1	10A 10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B R			1 1	1 1	
	Y1	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	
	B1	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	
	R2 R2 R2 R2	10A 10A 10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R R R R			1 1 1 1	1 1 1 1	
	Y2	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	
	B2	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	
	R3	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NUR SHAFIQAH BT AMINUDIN Time and Date: 11/05/2017 5.10 pm	digital insulation continuity tester Signature: Name: Time and Date: 05-10pm	Signature: Name: Time and Date:

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	Y3	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	
	B3	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	
	R4	10A	2 X 4mm²/1C, + 1x1.5mm²/1C, PVC	R Y B			1	1	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: SITI NURFITRIAH BT AMINUDDIN Time and Date: 11/08/17 5.10pm	Signature: Name: Time and Date: 11/8/17 05:10pm	Signature: Name: Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type: Model : Location: OFFICE GROUND FLOOR	Serial Number: Calibration Due Date: Panel Name:SSB-7 < 0 = 00 Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	60A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R Y B N	< 0 — —	< 0 < 0 —	< 0 < 0 < 0	< 0 < 0 < 0 < 0	
	RYB2	40A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R Y B N	< 0 — —	< 0 < 0 —	< 0 < 0 < 0	< 0 < 0 < 0 < 0	
	RYB3	125A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R Y B N	< 0 — —	< 0 < 0 —	< 0 < 0 < 0	< 0 < 0 < 0 < 0	
	RYB4	30A	SPARE	R Y B N	< 0 — —	< 0 < 0 —	< 0 < 0 < 0	< 0 < 0 < 0 < 0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shahriyah Time and Date:	Signature: Name: Time and Date: Lee Kah Woon.	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type: Model : Location: OFFICE GROUND FLOOR	Serial Number: Calibration Due Date: Panel Name:SSB-7E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	30A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB2	30A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	–	<0	
				N	–	–	–	<0	
	RYB3	30A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB4	30A	SPARE	R	–	–	–	–	
				Y	–	–	–	–	
				B	–	–	–	–	
				N	–	–	–	–	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiq Ah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Swan Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: GROUND FLOOR OFFICE	Panel Name:DB - 71E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	<0	—	<0	<0	
	Y1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	SPARE	R	—	—	—	—	
	Y2	10A	SPARE	Y	—	—	—	—	
	B2	10A	SPARE	B	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: shahigan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Nuan Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: FIRST FLOOR OFFICE	Panel Name:DB - 7 / 2E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	<0	-	<0	<0	
	Y3	10A	SPARE	Y	-	-	-	-	
	B3	10A	SPARE	B	-	-	-	-	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Siva Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: FIRST FLOOR OFFICE	Panel Name:DB - 7 / 3E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	/	—	<0	<0	
	Y3	10A	SPARE	Y	/	—	/	—	
	B3	10A	SPARE	B	/	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Sudirgan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: GROUND FLOOR OFFICE	Panel Name:DB - 7/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	10A	SPARE	B	—	—	—	-	
	R4	10A	SPARE	R	—	—	—	-	
	Y4	10A	SPARE	Y	—	—	—	—	
	B4	10A	SPARE	B	—	—	—	—	
	R5	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R6	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	-	—	<0	<0	
	Y6	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R7	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y7	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B7	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: GROUND FLOOR OFFICE	Panel Name:DB - 7/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R8	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y8	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B8	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R9	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R		—	<0	<0	
	Y9	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B9	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R10	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R		—	<0	<0	
	Y10	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B10	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R11	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y11	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B11	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shatrgan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: GROUND FLOOR OFFICE	Panel Name:DB - 7/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R4	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y4	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B4	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R5	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y5	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B5	10A	SPARE	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Suhaiyah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: FIRST FLOOR OFFICE	Panel Name:DB - 7/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y1	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B1	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R2	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y2	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B2	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R3	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y3	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B3	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R4	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y4	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B4	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R5	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y5	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B5	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R6	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y6	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B6	10A	2 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: shafiq ah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: OFFICE GROUND FLOOR	Panel Name:SSB-6 <0 = 00 Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	60A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB2	150A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB3	60A	SPARE	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB4	60A	4 x 1C 16MM2 +1 X 1C 25MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shahrgah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Tee Kean Woon

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type: Model : Location: OFFICE GROUND FLOOR	Serial Number: Calibration Due Date: Panel Name:SSB-6E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	30A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB2	30A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB3	30A	4 x 1C 16MM2 +1 X 1C 16MM PVC IN CABLE TRAY/TRUNKING	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB4	30A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Shafiqah Name: Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: GROUND FLOOR OFFICE	Calibration Due Date: Panel Name:DB - 6 / 1E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	~~>1~~	<1	<1	
	Y1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<1	<1	
	B1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<1	<1	
	R2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<1	<1	
	Y2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<1	<1	
	B2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<1	<1	
	R3	10A	SPARE	R	—	—	~~<1~~	~~<1~~	
	Y3	10A	SPARE	Y	—	—	~~<1~~	~~<1~~	
	B3	10A	SPARE	B	—	—	~~<1~~	~~<1~~	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiq Ch Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: FIRST FLOOR OFFICE	Panel Name:DB - 6 / 2E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	–	–	<0	<0	
	Y1	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	–	–	<0	<0	
	B1	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	–	–	<0	<0	
	R2	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	–	–	<0	<0	
	Y2	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	–	–	<0	<0	
	B2	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	–	–	<0	<0	
	R3	20A	3 x 2.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	–	–	<0	<0	
	Y3	20A	SPARE	Y	–	–	–	–	
	B3	20A	SPARE	B	–	–	–	–	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Sudhagah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: GROUND FLOOR OFFICE	Panel Name:DB - 6 / 3E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 x 1.5mm² / 1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B3	10A	SPARE	B	—	—	—	—	
	R4	10A	SPARE	R	—	—	—	—	
	Y4	10A	SPARE	Y	—	—	—	—	
	B4	10A	SPARE	B	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shatigan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: GROUND FLOOR OFFICE	Panel Name: DB- 6/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	>20	<0	
	Y1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	—	<0	<0	<0	
	Y4	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	—	<0	<0	<0	
	B4	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	/	—	<0	<0	
	Y5	10A	SPARE	Y	—	—	—	—	
	B5	10A	SPARE	B	—	—	—	—	
	R6	10A	SPARE	R	—	—	—	—	
	Y6	10A	SPARE	Y				—	
	B6	10A	SPARE	B	—	—	—	—	
					—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type: Model : Location: GROUND FLOOR OFFICE	Serial Number: Calibration Due Date: Panel Name: DB- 6/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	20A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y1	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B1	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R2	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y2	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B2	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R3	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y3	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B3	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R4	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y4	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B4	20A	2 X 2.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 6/12/2017
Test Equipment Name / Type: Model : Location: GROUND FLOOR OFFICE	Serial Number: Calibration Due Date: Panel Name: DB- 6/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	-	-	<0	<0	
	B1	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	-	-	<0	<0	
	R2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	-	-	<0	<0	
	B2	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	-	-	<0	<0	
	R3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	-	-	<0	<0	
	B3	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	-	-	<0	<0	
	R4	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y4	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	-	-	<0	<0	
	B4	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	B	-	-	<0	<0	
	R5	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y5	10A	2 X 1.5mm²/1C, PVC IN TRUNKING/CONDUIT	Y	-	-	<0	<0	
	B5	10A	SPARE	B	-	-	-	-	
	R6	10A	SPARE	R	-	-	-	-	
	Y6	10A	SPARE	Y	-	-	-	-	
	B6	10A	SPARE	B	-	-	-	-	
	R7	10A	SPARE	R	-	-	-	-	
	Y7	10A	SPARE	Y	-	-	-	-	
	B7	10A	SPARE	B	-	-	-	-	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Suatrgah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Siuam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 16/10/2017
Test Equipment Name / Type: Model :	Serial Number: Calibration Due Date:
Location: ZONE 3	Panel Name: SSB-3 Remark : ~~"1" = >200mega ohm~~ <0 = ∞ Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	40A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	–	
				Y	–	<0	<0	–	
				B	–	<0	<0	–	
				N	–	–	–	–	
	RYB2	40A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	–	
				Y	–	<0	<0	–	
				B	–	–	<0	–	
				N	–	–	–	–	
	RYB3	40A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	–	
				Y	–	<0	<0	–	
				B	–	–	<0	–	
				N	–	–	–	–	
	RYB4 (OFFICE)	100A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	–	
				Y	–	<0	<0	–	
				B	–	–	<0	–	
				N	–	–	–	–	
	RYB5	30A	SPARE	R	–	–	–	–	
				Y	–	–	–	–	
				B	–	–	–	–	
				N	–	–	–	–	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 16/10/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 3	Panel Name:DB - 3E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	–	–	<0	<0	
	Y1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	–	–	<0	<0	
	B1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	–	–	<0	<0	
	R2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	–	–	<0	<0	
	Y2	10A	SPARE	Y	–	–	<0	<0	
	B2	10A	SPARE	B	–	–	<0	<0	
	R3	20A	SPARE	R	–	–	<0	<0	
	Y3	20A	SPARE	Y	–	–	<0	<0	
	B3	20A	SPARE	B	–	–	<0	<0	
	R4	20A	SPARE	R	–	–	<0	<0	
	Y4	20A	SPARE	Y	–	–	<0	<0	
	B4	20A	SPARE	B	–	–	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shahiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Ruan Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 3	Calibration Due Date: Panel Name:DB - 3/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	10A	3 X 1C 1.5mm2 PVC IN CONDUIT	Y	—	—	<0	<0	
	B6	10A	3 X 1C 1.5mm2 PVC IN CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Ruan Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 3	Calibration Due Date: Panel Name:DB - 3/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	-	<0	<0	
	Y7	60A		Y	—	-	<0	<0	
	B7	10A	SPARE	B	-	-	<0	<0	
	R8	10A	SPARE	R	—	-	<0	<0	
	Y8	10A	SPARE	Y	—	-	<0	<0	
	B8	10A	SPARE	B	-	-	<0	<0	
	R9	10A	SPARE	R	—	-	<0	<0	
	Y9	10A	SPARE	Y	—	-	<0	<0	
	B9	10A	SPARE	B	-	-	<0	<0	
	R10	10A	SPARE	R	-	-	<0	<0	
	Y10	10A	SPARE	Y	-	-	<0	<0	
	B10	10A	SPARE	B	-	-	<0	<0	
	R11	10A	SPARE	R	-	-	<0	<0	
	Y11	10A	SPARE	Y	-	-	<0	<0	
	B11	10A	SPARE	B	-	-	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Suaqiq ah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1 GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 3	Calibration Due Date: Panel Name:DB - 3/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	20A	SPARE	R	—	—	—	—	
	Y5	20A	SPARE	Y	—	—	—	—	
	B5	20A	SPARE	B	—	—	—	—	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

Comments:		
PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Sharfiyan Time and Date:	Signature: Name: Time and Date: Acs.	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 3	Panel Name:DB - 3/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB1	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB2	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB3	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB4	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB5	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB6	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB7	20A	SPARE	R	—	—	~~<0~~	—	
				Y	—	—	~~<0~~	—	
				B	—	—	~~<0~~	—	
				N	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Swafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 3	Calibration Due Date: Panel Name:DB - 3/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB8	20A	SPARE	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB9	20A	SPARE	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Divan Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 2	Panel Name: SSB-2 Remark : ~~1' =>200mega ohm~~ <0 = ∞ Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB1	60A	1 X 4C 25mm^2 XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB2	40A	1 X 4C 16mm^2 XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB3	40A	1 X 4C 16mm^2 XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 2	Calibration Due Date: Panel Name:DB - 2E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	-	—	<0	<0	
				N	-	—	—	—	
	R3	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y3	20A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	-	<0	<0	
	B3	20A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	—	-	<0	<0	
				N	-	-	-	-	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1 GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type: Model : Location: ZONE 2	Serial Number: Calibration Due Date: Panel Name:DB -2/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shatriyah Time and Date:	Signature: Name: Time and Date:	Sivam K.M. Signature: Name: Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 2	Panel Name:DB - 2/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y7	60A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R8	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y8	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B8	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R9	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y9	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B9	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shatrgan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1 GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 2	Calibration Due Date: Panel Name:DB - 2/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

Comments:		
PREPARED BY:	**WITNESSED BY:**	**VERIFIED BY:**
Signature: Name: Suriyah Time and Date:	Signature: Name: Aiss Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2019
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 2	Panel Name:DB - 2/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB1	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB2	32A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB3	32A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB4	32A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB5	32A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB6	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB7	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 10/10/2017
Test Equipment Name / Type: Model : Location: ZONE 2	Serial Number: Calibration Due Date: Panel Name:DB - 2/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB8	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB9	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB10	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-		<0	
	RYB11	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB12	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB13	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB14	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 4	Panel Name: SSB-4 Remark : ~~'1' = >200mega ohm~~ <0 = ∞ Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	40A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB2	40A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB3	40A	1 X 4C 25mm² XLPE/SWA/PVC ON TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB4	30A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	—	—	—	
	RYB5	30A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 4	Panel Name:DB - 4E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B2	10A	SPARE	B	—	—	~~<0~~	~~<0~~	
	R3	20A	SPARE	R	—	—	—	—	
	Y3	20A	SPARE	Y	—	—	—	—	
	B3	20A	SPARE	B	—	—	—	—	
	R4	20A	SPARE	R	—	—	—	—	
	Y4	20A	SPARE	Y	—	—	—	—	
	B4	20A	SPARE	B	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 4	Panel Name:DB - 4/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	10A	3 X 1C 1.5mm2 PVC IN CONDUIT	B	—	—	<0	<0	
	R6	10A	3 X 1C 1.5mm2 PVC IN CONDUIT	R	—	—	<0	<0	
	Y6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Sharifyan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Siva Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 4	Calibration Due Date: Panel Name:DB - 4/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R7	60A		R	–	–	–	–	
	Y7	10A	SPARE	Y	–	–	–	–	
	B7	10A	SPARE	B	–	–	–	–	
	R8	10A	SPARE	R	–	–	–	–	
	Y8	10A	SPARE	Y	–	–	–	–	
	B8	10A	SPARE	B	–	–	–	–	
					–				
	R9	10A	SPARE	R	–	–	–	–	
	Y9	10A	SPARE	Y	–	–	–	–	
	B9	10A	SPARE	B	–	–	–	–	
	R10	10A	SPARE	R	–	–	–	–	
	Y10	10A	SPARE	Y	–	–	–	–	
	B10	10A	SPARE	B	–	–	–	–	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 4	Panel Name:DB - 4/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 4	Calibration Due Date: Panel Name:DB - 4/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	20A	SPARE	Y	—	—	<0	<0	
	B6	20A	SPARE	B	—	—	<0	<0	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

Comments:		
PREPARED BY:	**WITNESSED BY:**	**VERIFIED BY:**
Signature: Name: Shahryam Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 4	Panel Name:DB - 4/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB1	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB2	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB3	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB4	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB5	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB6	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB7	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 4	Panel Name:DB - 4/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB8	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB9	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB10	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB11	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB12	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB13	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	
	RYB14	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	—	—	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 15/11/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 4	Calibration Due Date: Panel Name:DB - 4/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB15	20A	5 X 4mm2/ 1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	-	<0	<0	
				N	—	—	-	<0	
	RYB16	20A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	—	—	-	—	
				N	—	—	-	—	
	RYB17	20A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	—	—	—	
	RYB18	20A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	-	—	—	—	
				N	-	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 20/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 5	Panel Name: SSB-5 Remark : ~~'1' = >200mega ohm~~ <0 = ∞ Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	40A	1 X 4C 25mm² XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	—	<0	<0	
				N	—	-	⟷	<0	
	RYB2	40A	1 X 4C 16mm² XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	=	<0	<0	<0	
				B	—	-	<0	<0	
				N	—	—	-	<0	
	RYB3	40A	1 X 4C 16mm² XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	—	<0	<0	<0	
				B	—	-	<0	<0	
				N	—	—	-	<0	
	RYB4	60A	SPARE	R	<	-	—	-	
				Y	-	-	—	—	
				B	-	—	—	—	
				N	—	—	—	-	
	RYB5	30A	SPARE	R	—	—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Suaibzah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

萬里 Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 20/12/2017
Test Equipment Name / Type: Model : Location: ZONE 5	Serial Number: Calibration Due Date: Panel Name:DB - 5E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	—	—	<0	<0	
	R3	20A	SPARE	R	—	—	—	—	
	Y3	20A	SPARE	Y	—	—	—	—	
	B3	20A	SPARE	B	—	—	—	—	
	R4	20A	SPARE	R	—	—	—	—	
	Y4	20A	SPARE	Y	—	—	—	—	
	B4	20A	SPARE	B	—	—	—	—	
	R5	20A	SPARE	R	—	—	—	—	
	Y5	20A	SPARE	Y	—	—	—	—	
	B5	20A	SPARE	B	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 20/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 5	Panel Name:DB - 5/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	–	–	<0	<0	
	Y5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	–	–	<0	<0	
	B5	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	
	R6	10A	3 x 1C 1.5mm² PVC IN CONDUIT	R	–	–	<0	<0	
	Y6	10A	3 x 1C 1.5mm² PVC IN CONDUIT	Y	–	–	<0	<0	
	B6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	–	–	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Suntrgan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 20/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 5	Panel Name:DB - 5/ 1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B7	60A	〃	B	—	—	<0	<0	
	R8	10A	SPARE	R	—	—	—	—	
	Y8	10A	SPARE	Y	—	—	—	—	
	B8	10A	SPARE	B	—	—	—	—	
	R9	10A	SPARE	R	—	—	—	—	
	Y9	10A	SPARE	Y	—	—	—	—	
	B9	10A	SPARE	B	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: sivagan Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1 GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 20/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 5	Panel Name:DB - 5/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	16A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	20A	SPARE	R	—	—	—	—	
	Y5	20A	SPARE	Y	—	—	—	—	
	B5	20A	SPARE	B	—	—	—	—	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

Comments:		
PREPARED BY:	**WITNESSED BY:**	**VERIFIED BY:**
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Siva Time and Date:

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 20/12/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 5	Panel Name:DB - 5/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB1	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<1	<1	<1	<1	
				Y	—	<1	<1	<1	
				B	—	—	<1	<1	
				N	—	-	—	<1	
	RYB2	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<1	<1	<1	<1	
				Y	<1	<1	<1	<1	
				B	—	—	<1	<1	
				N	—	—	—	<1	
	RYB3	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<1	<1	<1	<1	
				Y	—	<1	<1	<1	
				B	—	—	<1	<1	
				N	—	—	—	<1	
	RYB4	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<1	<1	<1	<1	
				Y	—	<1	<1	<1	
				B	—	—	—	<1	
				N	—	—		<1	
	RYB5	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<1	<1	<1	<1	
				Y	-	<1	<1	<1	
				B	—	—	<1	<1	
				N	-	—	—	<1	
	RYB6	20A	SPARE	R	<1	—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	-	-	-	
	RYB7	20A	SPARE	R		—	—	—	
				Y	—	—	—	—	
				B	—	—	—	—	
				N	—	—	—	—	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name: SSB-1 ~~Remark : '1' = >200mega ohm~~ <0 = ∞ Ω

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	RYB1	60A	1 X 4C 25mm² XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB2	60A	1 X 4C 16mm² XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB3	60A	1 X 4C 16mm² XLPE/PVC N TRAY	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB4	30A	SPARE	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	<0	<0	
	RYB5	125A	SPARE	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB6	30A	SPARE	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Tanny Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type: Model : Location: ZONE 1	Serial Number: Calibration Due Date: Panel Name:DB - 1E

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B1	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B2	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R3	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	R	-	-	<0	<0	
	Y3	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	Y	-	-	<0	<0	
	B3	10A	2 X 4mm2/1C, + 1x1.5mm2/1C, PVC IN TRUNKING / CONDUIT	B	-	-	<0	<0	
	R4	10A		R	-	-	-	-	
	Y4	20A		Y	-	-	-	-	
	B4	20A	SPARE	B	-	-	-	-	
	R5	20A	SPARE	R	-	-	-	-	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1 GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name:DB - 1/1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm) Y	B	N	E	Note
	R1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	10A	SPARE	R	—	—	—	—	
	Y5	10A	SPARE	Y	—	—	—	—	
	B5	10A	SPARE	B	—	—	—	—	
	R6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: S hafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sham Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 1	Calibration Due Date: Panel Name:DB - 1/ 1

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	Y	-	-	<0	<0	
	B7	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	-	-	<0	<0	
					-	-			
	R8	10A	8 X 1C 1.5mm2 PVC IN CONDUIT	R	-	-	<0	<0	
	Y8	10A	8 X 1C 1.5mm2 PVC IN CONDUIT	Y	-	-	<0	<0	
	B8	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	B	-	-	<0	<0	
	R9	10A	2 x 1C 4mm² + 1 x 1C 1.5mm² PVC IN TRUNKING/CONDUIT	R	-	-	<0	<0	
	Y9	10A	//	Y	-	-	<0	<0	
	B9	10A	//	B	-	-	<0	<0	
	R10	10A	//	R	-	-	<0	<0	
	Y10	10A	//	Y	-	-	<0	<0	
	B10	10A	//	B	-	-	<0	<0	
	R11	10A	//	R	-	-	<0	<0	
	Y11	10A	//	Y	-	-	<0	<0	
	B11	10A	//	B	-	-	<0	<0	
	R12	10A	SPARE	R	-	-	-	-	
	Y12	10A	SPARE	Y	-	-	-	-	
	B12	10A	SPARE	B	-	-	-	-	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Sharifuddin Time and Date:	Signature: Name: Aiz Time and Date:	Signature: Name: Sivam Time and Date:

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name:DB - 1/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B1	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B2	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B3	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B4	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B5	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1 GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name:DB - 1/2

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	R6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	Y	—	—	<0	<0	
	B6	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	B	—	—	<0	<0	
	R7	20A	3 x 2.5mm2/1C PVC IN TRUNKING/CONDUIT	R	—	—	<0	<0	
	Y7	20A	SPARE	Y	—	—	—	—	
	B7	20A	SPARE	B	—	—	—	—	
	R8	20A	SPARE	R	—	—	—	—	

Broad-Way

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

Comments:		
PREPARED BY:	**WITNESSED BY:**	**VERIFIED BY:**
Signature: Name: shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Siva Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name:DB - 1/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB1	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB2	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB3	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB4	30A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB5	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB6	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB7	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Azuan Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model : Location: ZONE 1	Calibration Due Date: Panel Name:DB - 1/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB8	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB9	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB10	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB11	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	~~<0~~	<0	
	RYB12	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB13	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	
	RYB14	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	–	<0	<0	<0	
				B	–	–	<0	<0	
				N	–	–	–	<0	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shatiyah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sikim Time and Date:

Broad-Way 萬里

INSULATION RESISTANCE MEASUREMENT FINAL SUB-CIRCUIT AND SUBMAIN

CADANGAN PEMBANGUNAN MEMBINA GUDANG MERANGKUMI :FASA 1-GUDANG 1 TINGKAT (120M X 360M) DENGAN PEJABAT / BLOK SOSIAL 2TINGKAT SERTA SEBUAH PENCAWANG ELEKTRIK DAN SERAH SEBAHAGIAN TANAH DIBAWAH SEKSYEN 200KTN UNTUK TAKUNGAN (2.414 ekar) DIATAS LOT 7316 (P.T.3609) JALAN KLANG BANTING,MUKIM TELUK PANGLIMA GARANG, DAERAH KUALA LANGAT, SELANGOR DARUL EHSAN.	Report No: Date: 28/9/2017
Test Equipment Name / Type:	Serial Number:
Model :	Calibration Due Date:
Location: ZONE 1	Panel Name:DB - 1/3

Circuit No.		Rate Amp	Cable Type & Size	Phase	Resistance (Mohm)				Note
					Y	B	N	E	
	RYB15	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB16	20A	5 X 4mm2/1C, PVC IN TRUNKING / CONDUIT	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	<0	<0	
	RYB17	20A	SPARE	R	<0	<0	<0	<0	
				Y	-	<0	<0	<0	
				B	-	-	<0	<0	
				N	-	-	-	<0	
	RYB18	20A	SPARE	R	-	-	-	-	
				Y	-	-	-	-	
				B	-	-	-	-	
				N	-	-	-	-	

Comments:

PREPARED BY:	WITNESSED BY:	VERIFIED BY:
Signature: Name: Shafiqah Time and Date:	Signature: Name: Time and Date:	Signature: Name: Sivam Time and Date:

6.0 AS BUILT DRAWING

PROJECT: AXIS MEGA DISTRIBUTION CENTER

SERVICE: ELECTRICAL SERVICES

SUBJECT: LIST OF AS BUILT DRAWING

ITEM	DRAWING NO.	DRAWING TITLE
A)	**ELECTRICAL SERVICES**	
1)	KBSB-SEL-16424-ALL-E-01	COMPOUND LIGHTING SITE PLAN, KEY PLAN, LOCATION PLAN
2)	KBSB-SEL-16424-ALL-E-02	SITE PLAN, LOCATION PLAN & KEY PLAN ELECTRICAL MANHOLE & DUCTING LAYOUT
3)	KBSB-SEL-16424-WH-E-01	WAREHOUSE LIGHTING LAYOUT ZONE 1 - 3
4)	KBSB-SEL-16424-WH-E-02	WAREHOUSE LIGHTING LAYOUT ZONE 4 - 5
5)	KBSB-SEL-16424-WH-E-03	WAREHOUSE POWER POINT LAYOUT ZONE 1 - 5
6)	KBSB-SEL-16424-WH-E-03A	COPACKING POWER POINT LAYOUT GROUND FLOOR MEZZANINE FLOOR
7)	KBSB-SEL-16424-WH-E-04	PUMP ROOM LIGHTING, POWER & LIGHTNING PROTECTION LAYOUT
8)	KBSB-SEL-16424-WH-E-05	GUARD HOUSE LIGHTING, POWER & LIGHTNING PROTECTION LAYOUT
9)	KBSB-SEL-16424-WH-E-06	WAREHOUSE OFFICE LIGHTING & POWER LAYOUT
10)	KBSB-SEL-16424-WH-E-07	MHE POWER LAYOUT LIGHTING LAYOUT (CO-PACKING), ISOLATER
11)	KBSB-SEL-16424-OFF-E-01	OFFICE BLOCK GROUND AND FIRST FLOOR OFFICE POWER POINT LAYOUT
12)	KBSB-SEL-16424-OFF-E-02	OFFICE BLOCK GROUND AND FIRST FLOOR OFFICE LIGHTING LAYOUT
13)	KBSB-SEL-16424-OFF-E-03	OFFICE BLOCK CHILL WATER PUMP ROOM DOMESTIC WATER PUMP AT ROOF
14)	KBSB-SEL-16424-SCH-E-01	HT MAIN SINGLE LINE DIAGRAM
15)	KBSB-SEL-16424-SCH-E-02	LV MAIN SINGLE LINE DIAGRAM
16)	KBSB-SEL-16424-SCH-E-03	SINGLELINE DIAGRAM SSB AND DB ZONE 1
17)	KBSB-SEL-16424-SCH-E-04	SINGLELINE DIAGRAM SSB AND DB ZONE 2

PROJECT: AXIS MEGA DISTRIBUTION CENTER

SERVICE: ELECTRICAL SERVICES

SUBJECT: LIST OF AS BUILT DRAWING

ITEM	DRAWING NO.	DRAWING TITLE
18)	KBSB-SEL-16424-SCH-E-05	SINGLELINE DIAGRAM SSB AND DB ZONE 3
19)	KBSB-SEL-16424-SCH-E-06	SINGLELINE DIAGRAM SSB AND DB ZONE 4
20)	KBSB-SEL-16424-SCH-E-07	SINGLELINE DIAGRAM SSB AND DB ZONE 5
21)	KBSB-SEL-16424-SCH-E-08	SINGLELINE DIAGRAM DB OFFICE GROUND FLOOR (PART 1)
22)	KBSB-SEL-16424-SCH-E-09	SINGLELINE DIAGRAM DB OFFICE GROUND FLOOR (PART 2)
23)	KBSB-SEL-16424-SCH-E-10	SINGLELINE DIAGRAM DB OFFICE FIRST FLOOR (PART 1)
24)	KBSB-SEL-16424-SCH-E-11	SINGLELINE DIAGRAM DB OFFICE FIRST FLOOR (PART 2)
25)	KBSB-SEL-16424-SCH-E-12	SINGLELINE DIAGRAM BATTERY CHARGING
26)	KBSB-SEL-16424-SCH-E-13	SINGLELINE DIAGRAM OTHER LOCATIONS
27)	ANC9763/04/17	PROPSED GENERATOR ROOM LAYOUT FOR 1 X 350 KVA GENSET
B)	**TELEPHONE SERVICES**	
1)	KBSB-SEL-16424-TEL-01	TELEPHONE INSTALLATION SITE PLAN, LOCATION PLAN & KEY PLAN TELEPHONE MANHOLE & DUCTING LAYOUT
C)	**PA SERVICES**	
1)	KBSB-SEL-16424-PA-01	PUBLIC ADDRESS INSTALLATION WAREHOUSE LAYOUT ZONE 1-5, 8
2)	KBSB-SEL-16424-PA-02	PUBLIC ADDRESS INSTALLATION OFFICE LAYOUT ZONE 6-7
3)	KBSB-SEL-16424-PA-03	PUBLIC ADDRESS INSTALLATION SCHEMATIC DIAGRAM