



**Safeguard your systems  
from electrical turbulence**

**U-POWER**  
**OMEGA**  
Air Circuit Breakers

**Stabilise systems with technology.**



Electrical power is the lifeline of industry, but it is unpredictable. Just like an ocean, it can be calm one moment and turbulent the next. You cannot predict when a sudden dip or surge will happen, but you can protect your installation from damage, when it does. That's where our highly sophisticated OMEGA ACBs can make a world of difference to the safety of an organisation's employees, systems and infrastructure.

OMEGA ACB range consists of highly compact units designed for high current, high power applications in Low Voltage (LV) distribution network systems. They are equipped with state-of-the-art Matrix protection and control releases to meet the most demanding protection and system co-ordination requirements. All this, with the assurance of compliance to the L&T 'Safe & Sure' policy.

**Awarded 'Overall Best Product  
by an Indian Exhibitor'  
at ELECRAMA**

**U-POWER**  
**OMEGA**  
Air Circuit Breakers



## **L&T -The bedrock of stability.**

Over the last five decades, Larsen & Toubro has earned a place among the leading manufacturers of Low Voltage Switchgear in the world, with the scale, sophistication and range to meet global benchmarks.

In keeping with our leadership position in the Indian market, we also provide expert assistance in product selection, installation and effective after-sales service, across the country.

**Change course quickly.**



The U-POWER OMEGA ACB range has been designed to adapt to changes in your requirements, and allow you to modify or upgrade your systems with ease. This means minimum down-time and enhanced protection at all times.

### Get the OMEGA advantage

- **Meet system upgradation needs** with ease throughout the life of your product, with click-fit, easy-to-mount accessories like U/V and U/V delay modules, Shunt and Closing releases.
- **Enjoy total system flexibility and scalability** by adding power metering and communication modules or by enabling/disabling each protection function, depending on the requirement.
- **Let your systems have better co-ordination** with protection devices and downstream loads, via a wide range of protection curves and fine adjustment of current pick-up threshold and time-delay settings.
- **Control a vast electrical installation** through Zigbee communication, along with the option of conventional industrial communication protocols such as MODBUS and PROFIBUS.
- **Customise terminals** by configuring terminal adaptors for Vertical/Horizontal busbar arrangements, to facilitate termination of Aluminium and Copper busbars.
- **Convert ACBs easily on site** from Fixed to Draw-out or from Mechanical to Electrical versions.



**Match performance with prudence.**



U-POWER OMEGA ACBs offer you the best of both worlds – high performance coupled with a range of exclusive features that deliver the highest level of electrical safety.

### Performance par excellence.

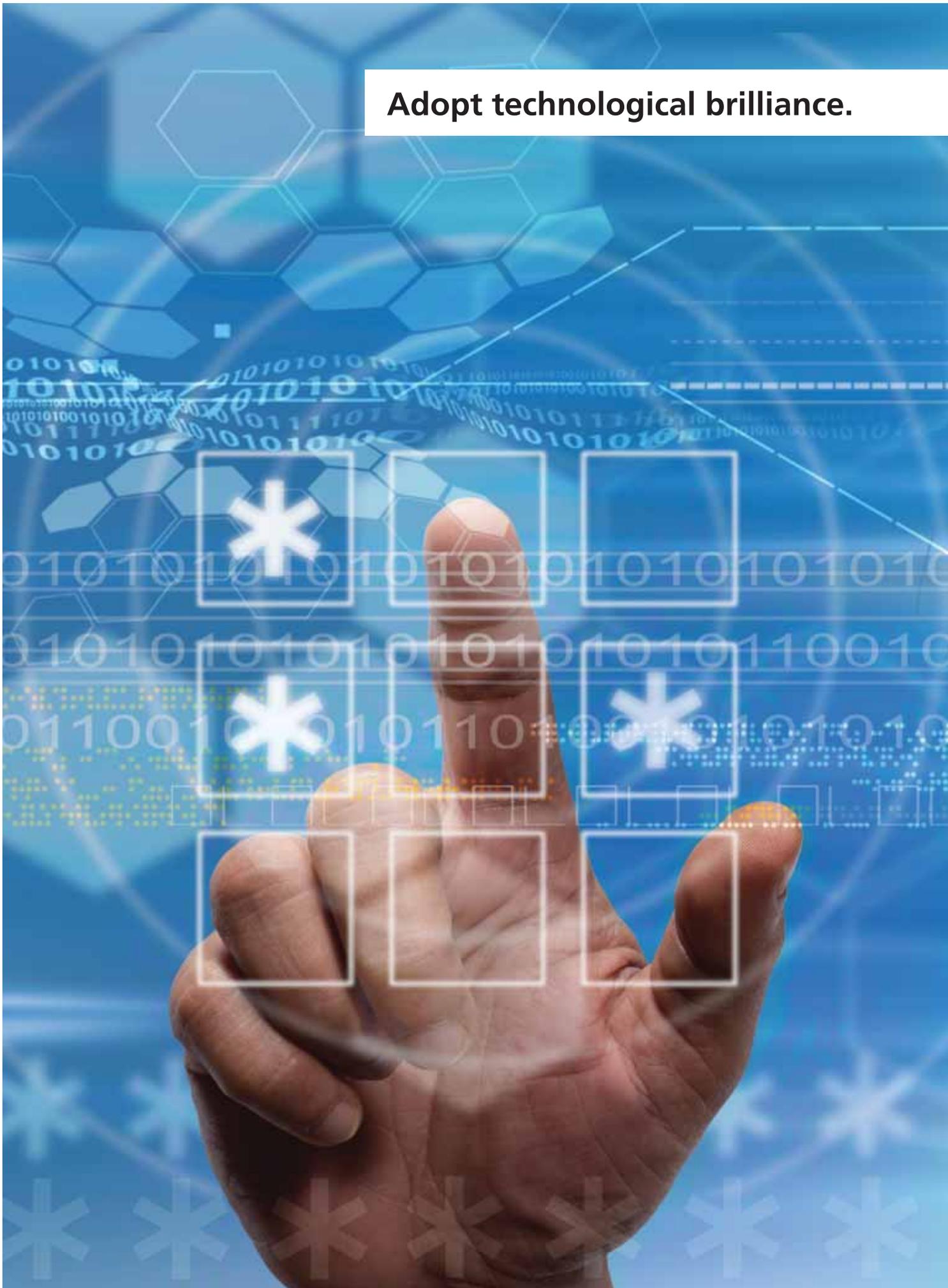
- **Save valuable space** with world's most compact ACBs, starting at just 347mm in width.
- **Enjoy total reliability** in even the harshest of conditions including high ambient temperatures and humidity levels.
- **Savour operational flexibility**, as the ACB discriminates between fault zones selectively, allowing downstream equipment to clear the fault in a prescribed time before intervening.

### Negating human error with safety features.

- **No Arc-chute, No closure:** Unique features like Arc-chute Interlocking and True Ready-to-Close (RTC) detection systems ensure that the ACB closes only when the Arc-chutes are in place and all other pre-requisite conditions are fulfilled.
- **Power ON, No racking operation:** An inbuilt Smart racking-shutter ensures that the ACB is racked-in/out only in 'OFF-state'.
- **One signal, One closure:** An inbuilt Electrical and Mechanical Anti-pumping System cancels the persistent closing signal after successful ACB closure.
- **No unauthorised setting changes:** An innovative Password Protection feature ensures that only authorised personnel can change the release settings.



**Adopt technological brilliance.**



U-POWER OMEGA ACBs are loaded with superior technology, across three frame sizes for the entire current range from 400A to 6300A. These features, including systems for communication, control and protection (Matrix), make these ACBs a dream to use.

**OMEGA ACBs allow you to:**

- **View** a snapshot of all parameters and symptoms through a user-friendly, state-of-the-art O-LED Display.
- **Control** the system parameters of vast installations easily, with a special Smart-card feature and user-friendly Touch-Screen Display.
- **Manage** energy consumption better by monitoring various energy parameters such as phase components, power factors, energy and maximum demand.
- **Communicate** between system elements wirelessly and stay informed at all times through mobile alerts.
- **Add and remove** Arc-chutes and various Volt-metric releases easily, without the need for tools.
- **Upgrade** systems for safety, protection, control and monitoring with a wide range of accessories and safety interlocks for versatile applications.
- **Enjoy** the benefit of total system compliance with all the relevant quality, safety and environmental standards.



**Keep an eye on upkeep.**



L&T's wide range of Electrical Standard Products includes powergear, controlgear, energy management devices, building electrical and automation products – each of which matches and exceeds global benchmarks for reliability and quality. However, in order to ensure that your business sails smoothly through any electrical turbulence, every element must be in perfect working condition.

At L&T, we offer you the benefit of five decades of experience in providing After-Sales Service for Low Voltage Distribution Systems in every type of industry and building in India.

## The L&T Service Advantage

- **Preventive Maintenance:** Advice is provided and preventive checks carried out on a regular basis.
- **Service On Call:** A network of over 100 approved Service Centres across India ensures that service is just a phone call away.
- **Annual Maintenance Contract:** Comprehensive care for your systems including Obsolescence Management and Part Replacement, as deemed necessary.
- **Obsolescence Management:** We offer spares and retro-fitment services, including upgrading all L&T Switchgear, to ensure that your systems run smoothly.
- **Training on Product Usage:** Our service engineers work with customers' maintenance staff to train them in the operation of switchgear products.

To find the perfect OMEGA ACB to protect your systems from electrical turbulence, turn the page.



U-POWER

# OMEGA

Air Circuit Breakers



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U-POWER

**OMEGA**

**Air Circuit Breakers**





U-POWER  
**OMEGA**  
Air Circuit Breakers

- Complete range conforms to IS/IEC 60947-2 & IEC 60947-2
- Current rating from 400A to 6300A in 3 frame sizes
- Available in 3 Pole/4 Pole, Manually & Electrically operated, Fixed & Draw-out versions
- Common Height & Depth across the range
- High short-time fault withstanding capacity,  $I_{cu} = I_{cs} = I_{cw}$  for 1 sec for total selectivity
- High mechanical and electrical operating life
- Modular & snap-fit accessories
- Ease of on-site conversion from Fixed to Draw-out & Manual to Electrical versions

**Breaking Capacities:**

$I_{cu} = I_{cs} = I_{cw}$

Rated current	800A	1000A	1250A	1600A	2000A	2500A	3200A	4000A	5000A	6300A
Frame-1	N : 50kA	■	■	■	■					
	S : 65kA	■	■	■	■	■	■			
	H : 80kA	■	■	■	■	■	■	■		
		<b>UW1-08</b>	<b>UW1-10</b>	<b>UW1-12</b>	<b>UW1-16</b>	<b>UW1-20</b>	<b>UW1-25</b>			
Frame-2	S : 65kA					■	■			
	H : 80kA	■	■	■	■	■	■	■		
		<b>UW2-08</b>	<b>UW2-10</b>	<b>UW2-12</b>	<b>UW2-16</b>	<b>UW2-20</b>	<b>UW2-25</b>	<b>UW2-32</b>		
Frame-3	H : 80kA							■	■	■
	V : 100kA	■	■	■	■	■	■	■	■	■
		<b>UW3-08</b>	<b>UW3-10</b>	<b>UW3-12</b>	<b>UW3-16</b>	<b>UW3-20</b>	<b>UW3-25</b>	<b>UW3-32</b>	<b>UW3-40</b>	<b>UW3-50</b>
									<b>UW3-63</b>	

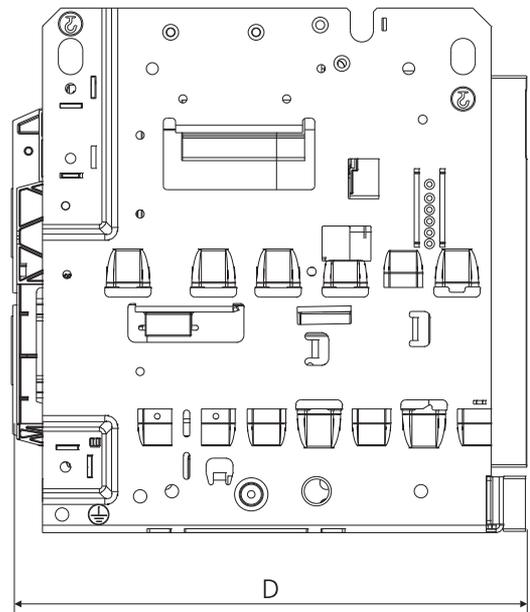
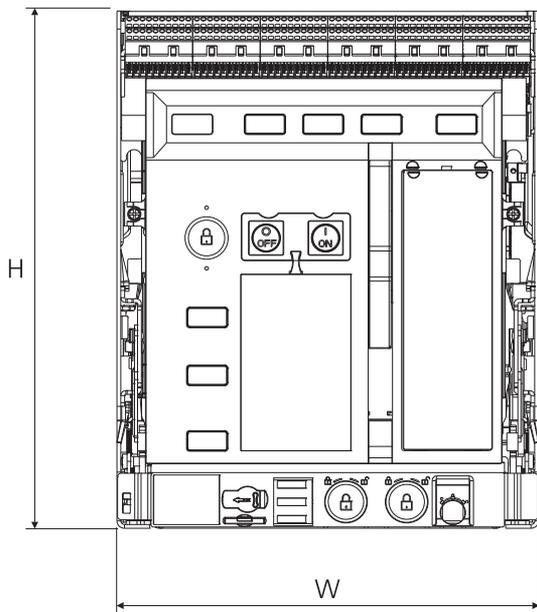
Frame			1				2				3				
Rated Uninterrupted Current (In) (A) at 50° C			400-1600		2000	2500\$	400-3200		400-5000		6300#				
Version			N	S	H	S	H	S	H	S	H	H	V	H	V
Rated Operational Voltage at 50/60 Hz.		Ue	upto 690V												
Rated Insulation Voltage at 50/60 Hz.		Ui	1000V												
Rated Impulse withstand Voltage		Uimp	12kV (Main Circuit) & 4kV (Auxiliary Circuit)												
Suitability for Isolation			Yes												
Degree of Protection on Breaker front			IP40 Intrinsic, IP53 available												
Pollution Degree Suitability			3												
Utilization Category			B												
Compliance			IS / IEC 60947 (Part-2), EN 60947-2, IEC 60947-2												
Rating for 4th Pole			100% & 200%								50% & 100%				
Rated Ultimate S.C. Breaking Capacity	Icu (kA)	400/415V	50	65	80	65	80	65	80	65	80	80	100	80	100
		500/550V	42	55	70	55	70	55	70	55	70	70	85	70	85
		660/690V	36	50	55	50	55	50	55	50	55	55	75	55	75
Rated Service S.C. Breaking Capacity	Ics (kA)	400/415V	100% Icu												
		500/550V													
		660/690V													
Rated Short-time Withstand Capacity	Icw (kA)	0.5sec	50	65	80	65	80	65	80	65	80	80	100	80	100
		1.0sec	50	65	80	65	80	65	80	65	80	80	100	80	100
		3.0sec	26	36	44	36	44	36	44	42	50	50	75	50	75
Rated S.C. Making Capacity	Icm (kA)	400/415V	105	143	176	143	176	143	176	143	176	176	220	176	220
		500/550V	88	121	154	121	154	121	154	121	154	154	187	154	187
		660/690V	76	105	121	105	121	105	121	105	121	121	165	121	165
Opening Time (ms)			40												
Closing Time (ms)			60												
Mechanical Life**		with maintenance	20000								15000		10000		
Electrical Life**		with maintenance	20000								15000		10000		
		without maintenance	10000*				5000				5000		5000		2000
Dimensions	Fixed ACB	W (mm)	Width 3P	347						447		647			
			Width 4P	447						581		847			
		D (mm)	Depth	324								334			
		H (mm)	Height	430											
	Draw-out ACB	W (mm)	Width 3P	347						447		647			
			Width 4P	447						581		847			
		D (mm)	Depth	421								431			
		H (mm)	Height	433											

# Rated Uninterrupted Current (In) (A) at 40° C

\* 8000 for 1600 N&amp;S versions

\*\* Value corresponds operating cycle

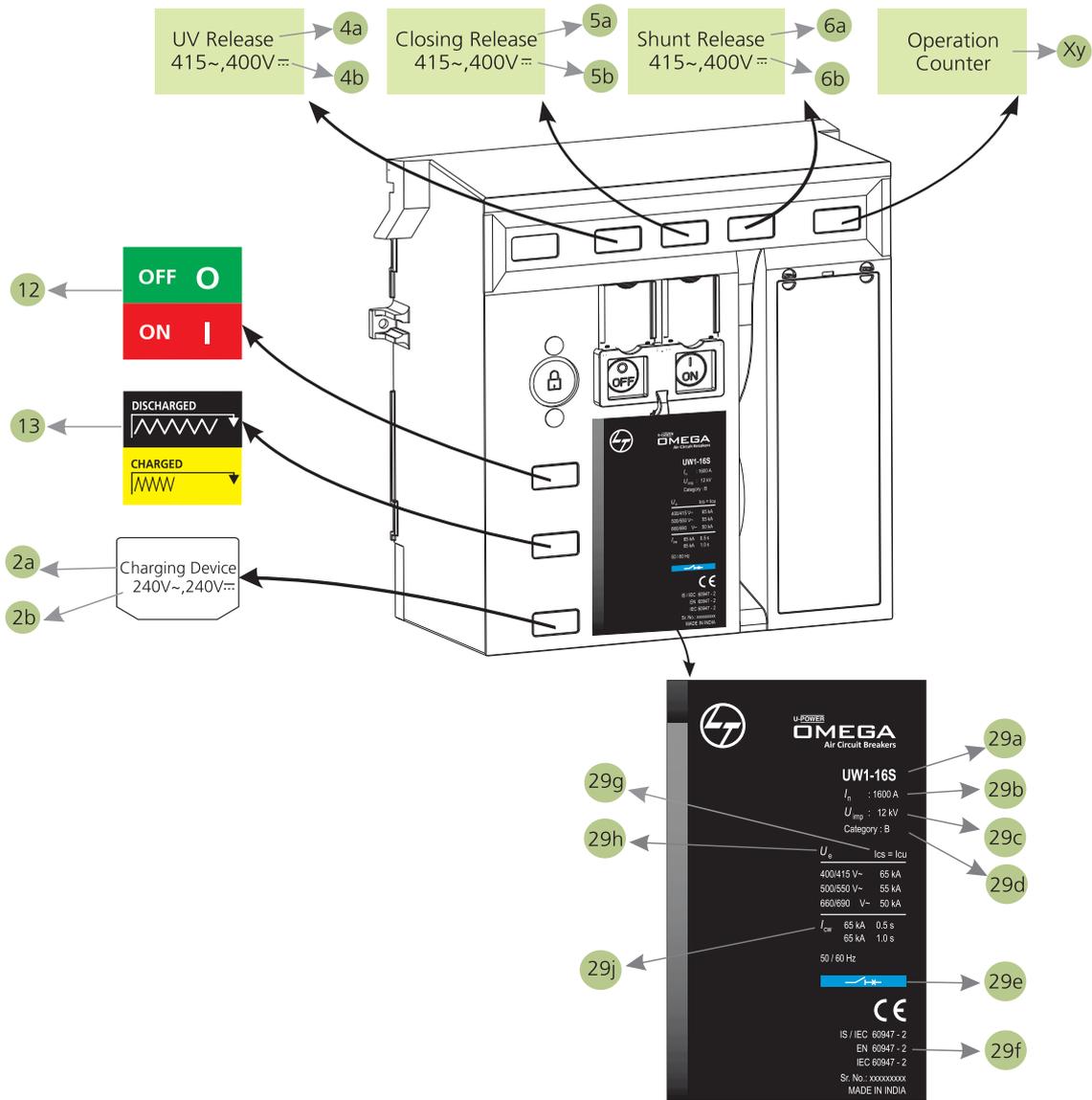
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H : Height  
 W : Width  
 D : Depth with flat terminals

Rating Specification Parameters for 50% N ACB				
Frame	3			
Version	H / V			
Rated Uninterrupted Current		In (A)	3200-6300	
Dimensions	Fixed	Width 4P	50% W (mm)	747
	D/O	Width 4P	50% W (mm)	747
Pitch	Ph-N	50% N	mm	150
Termination Width	Neutral	50% N	mm	65

Rating Specification Parameters for 200%N ACB						
Frame			1	2	3	
Version			N & S	S & H	H & V	
Rated Uninterrupted Current		In (A)	400 to 1250	1600	2000-2500	
Dimensions	Fixed ACB		200% W (mm)	447	581	647
	Draw-out ACB		200% W (mm)	447	581	647
Pitch	Ph-N	200% N	mm	100	133.3	200
Termination Width	Neutral	200% N	mm	65	65	165



- 2a - Type designation for Electrical Charging Device (ECD)
- 2b - Operating Voltage for ECD
- 4a - Type designation for Under-voltage release
- 4b - Operating Voltage for Under-voltage release
- 5a - Type designation for Closing Release (CR)
- 5b - Operating Voltage for CR
- 6a - Type designation for Shunt Release (SR/SRW)
- 6b - Operating Voltage for SR/SRW
- 12 - ON-OFF indication
- 13 - Spring Status Indication
- Xy - Operation Counter

29a - **UW1-16S**

Rated Uninterrupted Current ( $I_n$ )

04	400A
06	630A
08	800A
10	1000A
12	1250A
16	1600A
20	2000A
25	2500A
32	3200A
40	4000A
50	5000A
63	6300A

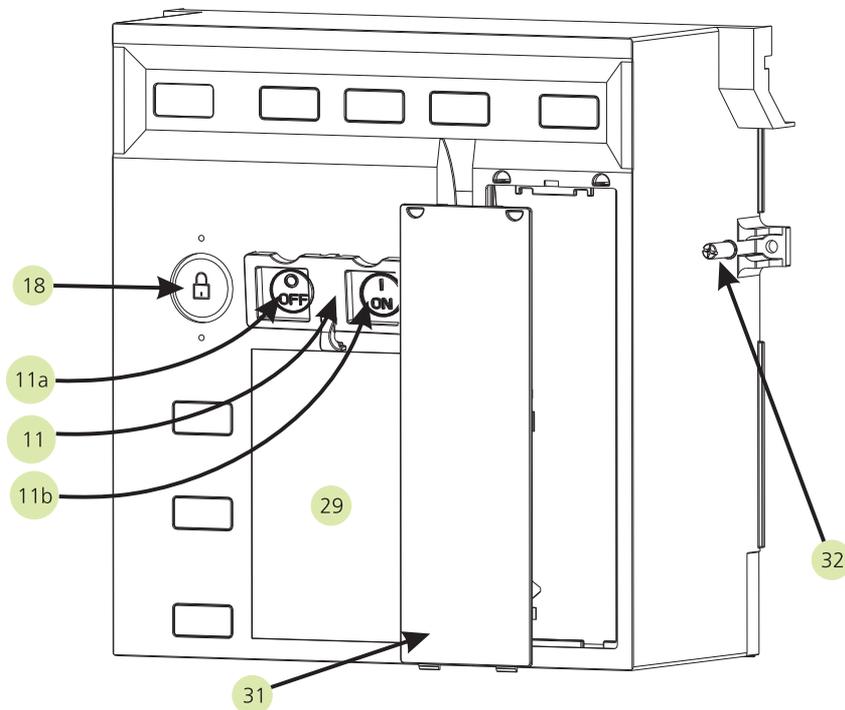
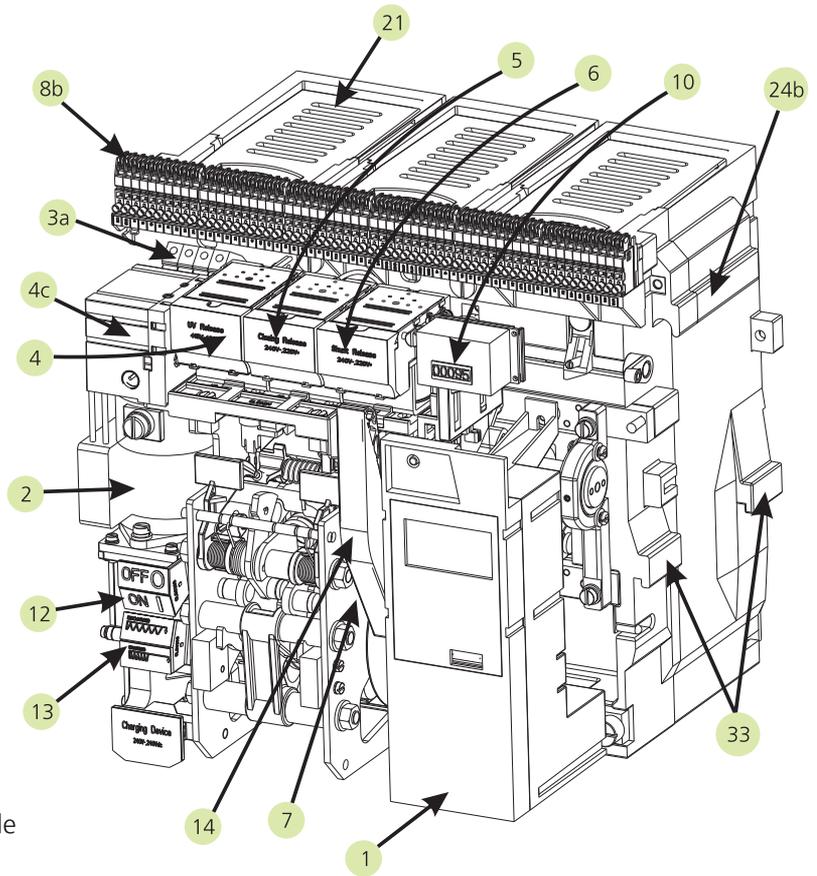
Version for Breaking Capacity

N	50 kA
S	65 kA
H	80 kA
V	100 kA

- 29b - Rated Uninterrupted Current
- 29c - Rated impulse withstand voltage
- 29d - Utilization Category
- 29e - Suitability for isolation
- 29f - Standards compliance
- 29g - Rated Service breaking capacity
- 29h - Rated Operational Voltage
- 29j - Rated short-time withstand current

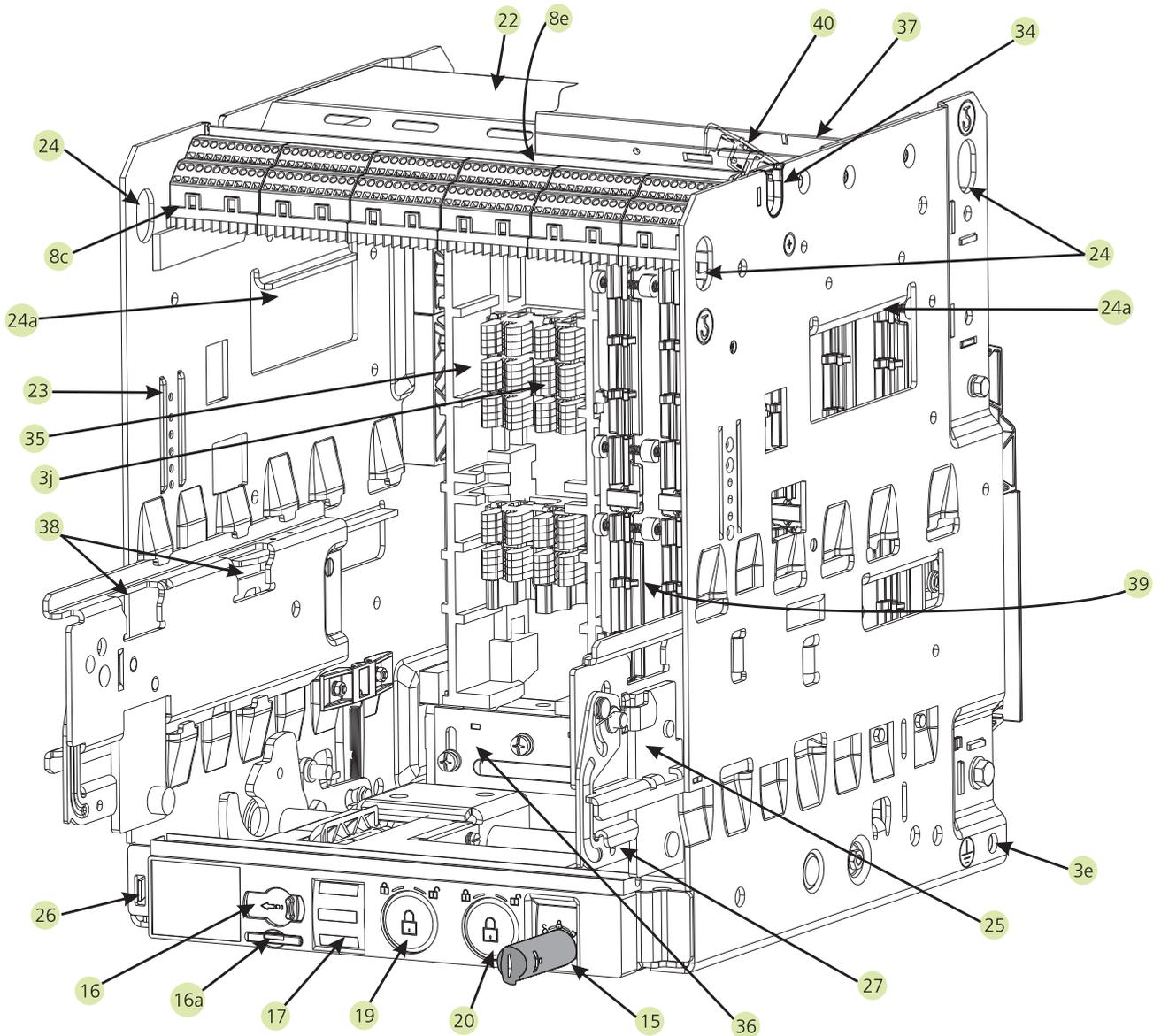
**Breaker:**

- 1 Protection & Control Unit
- 2 Electrical Charging Device
- 3a Auxiliary Contacts
- 4 Under-voltage Release
- 4c Under-voltage Release Controller
- 5 Closing Release
- 6 Shunt Release
- 7 Ready-To-Close (Microswitch)
- 8b Secondary Isolating Contacts on Breaker
- 10 Operation Counter
- 12 ON-OFF Indication
- 13 Spring Status Indication
- 14 Charging Handle
- 21 Arc-Chute
- 24b Lifting Location on Breaker
- 33 Projection for resting Breaker on Cradle



**Facia:**

- 11 Shroud for ON-OFF Buttons
- 11a OFF Button
- 11b ON Button
- 18 OFF Button locking
- 29 Facia Sticker
- 31 Cover for Protection & Control Unit (UW-MTX Releases)
- 32 Facia Fixing screw



### Cradle:

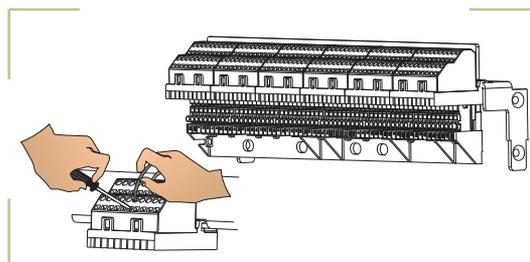
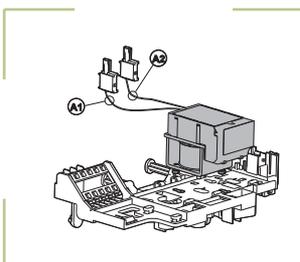
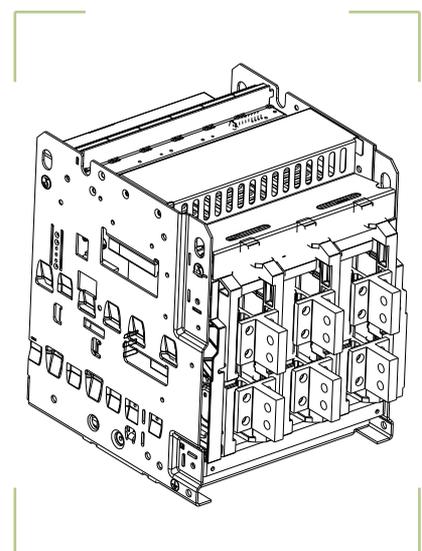
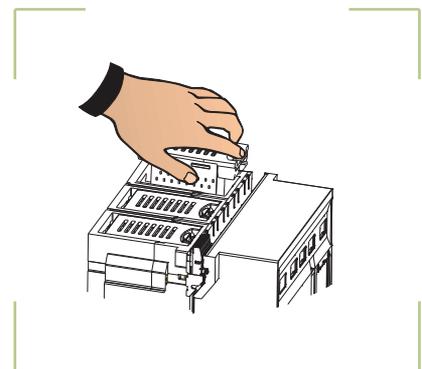
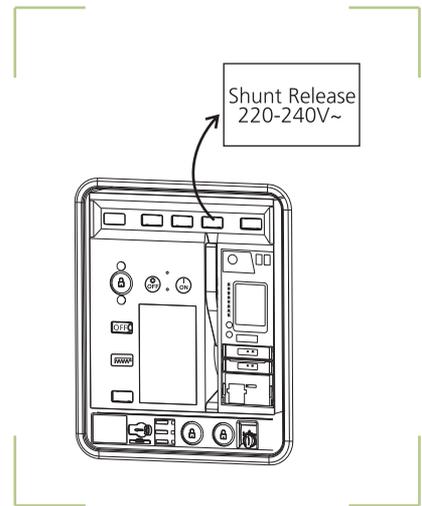
- |   |                                  |                                       |
|---|----------------------------------|---------------------------------------|
| 3e Hole for Earthing Connection           | 19 Position Lock – 1             | 34 Guide for routing Control Wiring   |
| 3j Jaw Contacts                           | 20 Position Lock – 2             | 35 Terminal Supports                  |
| 8c Secondary Isolating Contacts on Cradle | 22 Arc-Shield                    | 36 Cradle Bottom cross-component      |
| 8e Electrical Position Indication         | 23 Rating Error-Preventer        | 37 Cradle Top cross-component         |
| 15 Racking Handle                         | 24 Lifting Locations (4 nos.)    | 38 Slot for placing breaker on Cradle |
| 16 Smart Racking-Shutter                  | 24a Additional Lifting Locations | 39 Safety Shutter                     |
| 16a Pad-lock for Racking-Shutter          | 25 Withdrawal Rails              | 40 Door-Interlock                     |
| 17 Position Indicator                     | 26 Door Racking Interlock        |                                       |
|   | 27 Breaker Pull-out Handle       |                                       |

## User friendly:

- Unique breaker front-facia architecture displays the electrical accessories mounted on the ACB (with rated control voltage & type of operating voltage)
- Modular & snap-fit accessories such as UVR, SR & CR modules, redefine the modularity on a time scale of 5 mins.
- Ease of on-site convertibility from Manual to Electrical & Fixed to Draw-out version
- Tool-less Arc-Chutes removal facilitates quick inspection of electrical contacts
- Use of environment friendly packaging material

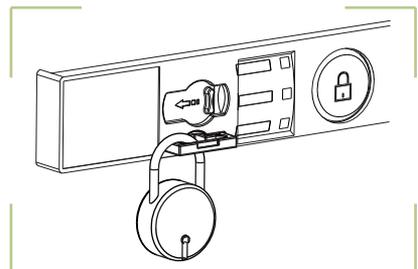
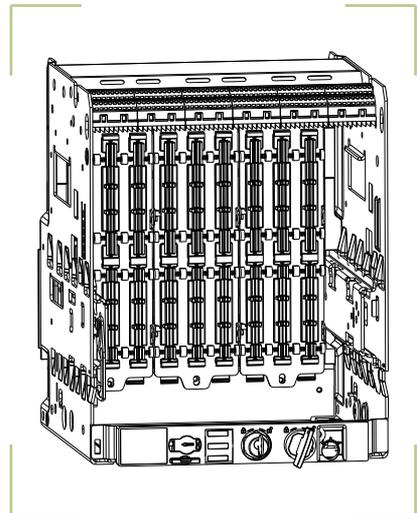
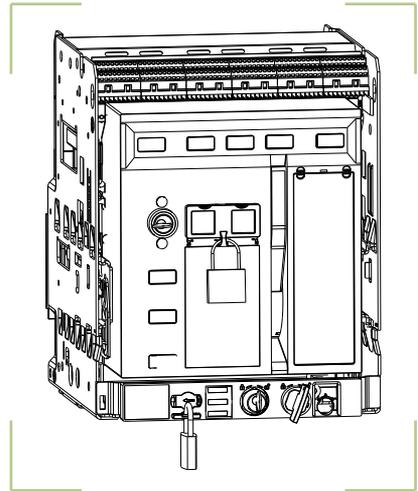
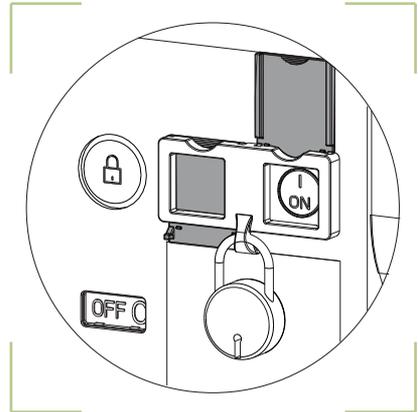
## Switchboard friendly:

- Three compact frame sizes help in optimizing the switchboard
- Right aligned design of ACB helps in better space utilization within the switchboard
- True 50% & 200% neutral options, along with the conventional 100% neutral (as standard) help in designing the switchboards as per applications & lead to optimized switchboard design
- Common height & depth across the range help in reducing the number of connection layouts & facilitate the easy modification of panel design & busbar layouts
- Terminal adaptors offer ease of configuration of vertical/horizontal busbar arrangements
- Option of interleaving busbar design at breaker terminals offer superior performance
- Supports multi-tier arrangement with minimal clearance with the help of arc-shield
- Self-aligning, Snap-fit Secondary Isolating Contacts enable the quick termination of 2 control wires (even without lugs) each of up to 2.5 sq.mm
- Option of NRYB or RYBN configuration simplifies the bus-duct trunking
- 2m/3m/5m Bowden wire mechanical interlocking kit facilitates ease of mechanical interlocking among various frames of Fixed / Draw-out / Mixed versions of Omega ACBs



## Superior Safety & Security:

- Inbuilt Electrical & Mechanical Anti-pumping prevents multiple breaker closures due to persistent closing commands
- Arc-Chute interlocking prevents the closure of ACB if arc-chute is missing or not properly installed
- Smart-racking shutter interlock ensures that breaker is switched-off before it is being racked-out
- Unique wide-band (10-130%  $U_e$ ) Shunt release ensures the reliable tripping of breaker at very low operating voltages
- Unique True Ready-To-Close (RTC) gives electrical signal after ensuring that:
  - a) Main spring is charged
  - b) Shunt release is de-energized
  - c) Under-voltage release is energized
  - d) Racking-Shutter is closed
  - e) Trip indication lever on electronic release is reset
  - f) Breaker is OFF
  - g) Arc-Chutes are properly placed
- Closing of ACB only in distinct Service/Test/Isolated positions ensures safety of the operating personnel
- Door-Racking interlock prevents rack-in/rack-out operation of breaker if panel door is open
- Modular safety-shutters with pad-locking facility prevent the unintended contact with the live terminals
- Rating Error-preventer avoids the breaker-cradle mismatch of rated current & breaking capacity version
- Option to pad-lock the ON/OFF push buttons independently to prevent unauthorized operations
- Facility to lock breaker in OFF condition offers the key-lock based interlocking arrangement
- Option for pad-locking the racking-shutter prevents the inadvertent racking operation & facilitates implementation of 'LOTO' system in industry
- Flexibility of locking the ACB in all positions or only in disconnected position
- Door-interlock prevents the opening of panel door in Service & Test positions



## ANTI-PUMPING IN OMEGA AIR CIRCUIT BREAKER

Anti-pumping device is one which prevents the breaker from reclosing after an opening operation even though the device initiating closing is maintained in the position of closing.

Anti-pumping is generally achieved by providing electrical interlocks which ensure that the persistent closing command breaks the moment the breaker trips on fault or opens. The breaker can then be reclosed only after a fresh command is given. This method of providing anti-pumping is known as electrical anti-pumping.

Following anti-pumping methods are used to ensure reliability of entire distribution system.

- **Mechanical anti-pumping**

Mechanical anti pumping is achieved by providing linkage interlocks which ensure that anti-pumping lever does not reset until the manual persistent closing command is relieved. Even in case of a fault, breaker trips but the anti-pumping lever remains in the downward position until a persistent command is relieved. Hence the breaker can be reclosed only after a fresh command is given.

- **Electrical anti-pumping**

- a) **By providing external circuit**

To achieve this anti-pumping, there is a need for an auxiliary contactor or a relay which will get actuated by the first closing command and will break the closing circuit and will prevent the breaker from closing after the breaker has tripped on fault, this anti-pumping contactor or relay is reset only when the closing command is removed, thus proving anti-pumping.

- B) By having inbuilt feature in closing release (CR) of OMEGA ACB**

In OMEGA, closing release consists of an electronic circuit to ensure no watt loss, inspite of continuous power supply, thus saving energy.

When a closing command is given, closing coil of the circuit breaker gets supply through an electronic circuit which comprises of IC555 timer. The closing coil is energized and the breaker closes. The closing command persists only for the 500ms time duration. In order to close the circuit breaker again, the closing coil circuit will have to be reset only when the closing command is removed. This ensures that once the breaker has closed and tripped on fault the breaker can close again only after the first closing command is removed and a fresh closing command is given, thus providing anti-pumping.

# MATRIX

Protection & Control Units





- 1) State-of-the-art touch-screen technology feature in Matrix 4.5 releases offer ease of navigation
- 2) Unique withdrawable power metering & communication modules offer ease of flexibility, scalability & customization of electrical systems
- 3) Option of both Modbus & Profibus industrial communication protocols
- 4) Zigbee offers wireless monitoring parameters of Matrix releases & supplementary modules
- 5) Wide range of Overload protection curves (such as I<sup>2</sup>t, I<sup>4</sup>t, SI & LI/VI) offer precise co-ordination with large variety of electrical loads
- 6) Option of Enabling/Disabling each protection function offers greater flexibility in designing the overall protection system
- 7) Directional & Double Short-circuit protection
- 8) Password protection in releases prevents unauthorized access to protection release
- 9) Unique O-LED display offers better contrast & wider-viewing angle
- 10) Ease of parameterisation through Smart-card modules
- 11) Dual time-based set group protection provides the option of setting two sets of protection curves
- 12) Front connector for secondary injection testing of release (through hand-held portable test simulation kit) offers ease of testing the releases
- 13) Soft-rating plug offers the precise protection of electrical system at lower value of system currents
- 14) Query button for last trip information furnishes the "Trip Info" details such as cause of tripping, date and time stamping of tripping
- 15) Test button for self-diagnostic test
- 16) 5 Trip & 10 Event records
- 17) Elimination of relays & measurement devices
  - Less time required for switchboard assembly (no wiring or cut-outs on the front panel)
  - Fewer devices required and less time spent on their selection, purchase, storage and installation
- 18) Harmonics metering up to 27th order of fundamental frequency along with display of THD
- 19) Oscillograph of fault current waveforms (10 cycles before pick-up/Trip & 5 cycles after pick-up/Trip)



Matrix releases designed for "Flexibility, Scalability & Customization" offers wide variety of withdrawable modules such as Modbus, Profibus, Zigbee, Smart Configurator & Power metering. To start with one can go for a basic version of MTX3.5 release and based on future needs and system demands, one can upgrade the protection release with Power metering & Communication modules.





**MTX1.0**



**MTX1G**



**MTX1.5G**

## Features:

- Overload, Short-circuit & Instantaneous protection with adjustable current & time-delay settings
- Inbuilt Earth-fault & neutral protection in MTX1G & MTX1.5G
- Switchable thermal memory for cable protection on repetitive overloads
- I<sup>2</sup>t ON curve for Short-circuit & Earth-fault protection
- Current metering in MTX1.5G through 3-line O-LED display
- Local fault annunciation through LED indication & pre-trip alarm
- Front accessible test port
- Query button for last trip record
- Inbuilt rating-plug through DIP switches
- Test button to check the health of protection release
- Self-powered protection

## Protection parameters:

Parameters		MTX1.0	MTX1G	MTX1.5G
Overload (Phase)	Protection: Enable/Disable	✓	✓	✓
	Pick-up (I <sub>r</sub> )=I <sub>n</sub> x... for I <sup>2</sup> t	OFF- 0.4-0.5-0.6-0.7-0.8-0.85-0.9-0.95-1		
	Delay (tr) in sec	10	0.5-1-2-4-6-12-18-24-30	
	Pre-alarm		0.9 x I <sub>r</sub> (fixed)	
	Thermal Memory ON/OFF	✓	✓	✓
Overload (Neutral)	Protection: Enable/Disable	-	✓	✓
	Pick-up (I <sub>n</sub> )=I <sub>r</sub> x...	-	50%-100%-150%-200%	
	Pre-alarm	-	0.8 x I <sub>n</sub> (fixed)	
	Delay (tr) in s	-	Same as Overload Phase	
Short-Circuit	Protection: Enable/Disable	x	x	x
	I <sup>2</sup> t ON/OFF	✓	✓	✓
	Pick-up (I <sub>s</sub> )=I <sub>n</sub> x...		0.6-1-1.5-2-3-4-6-8-10-12	
	Delay (ts)		20-100-200-300-400 ms	
	Pre-alarm		0.5 x I <sub>s</sub> (fixed)	
Instantaneous	Protection: Enable/Disable	✓	✓	✓
	Pick-up (I <sub>p</sub> )=I <sub>n</sub> x...		OFF-1.5-2-3-4-6-8-10-12-15	
Earth-Fault	Protection: Enable/Disable	-	✓	✓
	I <sup>2</sup> t : ON/OFF	-	✓	✓
	Pick-up (I <sub>g</sub> )=I <sub>n</sub> x...	-	OFF-0.2-0.3-0.4-0.5-0.6	
	I <sup>2</sup> t OFF (tg)	-	0.1-0.2-0.3-0.4-1	
	I <sup>2</sup> t ON (tg)	-	0.1-0.2-0.3-0.4	
	Pre-alarm	-	0.8 x I <sub>g</sub> (fixed)	



UW-MTX2.5/2.5G



UW-MTX3.5/3.5EC



UW-MTX4.5

Features	Parameter	MTX2.5	MTX2.5G	MTX3.5	MTX3.5EC	MTX4.5
Basic Protection	Overload - Phase	✓	✓	✓	✓	✓
	Overload - Neutral		✓	✓	✓	✓
	Short-Circuit	✓	✓	✓	✓	✓
	Directional Short-Circuit			✓	✓	✓
	Instantaneous	✓	✓	✓	✓	✓
	Earth-Fault		✓	✓	✓	✓
Additional Protection	Current			✓	✓	✓
	Voltage			*	✓	✓
	Frequency			*	✓	✓
	Reverse Power			*	✓	✓
	Maximum Demand			*	✓	✓
Trip Records	Last 5 trip data	✓	✓	✓	✓	✓
Event Records	Last 10 event data	✓	✓	✓	✓	✓
Smart Card				*	*	*
Communication	Modbus			*	✓	✓
	Profibus			*	*	*
	Zigbee (wireless)			*	*	*
Advanced Protection	Trip Circuit Supervision (TCS)			*	*	*
	Zone Selective Interlocking (ZSI)			*	*	*
	Temperature rise (TM)			*	*	*
	Earth Leakage (EL)			*	*	*
	Restricted Earth-Fault (REF)			*	*	*
Additional Features	Relay output			*	*	*
	Load Management			*	*	*
	Digital Input & Output			*	*	*
	Analog Output			*	*	*
Metering	Current	✓	✓	✓	✓	✓
	% Loading	✓	✓	✓	✓	✓
	Voltage			*	✓	✓
	Power & Energy			*	✓	✓
	Harmonics					✓
Storable Settings (2 sets)		✓	✓	✓	✓	✓
Auxiliary Supply (24V DC)		*	*	*	*	✓

\* - Optional feature



## UW-MTX2.5/2.5G

- Overload and short-circuit protection with variable current & time delay setting
- $I^2t$ ,  $I^4t$ , SI, LI/VI protection curves
- Instantaneous & Double Short-circuit protection
- Earth-fault protection in MTX2.5G with variable current & time delay settings
- Selectable  $I^2t$  based curves for short-circuit and earth-fault protection
- Switchable neutral overload protection in MTX2.5G (50%-200%) in step of 5%
- Thermal reflectivity & soft rating-plug
- Local fault annunciation & pre-trip alarm
- Current metering & percentage loading
- Dual time-based protection set groups
- Self-powered protection
- Trip & Event recording



## UW-MTX3.5/3.5EC

- Overload, Short-circuit and Earth-fault protection with variable current & time delay setting
- Instantaneous protection
- $I^2t$ ,  $I^4t$ , SI, LI/VI protection curves
- Directional & Double Short circuit protections
- Reverse power and phase sequence protection
- Selectable  $I^2t$  based curves for short-circuit and earth-fault protection
- Switchable neutral overload protection (50%-200%) in step of 5%
- Additional current & voltage based protections
- Protection against temperature rise
- Advance protection - ZSI, TCS, REF & EL
- Communication through Modbus, Profibus & wireless Zigbee
- Smart Configurator module for easy parameterisation of the release
- Local & remote fault annunciation & pre-trip alarm
- Current, Voltage, Power & Energy metering & % loading
- Dual time-based protection set groups
- Thermal reflectivity & soft rating-plug
- Self-powered protection
- Trip & Event recording



### UW-MTX4.5

- Overload, Short-circuit and Earth-fault protection with variable current & time delay setting
- $I^2t$ ,  $I^1t$ , SI, LIMI protection curves
- Navigation through Touch-Screen
- Bar-graph representation of current, voltage & power parameters
- Directional & Double Short-circuit protection
- Instantaneous protection
- Selectable  $I^2t$  based curves for Short-circuit and Earth-fault protection
- Switchable neutral overload protection (50%-200%) in step of 5%
- Harmonics metering up to 27th order of fundamental frequency along with display of THD percentage
- Oscillograph of fault current waveforms (10 cycles before pick-up/Trip & 5 cycles after pick-up/Trip)
- Metering of sequence components of current waveform, form factor, peak factor
- Additional current & voltage based protections
- Protection against temperature rise
- Advance protection - ZSI, TCS, REF & EL
- Communication through Modbus, Profibus & wireless Zigbee
- Local & remote fault annunciation & pre-trip alarm
- Dual time-based protection set groups
- Thermal reflectivity & soft rating-plug
- Self-powered protection
- Trip & Event recording

### Simulation Kit for Matrix releases

- Universal test kit for all versions of Matrix releases
- Generates 3 phase current and voltage with adjustable phase angles
- Graphical display & smart GUI with multi-functional key operation
- Portable & hand held device to simulate faults
- Dual Power ON-battery & external supply
- Auto sensing of release connectivity
- Memory card for data storage upto 32 GB
- Stores 10 test records
- PC interface through USB & Modbus



## Basic protection in UW-MTX 2.5/2.5G/3.5/3.5EC/4.5 Series

	Parameter	UW-MTX2.5	UW-MTX2.5G	UW-MTX3.5	UW-MTX3.5EC	UW-MTX4.5
Overload (Phase)	Protection : Enable/Disable	✓	✓	✓	✓	✓
	Pick-Up (Ir)=In x ...for I <sup>2</sup> t, I <sup>t</sup> , SI, LI/VI	0.4 to 1 In in step of 0.05				
	Delay(tr) in s	0.5-1-2-4-6-12-18-24-30				
	Pre-alarm	0.5 to 0.95 in step of 0.05 x Ir				
	Thermal Memory ON/OFF	✓	✓	✓	✓	✓
Overload (Neutral)	Protection: Enable/Disable	-	✓	✓	✓	✓
	Pick-Up I <sub>n</sub> =I <sub>r</sub> x ...	-	0.5 to 2 in step of 0.05			
	Pre-alarm	-	0.5 to 0.95 in step of 0.05 x I <sub>n</sub>			
	Delay(tr) in s	-	same as Overload Phase			
Short-Circuit	Protection: Enable/Disable	✓	✓	✓	✓	✓
	Double S/C ON/OFF	✓	✓	✓	✓	✓
	I <sup>2</sup> t ON/OFF	✓	✓	✓	✓	✓
	Pick-Up Lo, I <sub>s</sub> =I <sub>n</sub> x ...	0.6 to 12 In in step of 0.05				
	Pick-Up Hi, I <sub>s</sub> =I <sub>n</sub> x ...	0.6 to 12 In in step of 0.05				
	Delay Hi (ts)	20-100-200-300-400 ms				
	Delay Lo (ts)	20-100-200-300-400 ms				
	Pre-alarm	0.5 to 0.95 in step of 0.05 x I <sub>s</sub>				
	Cold Pick-Up ON/OFF	✓	✓	✓	✓	✓
	Cold Delay	100 ms to 10s in step of 100ms				
Directional Short-Circuit	Protection: Enable/Disable	x	x	✓	✓	✓
	Direction: Top/Bottom	-	-	✓	✓	✓
	I <sup>2</sup> t: ON/OFF	-	-	✓	✓	✓
	Pick-up(I <sub>s</sub> ): In x ...	-	-	0.6 to 12 In in step of 0.05		
	Delay(ts)	-	-	20-100-200-300-400 ms		
	Pre-alarm	-	-	0.5 to 0.95 in step of 0.05 x I <sub>s</sub>		
	Cold Pick-Up ON/OFF	-	-	✓	✓	✓
	Cold Delay	-	-	100 ms 10s in step of 0.05 x I <sub>s</sub>		
Instantaneous	Protection: Enable/Disable	✓	✓	✓	✓	✓
	Pick-up(I <sub>p</sub> )=In x ...	1.5 to 10 in step of 0.1; 10 to 15 in step of 1				
Earth-Fault	Protection: Enable/Disable	x	✓	✓	✓	✓
	I <sup>2</sup> t: ON/OFF	-	✓	✓	✓	✓
	Pick-Up(I <sub>g</sub> )=In x ...	-	0.2-0.3-0.4-0.5-0.6			
	I <sup>2</sup> t OFF(tg)	-	100 ms to 1s in step of 100 ms			
	I <sup>2</sup> t ON(tg)	-	100-200-300-400 ms			
	Pre-alarm	-	0.5 to 0.95 in step of 0.05 x I <sub>g</sub>			
	Cold Pick-Up: ON/OFF	-	✓	✓	✓	✓
	Cold Delay	-	100ms to 5sec in step of 100 ms			

## Advanced protection in UW-MTX 2.5/2.5G/3.5/3.5EC/4.5 Series

	Parameter	UW-MTX2.5	UW-MTX2.5G	UW-MTX3.5*	UW-MTX3.5EC	UW-MTX4.5
Under Current	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up= $I_r \times \dots$	-	-	0.2 to 0.8 in step of 0.05		
	Delay	-	-	1 to 255sec in step of 1sec		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Current Unbalance	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up= $I_n \times \dots$	-	-	10 to 90% in step of 5%		
	Delay	-	-	500 ms to 60s in step of 0.5s		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Under Voltage	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up( $V_s$ )= $V_n \times \dots$	-	-	0.7 to 0.95 in steps of 0.01		
	Delay	-	-	100 ms to 5s in step of 100 ms		
	$V_s$ reset	-	-	1.01/1.02/1.03/1.04 x $V_s$		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Over Voltage	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up( $V_s$ )= $V_n \times \dots$	-	-	1.05 to 1.5 $V_n$ in step of 0.01		
	Delay	-	-	100 ms to 5s in steps of 100 ms		
	$V_s$ reset	-	-	0.95 to 0.99 $V_s$ in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Voltage Unbalance	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up( $V_s$ )= $V_n \times \dots$	-	-	5 to 20% in step of 1%		
	Delay	-	-	500ms to 60s in step of 0.5s		
	$V_s$ reset	-	-	0.95 to 0.99 $V_s$ in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Residual Voltage	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up ( $V_s$ )= $V_n \times \dots$	-	-	0.15/0.2/0.25/0.3/0.4		
	Delay	-	-	100ms to 5s in step of 100 ms		
	$V_s$ Reset	-	-	0.95 to 0.99 $V_s$ in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Under Frequency	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up (Fn)	-	-	45-50 Hz in step of 0.1Hz		
	Delay	-	-	1-30sec in step of 0.1sec		
	Reset Freq	-	-	1.01 to 1.05 Fn in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Over Frequency	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up (Fn)	-	-	50-55 Hz in step of 0.1 Hz		
	Delay	-	-	1-30sec in step of 0.1sec		
	Reset Freq	-	-	0.95 to 0.99 Fn in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Rev Power	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up= $P_n \times \dots$	-	-	0.05 to 0.4 in step of 0.01		
	Delay	-	-	100ms-20s in step of 0.1s		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Earth Leakage**	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
	Protection: Enable/Disable	-	-	✓	✓	✓
	Pick-Up( $I_r$ )	-	-	0.3 to 30A in step of 0.1 A		
	Delay	-	-	100-200-300-400-500 ms		
Restricted EF**	Protection: Enable/Disable	x	x	✓	✓	✓
	$I^2t$ : OFF/ON	-	-	✓	✓	✓
	Pick-Up( $I_g$ )= $I_n \times \dots$	-	-	0.1 to 0.6 in step of 0.1		
	$I^2t$ OFF (tg)	-	-	100 ms to 5sec in step of 0.1s		
	$I^2t$ ON (tg)	-	-	100-200-300-400 ms		
	Pre-alarm	-	-	0.5 to 0.95 in step of 0.05 x $I_g$		
	Cold Pick-Up: ON/OFF	-	-	60 ms to 10s in step of 20ms		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓

\* Requires Power Metering module for Advanced protections  
 \*\* Separate Modules required

## Advanced Protection in UW-MTX 2.5/2.5G/3.5/3.5EC/4.5 Series

	Parameter	UW-MTX2.5	UW-MTX2.5G	UW-MTX3.5*	UW-MTX3.5EC	UW-MTX4.5
Leading PF	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up=Pf x ...	-	-	0.5 to 0.99 in step of 0.01		
	Delay	-	-	1/2/3/4/5 s		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Lagging PF	Protection: Enable/Disable	x	x	✓	✓	✓
	Pick-Up=Pf x ...	-	-	0.5 to 0.99 in step of 0.01		
	Delay	-	-	1/2/3/4/5 s		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
MD Active	Protection: Enable/Disable	x	x	✓	✓	✓
	Type	-	-	Deliver/Receive		
	Pick-Up=En x ...	-	-	0.4 to 1 in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
MD Reactive	Protection: Enable/Disable	x	x	✓	✓	✓
	Type	-	-	Deliver/Receive		
	Pick-Up=En x ...	-	-	0.4 to 1 in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
MD Apparent	Protection: Enable/Disable	x	x	✓	✓	✓
	Type	-	-	Deliver/Receive		
	Pick-Up=En x ...	-	-	0.4 to 1 in step of 0.01		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Phase Sequence	Protection: Enable/Disable	x	x	✓	✓	✓
	Delay	-	-	100ms to 5s in step of 100ms		
	Mode: Trip/Alarm/Both	-	-	✓	✓	✓
Breaker Failure	Protection: Enable/Disable	x	x	✓	✓	✓
	Delay	-	-	50ms to 2sec in step of 0.05sec		

\* Requires Power Metering module for Advanced protections

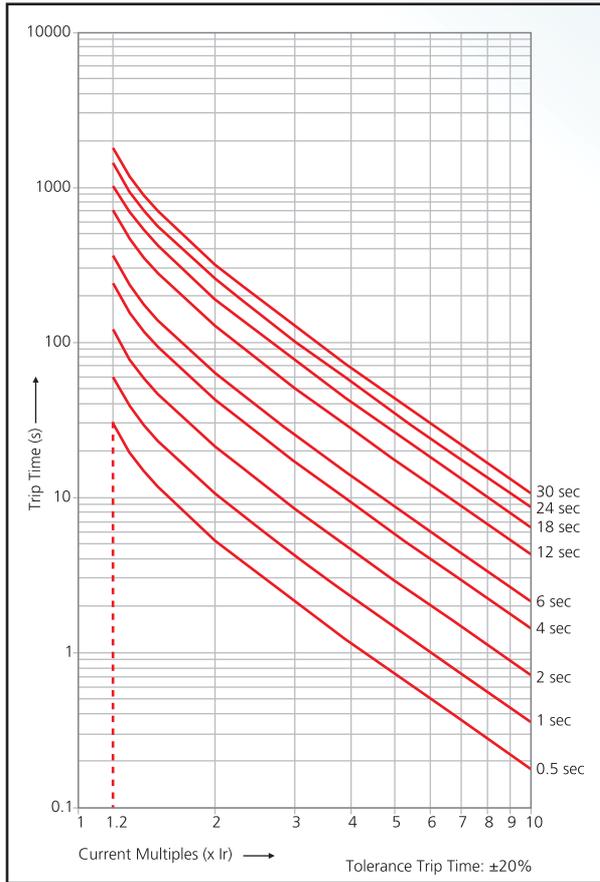
## Metering Functions

Parameter	Screen abbreviation	Details	MTX2.5/2.5G	MTX3.5/3.5EC	MTX4.5
Current	I	Phase, Neutral and Earth	✓	✓	✓
	I <sub>e</sub> , IREF	Earth Leakage, Restricted EF Current		✓	✓
	I max	Maximum Running Current Per Phase	✓	✓	✓
	% Load	Percentage Loading Per Phase	✓	✓	✓
	Avg.I	Average Phase Current	✓	✓	✓
Voltage*	V	Phase-Neutral Voltage		✓	✓
	Max V	Maximum Voltage Per Phase		✓	✓
	V12	Ph-Ph Voltage		✓	✓
	Max V12	Maximum Ph-Ph Voltage		✓	✓
	Avg. Vp-p	Average Ph-Ph Voltage		✓	✓
	Avg Vp-n	Average Ph-N Voltage		✓	✓
Frequency*	F	System Frequency		✓	✓
Power Factor*	PF	System Power Factor		✓	✓
Power*	W	Active Power Per Phase and total (kW)		✓	✓
	VAr	Reactive Power Per Phase and total (kVar)		✓	✓
	VA	Apparent Power Per Phase and total (kVA)		✓	✓
Energy*	Wh	Active Energy Per Phase and total (kwh)		✓	✓
	VArh	Reactive Energy Per Phase and total (kVArh)		✓	✓
	VAh	Apparent Energy Per Phase and total (kVAh)		✓	✓
Max Demand*	Wh	Active Energy		✓	✓
	VArh	Reactive Energy		✓	✓
	VAh	Apparent Energy		✓	✓
Temperature <sup>#</sup>	Ø	Temperature Per Phase (°C)		✓	✓
Harmonics Metering*	THD & Phase components	Phase-1, 2 & 3-Total, Fundamental, THD			✓

\* Requires Power Metering module # Requires Temperature-rise module

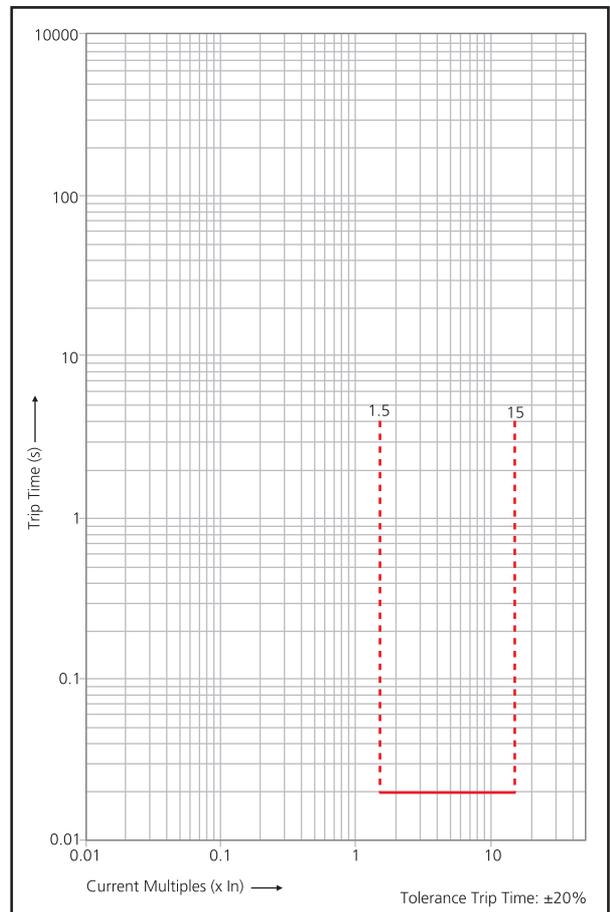
**Overload -  $I^2t$**

(UW-MTX 1G/1.5G/2.5/2.5G/3.5/3.5EC/4.5)



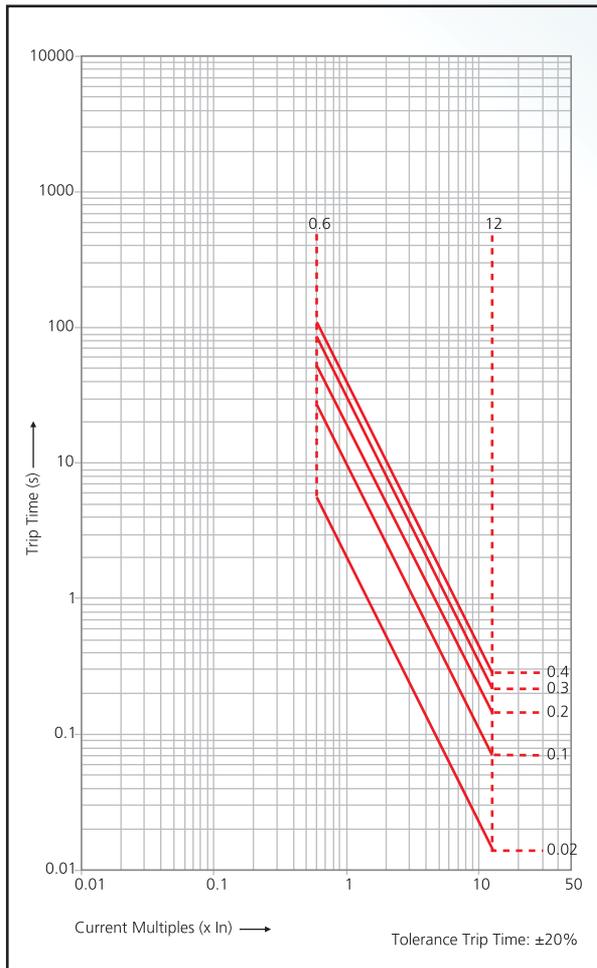
**Instantaneous**

(UW-MTX 1.0/1G/1.5G/2.5/2.5G/3.5/3.5EC/4.5)



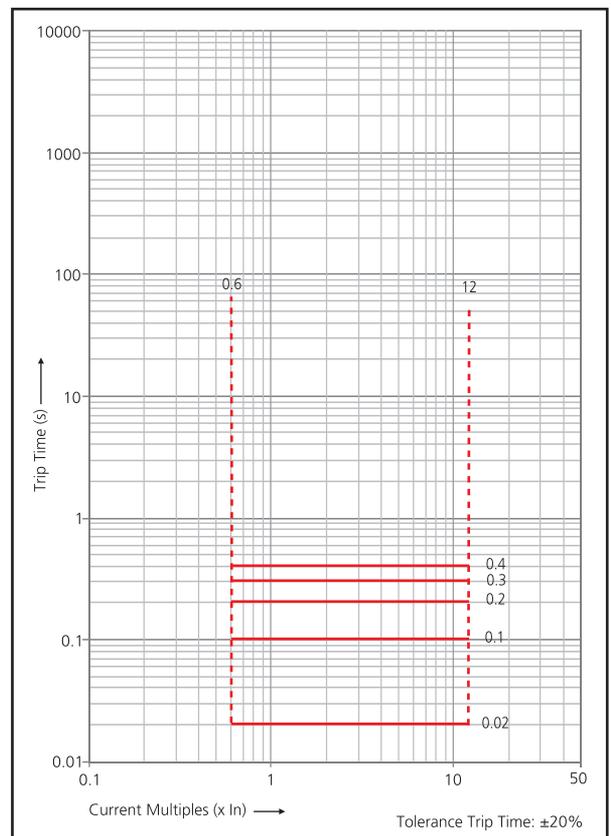
## Short-Circuit - I<sup>2</sup>t ON

(UW-MTX 1.0/1G/1.5G/2.5/2.5G/3.5/3.5EC/4.5)



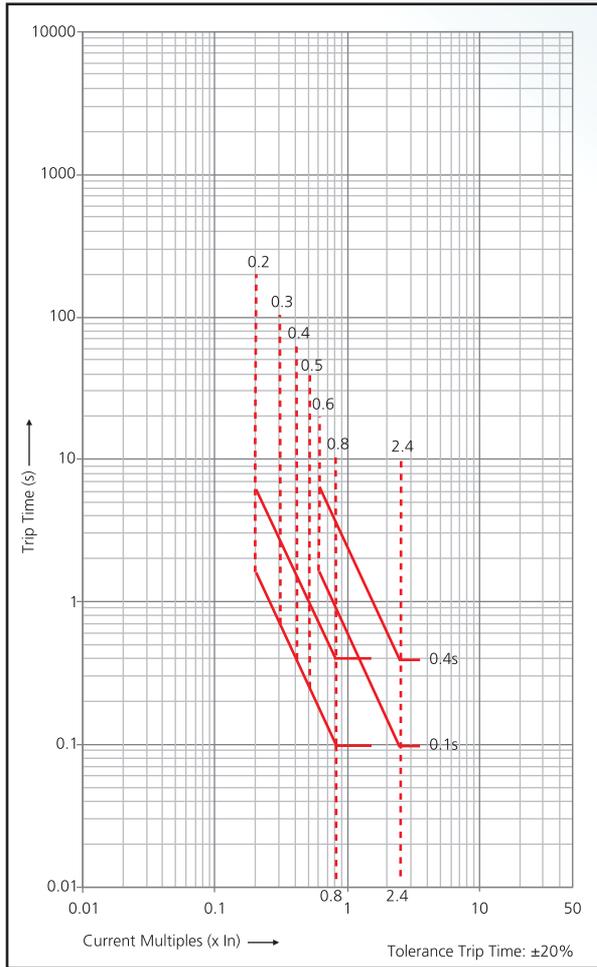
## Short-Circuit - I<sup>2</sup>t OFF

(UW-MTX 1.0/1G/1.5G/2.5/2.5G/3.5/3.5EC/4.5)



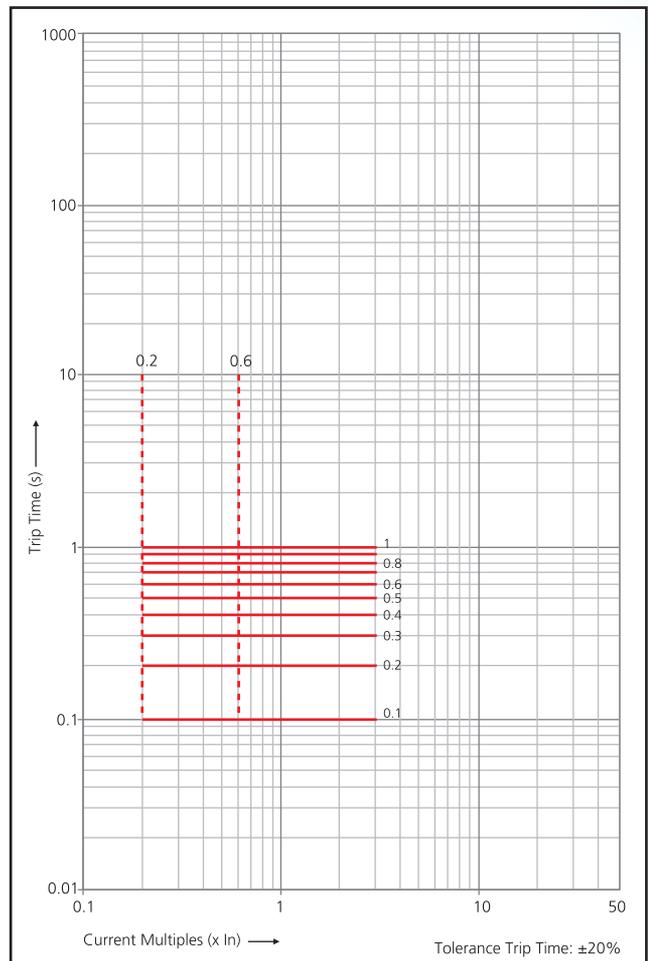
**Ground Fault - I<sup>2</sup>t ON**

(UW-MTX 1G/1.5G/2.5G/3.5/3.5EC/4.5)

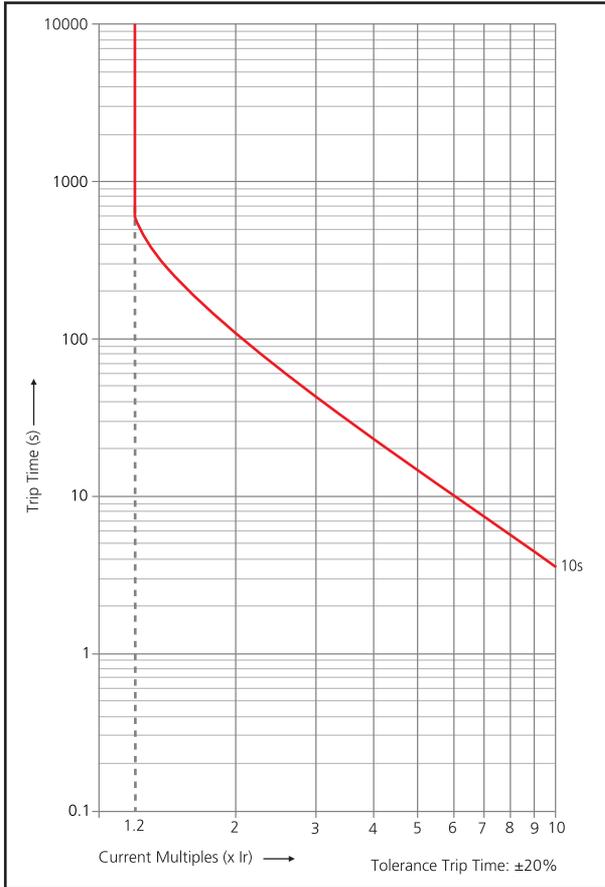


**Ground Fault - I<sup>2</sup>t OFF**

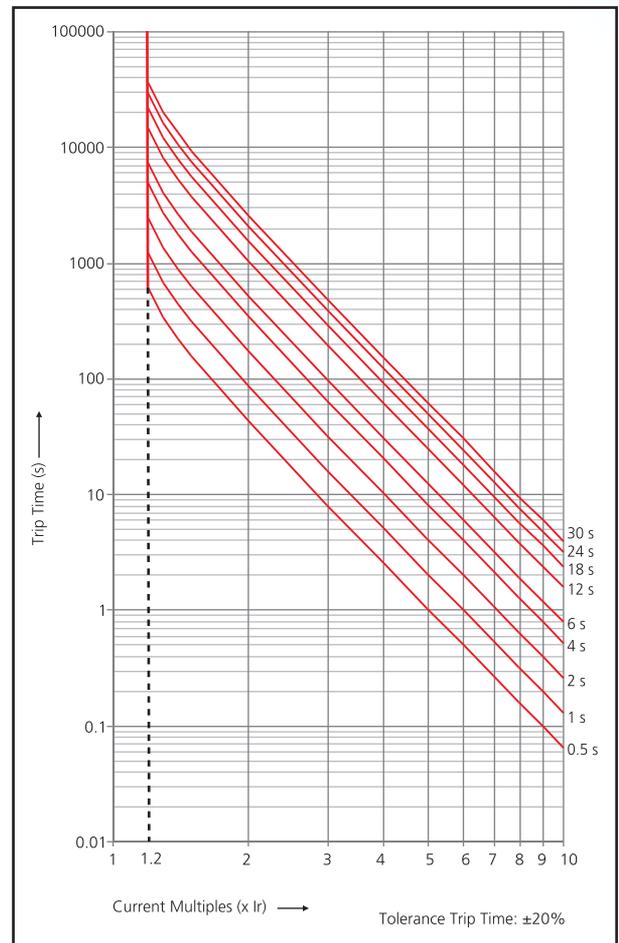
(UW-MTX 1G/1.5G/2.5G/3.5/3.5EC/4.5)



## Overload - $I^2t$ (UW-MTX1.0)

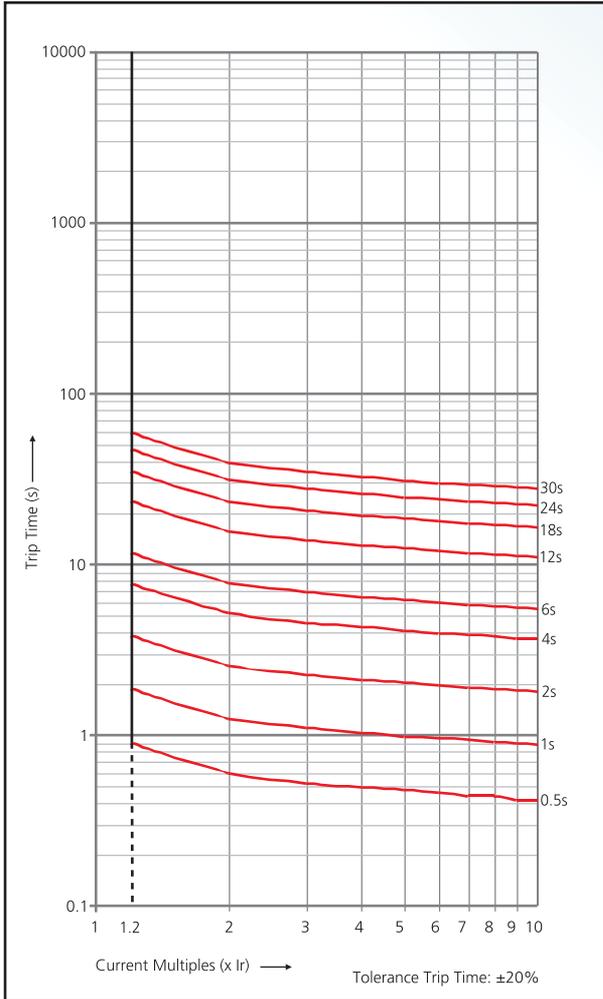


## Overload - $I^4t$ (UW-MTX2.5/2.5G/3.5/3.5EC/4.5)



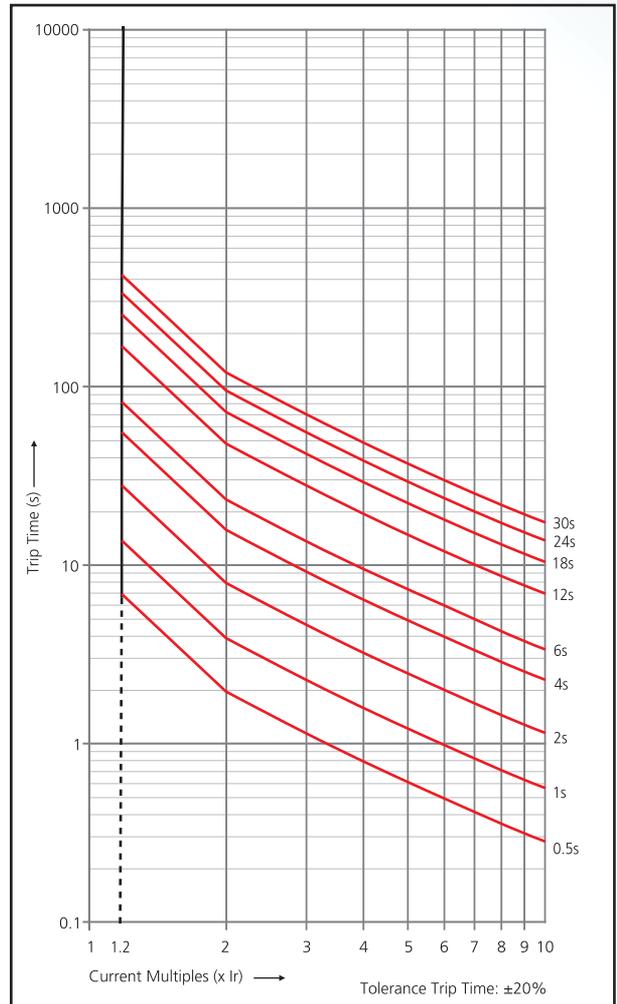
**Overload - SI**

(UW-MTX2.5/2.5G/3.5/3.5EC/4.5)



**Overload - LI/VI**

(UW-MTX2.5/2.5G/3.5/3.5EC/4.5)



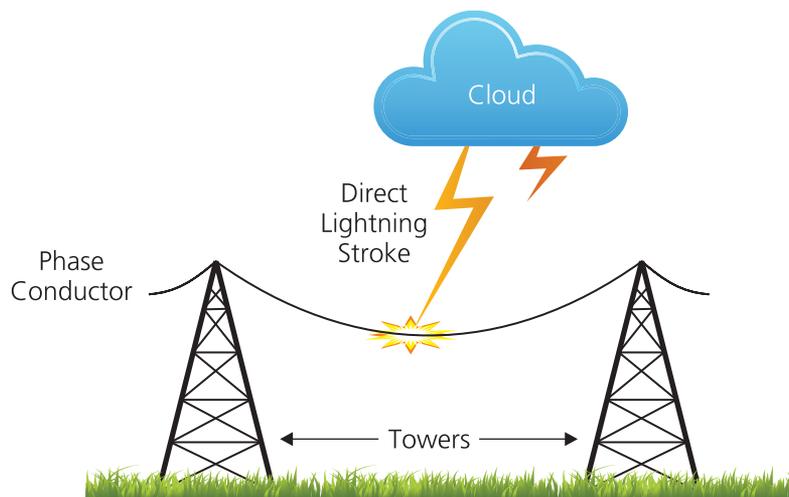
## Over voltage causes and effects

Over voltage (or surges) in the power system are the abrupt rise in the voltage level in the system. There could be several reasons for over voltage. The normal operating voltages of the system do not stress the insulation severely. But the voltage stresses due to over voltages can be so high that they may become dangerous to both the cables and the connected equipment and may cause damage, unless some protective measure against the over-voltages are taken. Over-voltages occurrence in the system can be categorized by reasons:

### 1. EXTERNAL OVER VOLTAGES:

These over-voltages originate from the atmospheric disturbances, mainly due to lightning. These over-voltages take the form of a unidirectional impulse whose maximum possible amplitude has no direct relation with the operating voltage of the system. They may be due to any one of the following causes:

a. Direct lightning strokes



- b. Electromagnetically induced voltages due to the lightning discharge near the line (sidestroke)
- c. Voltage induced due to the changing atmospheric condition along the transmission line
- d. Electrostatically induced over voltages due to the presence of the charged clouds
- e. Due to the friction of the charged particles like dust, snow in the atmosphere or due to change in the altitude of the line

## 2. INTERNAL OVER VOLTAGES:

Caused due to changes in the operating condition of the network. Can be further classified in two groups:

### a. Switching or transient over voltages

These over voltages are generally of oscillatory nature caused by the transient phenomena which appears when the state of the network is changed by switching operation or a fault condition.

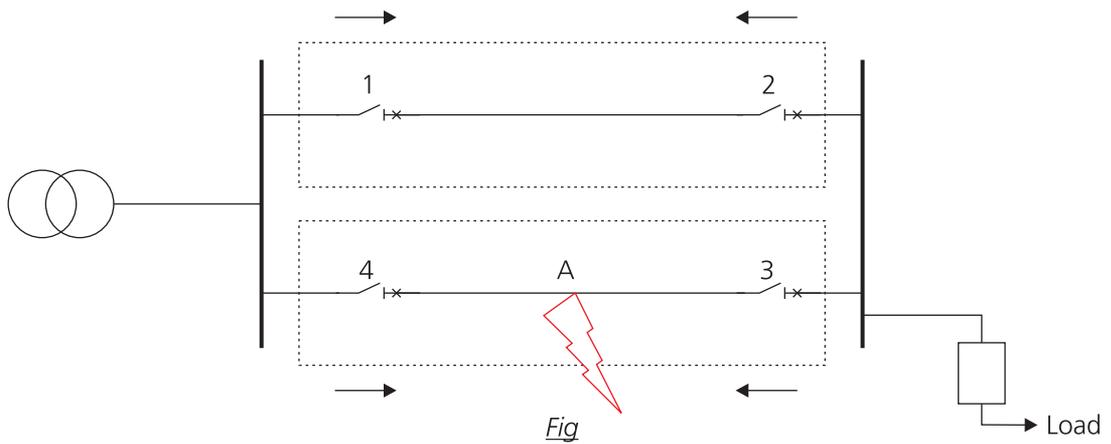
The frequency of the oscillations is governed by the inherent inductance and capacitance of the system & may vary from few hundred Hz to few kHz

- For e.g.
- i. Switching On & OFF of equipment, like switching of high voltage reactors or switching of transformer on no load
  - ii. If fault occurs in any one phase the voltage of other phases with respect to the ground increases until the faults get cleared
  - iii. Because of the re-striking voltage across the contacts of the breaker, when breaker has tripped on fault, voltage of amplitude nearly twice the system voltage and relatively high frequency gets generated

### b. Steady-state or temporary over voltages

These are over voltages developed due to the disconnection of loads at power frequency.

## DIRECTIONAL SHORT CIRCUIT PROTECTION



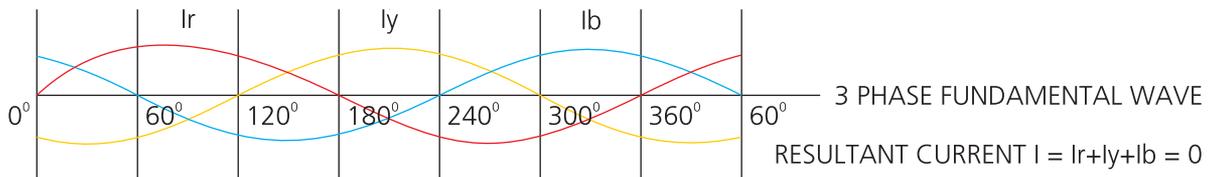
Consider a single-end-fed system of parallel feeders. In above Fig, for fault at A, Breakers 3 & 4 should trip, so as to keep the load bus charged for uninterrupted power supply. Breaker 4 will trip instantaneously, as it will see the fault current in its zone. Even after Breaker 4 trips, the transformer will feed the fault through Breaker 1, Breaker 2 and Breaker 3. The Breaker 3 has to protect the faults occurring on the load bus also. Directional protection allows the Breaker 3 to trip on faults at A, for the complete isolation of the faults at A.

### Linear Loads:

The AC loads are called linear loads when the current and voltage resultant waveform is sinusoidal in nature (i.e. not distorted). Also the current at any instant is proportional to the voltage at that instant.

Thus in linear systems there are no harmonic components in current and the voltage waveforms.

e.g. Heaters, Power factor improvement capacitors, etc.



CURRENT WAVE FOR LINEAR LOAD

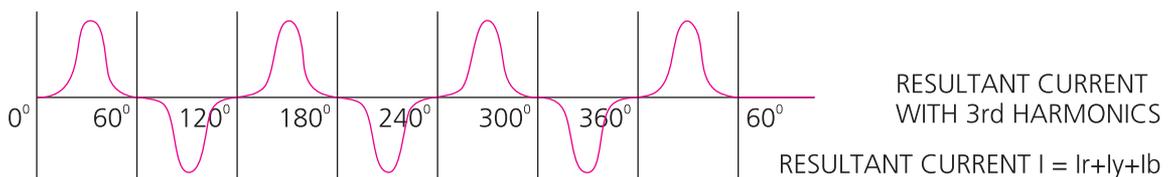
### Non-Linear Loads:

The AC loads which cause the current waveform to distort from the normal sinusoidal nature are called as non-linear loads. Current distortion leads to the distortion of the voltage waveform also. Thus the voltage and current are no longer proportional.

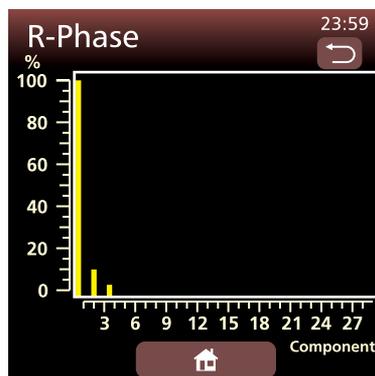
The distorted current and the voltage waveforms can be decomposed into pure sinusoidal and associated frequencies of the higher order through Fourier Transformation.

Harmonic spectrum gives a clear analysis of amount and order of the harmonics present in the system, which helps in the designing the filter for the system.

e.g. SMPS, Rectifiers, PLC, Electronic Ballasts, Laser Printers, Computers, etc.



CURRENT WAVEFORM FOR NON-LINEAR LOAD



HARMONIC SPECTRUM

**Harmonics** are basically the sinusoidal component of the periodic wave with frequency that is an integral multiple of the fundamental frequency.

Harmonics content purely determines the quality of power. Having harmonics in the system will affect the system and the severity of effect on the system/equipment will depend on the stiffness of the system and the amount of the harmonic pollution.

## **Harmonics can be generated in the system because of the following reasons:**

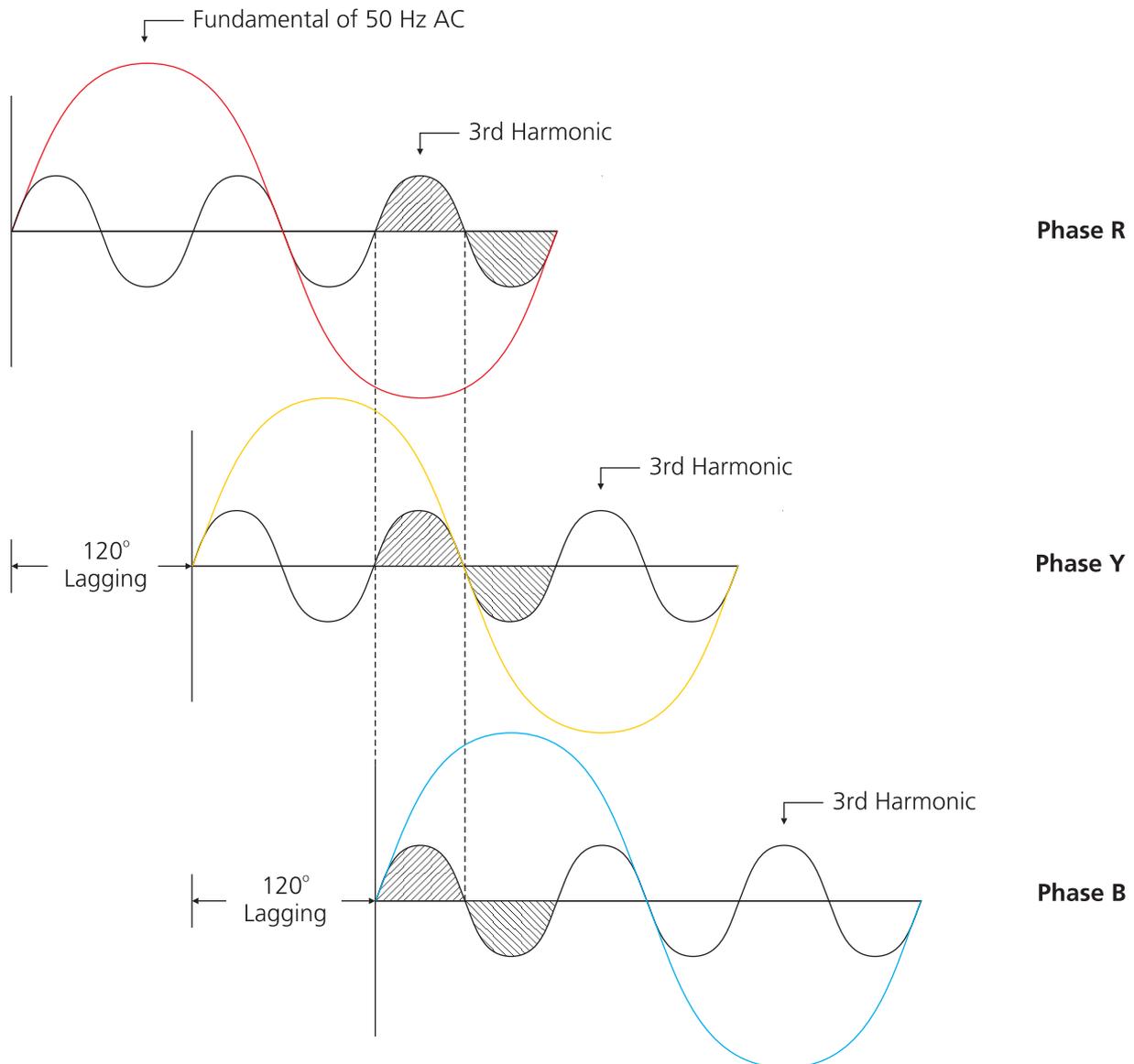
- Non-linear loads generate current harmonics
- Harmonic currents flow largely through capacitors
- Harmonic currents also flow through network
- The flow of harmonic currents causes voltage harmonics
- Harmonics are thus injected to other linear loads connected in the same bus
- Harmonics injected into the network flow towards other users connected to the network

## **Some of the typical loads causing the generation of the harmonics in the system are:**

- **Equipment using switched mode power supply:**
  - ▶ Television
  - ▶ Computers, other IT loads
- **Equipment using power electronic devices:**
  - ▶ AC & DC drives
  - ▶ Frequency converters
  - ▶ Rectifiers
  - ▶ Arc & induction furnaces
  - ▶ UPS
  - ▶ Compact fluorescent & other discharge lamps

**Some of the typical results of the harmonics in the system are:**

1. Neutral over current: Odd triplen harmonics because of its additive nature adds up in the neutral current causing the overheating of the neutral.



*Fig.1*

As shown in the Fig.1 any odd triplen harmonic when multiplied by 120 degrees will always produce the product which is integral multiple of the 360 degrees. Thus being shifted by integral multiples of the 360 degrees, the odd triplen harmonics will always be in phase with each other in neutral.

2. Incorrect readings: In case of induction disc W-hr meters and averaging type current meters
3. Additional losses in capacitors and rotating machines
4. Reduced true PF:  $Pf = \text{watts}/VA$
5. Transformer overheating especially delta windings where triplen harmonics generated on the load side of a delta-wye transformer will circulate in the primary side. Some type of losses go up as the square of harmonic value (such as skin effect and eddy current losses). This is also true for solenoid coils and lighting ballasts.
6. Zero, negative sequence voltages on motors and generators. In a balanced system, voltage harmonics can either be positive (fundamental, 4th, 7th...), negative (2nd, 5th, 8th...) or zero (3rd, 6th, 9th,...) sequencing values. This means that the voltage at that particular frequency tries to rotate the motor forward, backward, or neither (just heats up the motor), respectively. There is also heating from increased losses as in a transformer.

<b>Harmonic order</b>	1	2	3	4	5	6	7	8	9
<b>Phase Sequence</b>	+	-	0	+	-	0	+	-	0

7. Nuisance operation of protective devices, including false tripping of relays and failure of a UPS to transfer properly, especially if controls incorporate zero-crossing sensing circuits.
8. Bearing failure from shaft currents through uninsulated bearings of electric motors.
9. Blown-fuses on PF correction caps, due to high voltage and currents from resonance with line impedance.
10. Mis-operation or failure of electronic equipment.
11. If there are voltage sub-harmonics in the range of 1-30Hz, the effect on lighting is called flicker. This is especially true at 8.8Hz, where the human eye is most sensitive, and just 0.5% variation in the voltage is noticeable with some types of lighting.

## TOTAL HARMONIC DISTORTION:

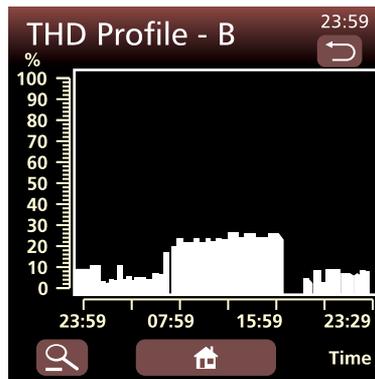
Power sources act as non-linear loads, drawing a distorted waveform that contains harmonics. These harmonics can cause problems ranging from telephone transmission interference to degradation of conductors and insulating material in motors and transformers. Therefore it is important to gauge the total effect of these harmonics. The summation of all harmonics in a system is known as Total Harmonic Distortion (THD).

Harmonics have frequencies that are integral multiples of the waveform’s fundamental frequency. For example, given a 50Hz fundamental waveform, the 2nd, 3rd, 4th and 5th harmonic components will be at 100Hz, 150Hz, 200Hz and 250Hz respectively. Thus, harmonic distortion is the degree to which a waveform deviates from its pure sinusoidal values as a result of the summation of all these harmonic elements.

The ideal sine wave has zero harmonic components. In that case, there is nothing to distort this perfect wave. Total Harmonic Distortion or THD, is the summation of all harmonic components of the current waveform compared against the fundamental component of the current wave:

$$THD = \left[ \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + \dots + I_n^2}}{I_1} \times 100 \right] \%$$

The formula above shows the calculation for THD on a current signal. The end result is a percentage comparing the harmonic components to the fundamental component of a signal. The higher the percentage, the more distortion that is present on the mains signal.



THD PROFILING

### Crest Factor (CF):

**The Crest Factor of a power source is defined as:**  $I_{\text{peak}} / I_{\text{RMS}}$

Crest Factor is an important parameter to understand when trying to take accurate measurements of low frequency signals.

**CF for sine wave = 1.414**

However, the Crest Factor for a non-sinusoidal current waveform can differ dramatically for loads that are not power factor corrected, such as a switching power supply or lamp ballast, which gives a current waveform that is short in duration but high in amplitude.

CF specified in various communication devices QPSK, QAM, WCDMA should be maintained in the system for reliable communication.

### Form Factor (FF):

**The Form Factor of a power source is defined as:**  $I_{\text{RMS}} / I_{\text{avg}}$

**FF for pure sine wave = 1.11**

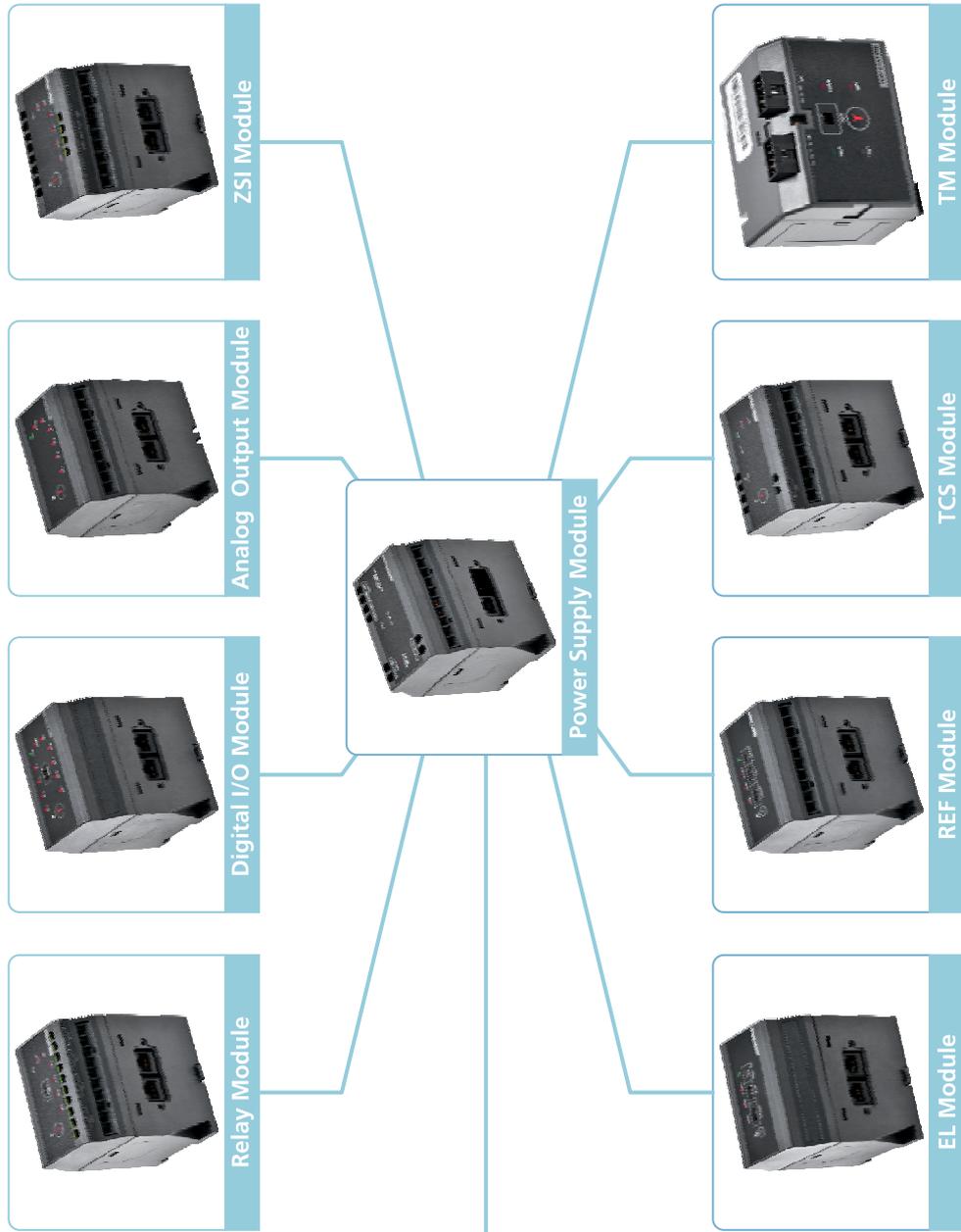
FF remains independent of the amplitude of the waveform and will remain same for a particular waveform.

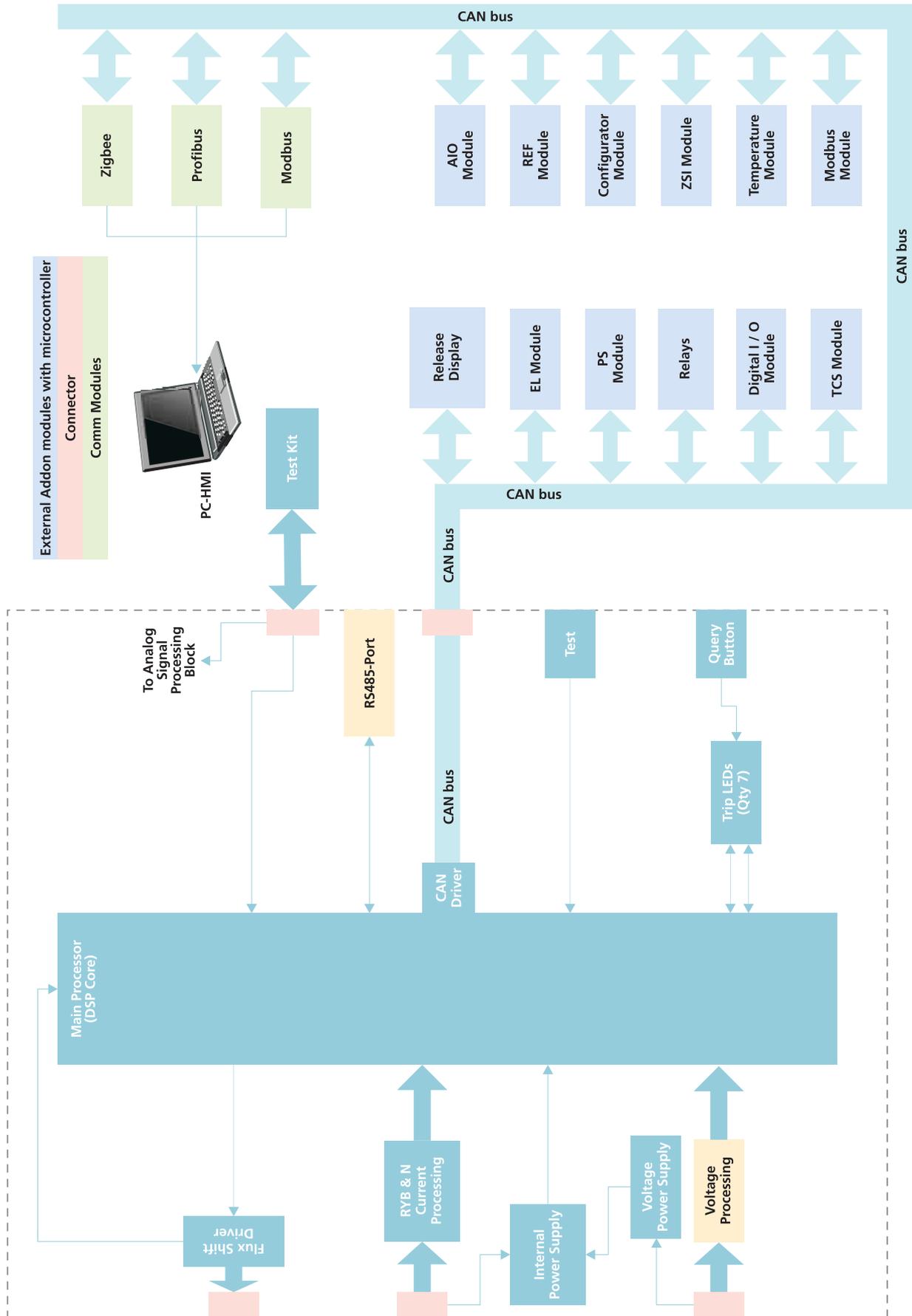
### Peak Factor (PF):

**The Peak Factor of a power source is defined as:**  $I_{\text{peak}} / I_{\text{avg}}$

All the above power quality indicators are inbuilt in MTX 4.5

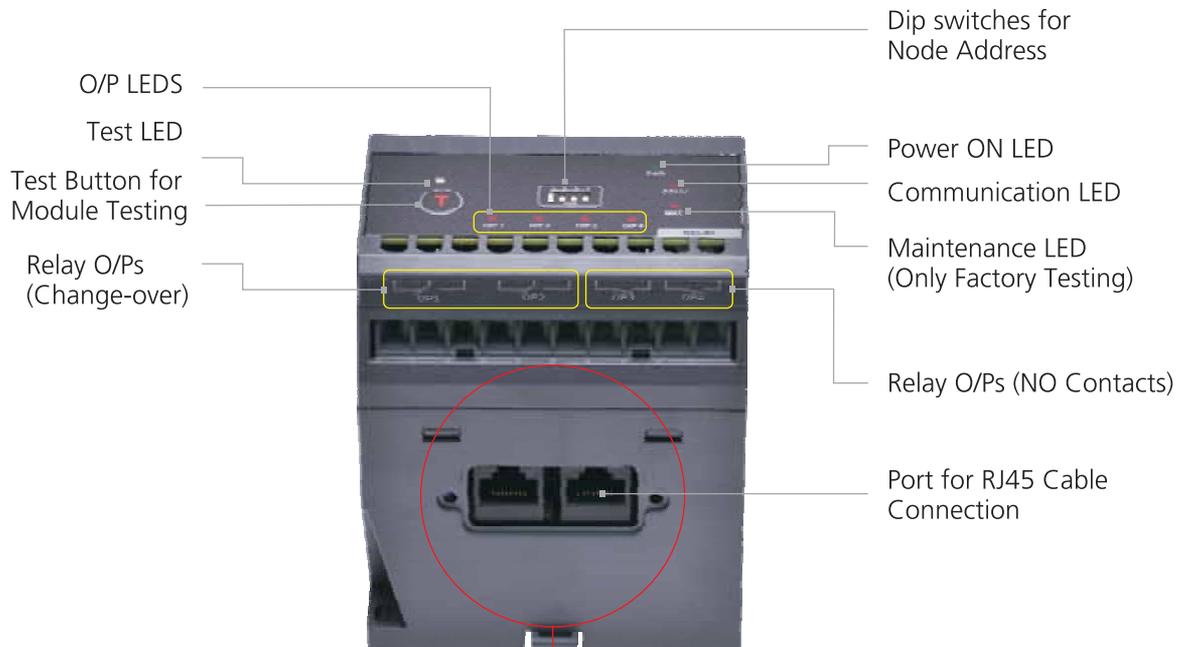
## MATRIX Release System Architecture with Supplementary Modules





## Matrix Protection releases supplementary Modules

UW-MTX 3.5/4.5 releases are backed up by different supplementary modules to enhance the functionality of the Protection & Control Unit to provide customer more advance and complete system protection.



Matrix Modules can be looped with another module using RJ45 modular connectors ensuring reliable and error-free communication, supporting unique CAN bus protocol.

## RELAY MODULE

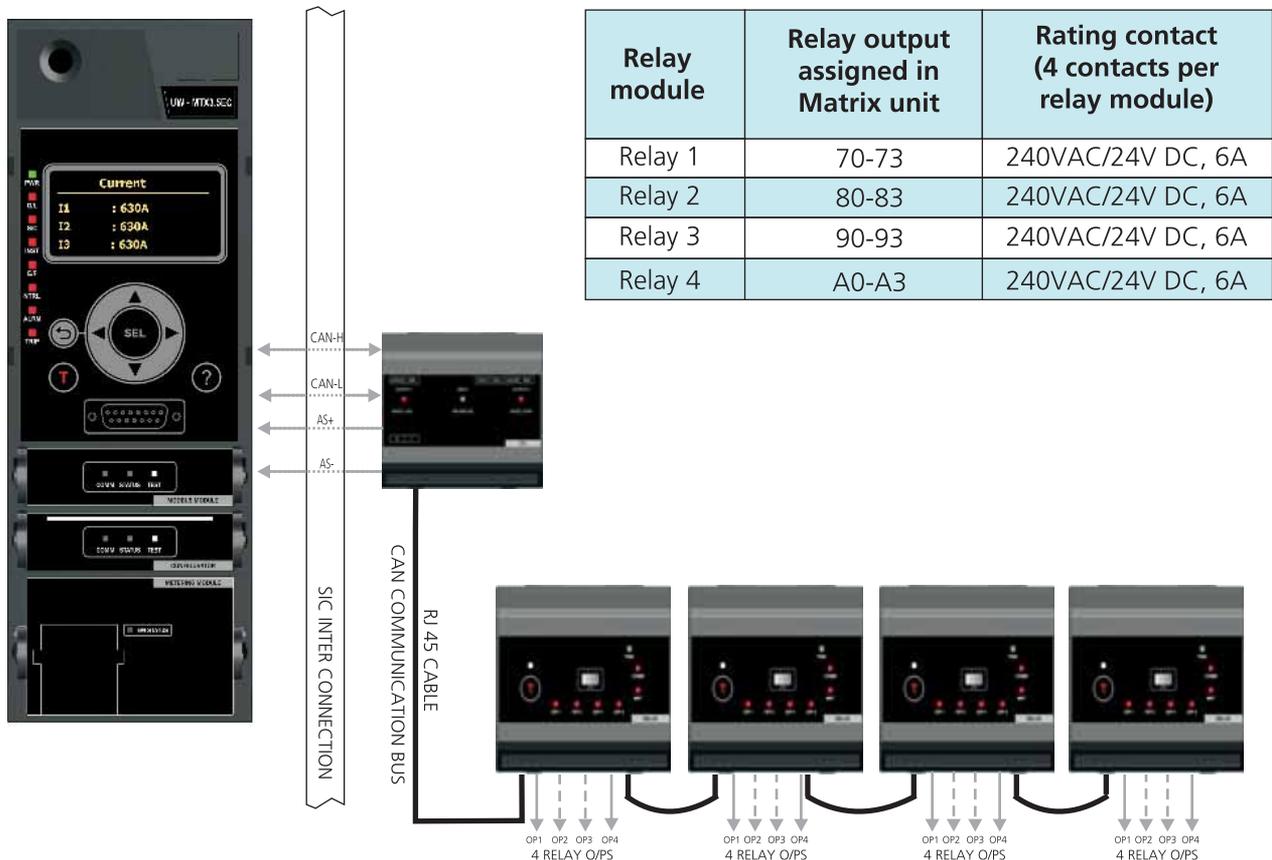
Relay module helps in remote annunciation, interlocking and load management of the system. Relay module consists of four configurable O/Ps (2NO & 2 Changeover) which can be programmed through the release on any of the following protection:

- |                     |                        |
|---------------------|------------------------|
| i. Overload         | vii. Phase sequence    |
| ii. Short circuit   | viii. Under voltage    |
| iii. Instantaneous  | ix. Over voltage       |
| iv. Earth fault     | x. Under frequency     |
| v. Neutral overload | xi. MD (Active)        |
| vi. Reverse power   | xii. Breaker operation |

Each of the above protection can be programmed for "Trip" mode or "Alarm" mode (Breaker operation can be programmed for breaker ON or breaker OFF mode).

Relay module can also be used for switching off the non-critical loads during the Overload condition so as to prevent the complete shutdown of the system.

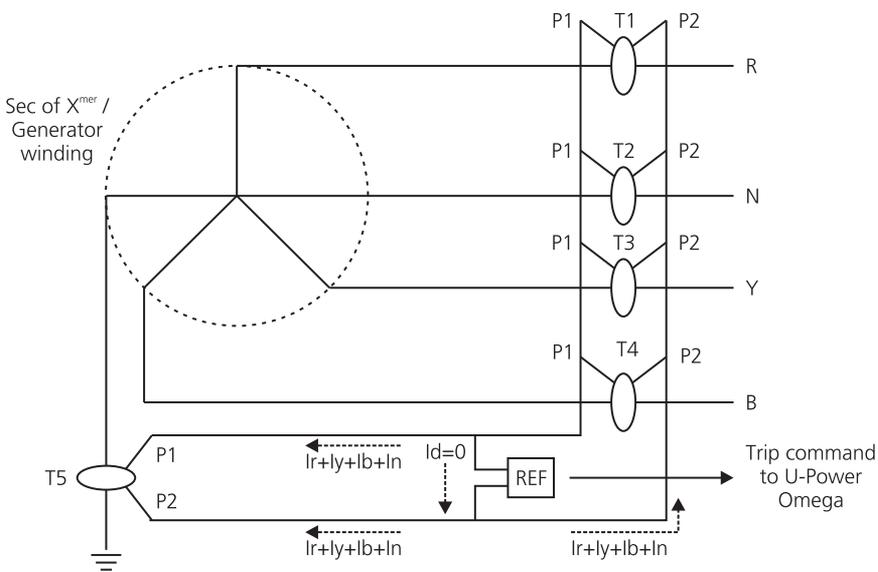
Four relay modules can be looped together to one release at a time. Each relay module node address can be set using the dip switches on the module.



## RESTRICTED EARTH FAULT (REF) MODULE

REF protection is usually applied for star winding of Transformer & Generator. Special protection class CTs i.e. Class PS CTs are to be used for achieving the protection. Protection works on differential principle.

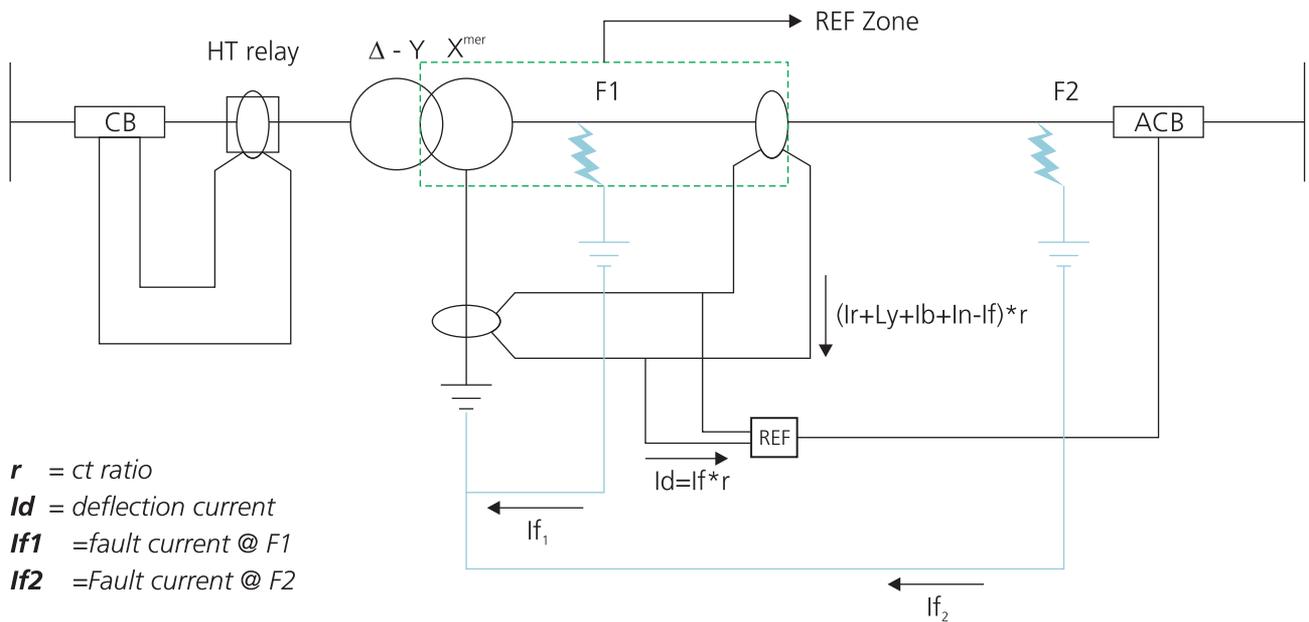
REF protection is used to detect and to trip the breaker in the selected zone only i.e. secondary winding of the transformer/generator.



If transformer star node is further used as a neutral in the system, the 5th CT should be used to avoid the nuisance tripping during the unbalance condition.

*During the unbalanced load condition the unbalanced current will flow back through neutral. As the direction of the neutral current is in opposite direction as that of phases, the REF relay will not give nuisance tripping on current unbalance.*

*In absence of the 5th CT, the breaker will not be able to sense the unbalance condition flowing through the neutral and relay may give trip command.*



### Case 1. EF inside the restricted zone (F1)

During EF within the zone, current flows back to Xmer star point through neutral sensing CT. The REF module will give trip command to the breaker depending on pickup value.

### Case 2. EF outside the restricted zone (F2)

For EF outside the zone, fault current flows through phase CT & neutral CT in opposite direction preventing the nuisance tripping from REF.

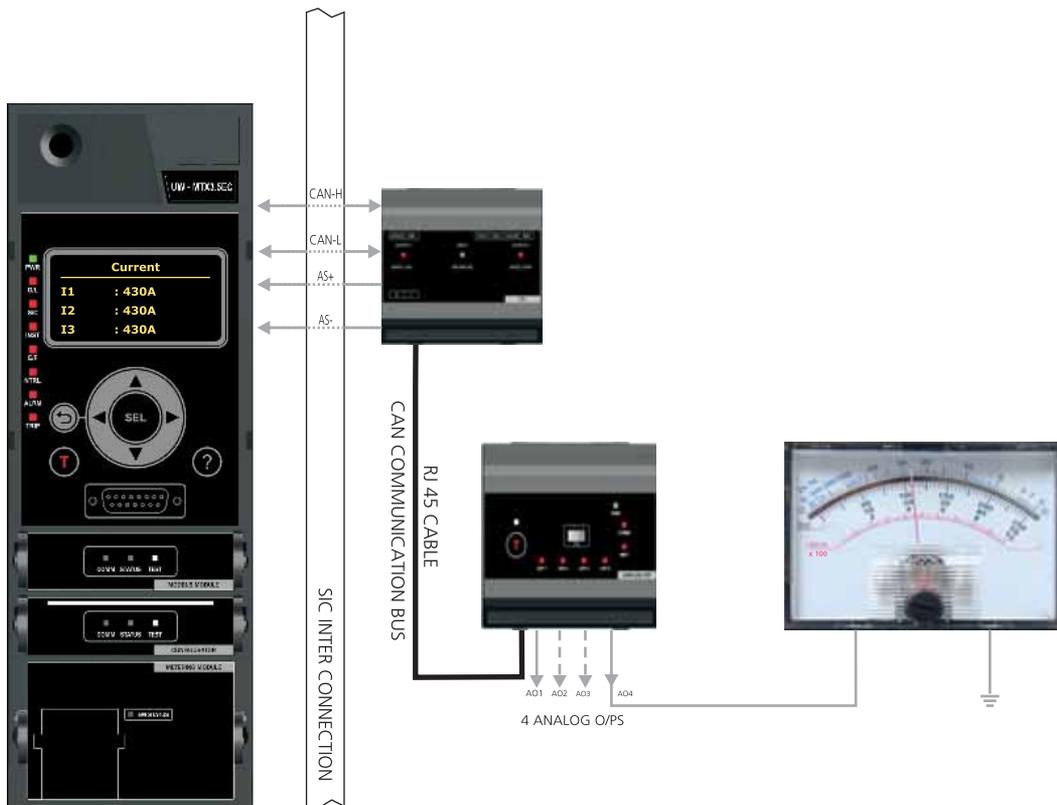
## ANALOG OUTPUT (AO) MODULE

Analog module can be seen as metering option to other panel display meters.

Four different outputs can be configured for voltage metering or current metering with analog signal output in range of 4-20mA to which analog ammeter and voltmeter can be connected.

4mA corresponds to zero current and voltage while 20mA corresponds to 1.5 times the set I-frame value of current or 1.5 times set Vn value in Matrix release.

AO module communicates on CAN bus protocol with the Matrix Protection and control Unit.



## TEMPERATURE (TM) MODULE

Overheating of the Bus-bar can reduce the life of the insulation sleeves, Bus-bar / cables & even Breakers. Periodic loading conditions can cause the metal to heat and cool continuously resulting in the deterioration of the Bus-bar material and loosening of the joints. This becomes even more critical in case if Bus-bars consist of metals of different heat coefficient.

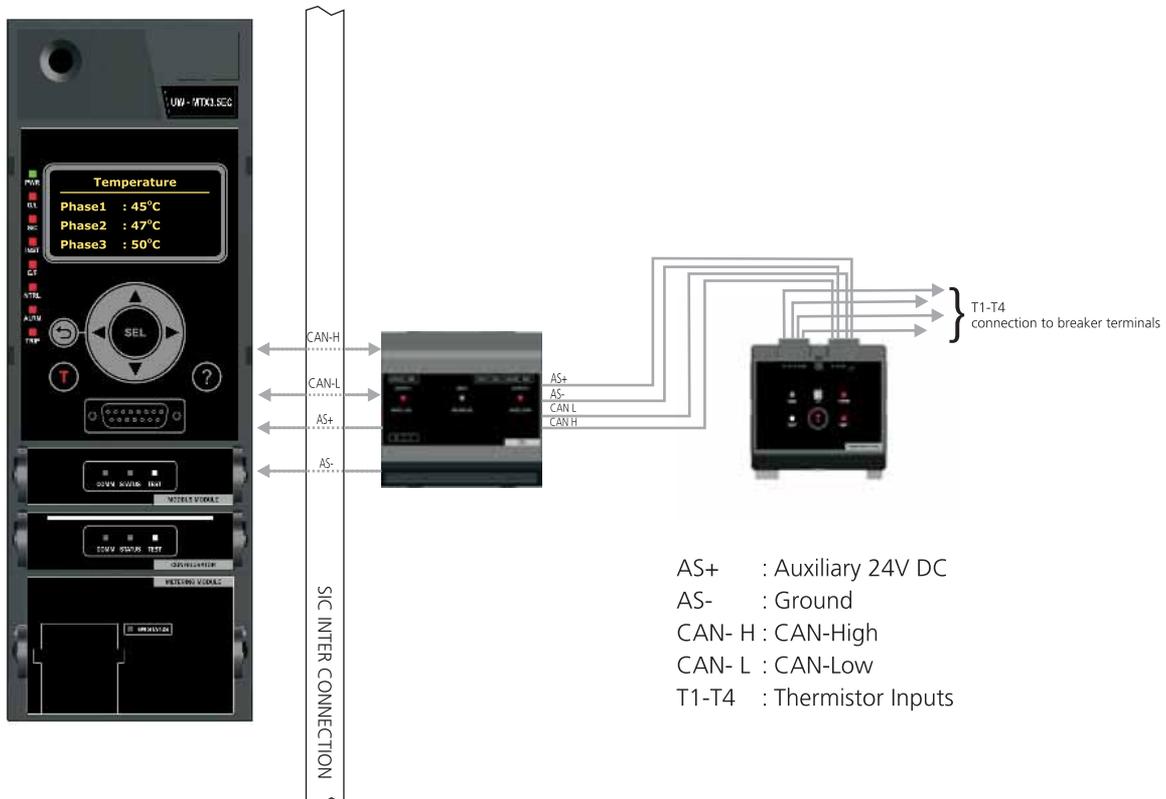
### Causes of overheating:

Any of the following reasons can lead to heat generation at the breaker terminal

- Improper termination
- Improper Bus-bar design
- Loosen Joints
- De-rating not considered while selection of breaker
- Eddy currents

Temperature Module senses the real time temperature at the breaker terminals and displays on the Matrix release screen. TM module can be used to give alarm on the release or to trip the breaker with the temperature pickup range from 85°C to 115°C, which can be configured through Matrix release.

The module is to be mounted inside the breaker, hence is a factory fitted option.



## ZSI (Zone Selective Interlocking)

Using the zone Selective Interlocking feature of the Matrix releases, intelligence can be imparted into the electrical system for the quick trip and isolation of the fault element of the system.

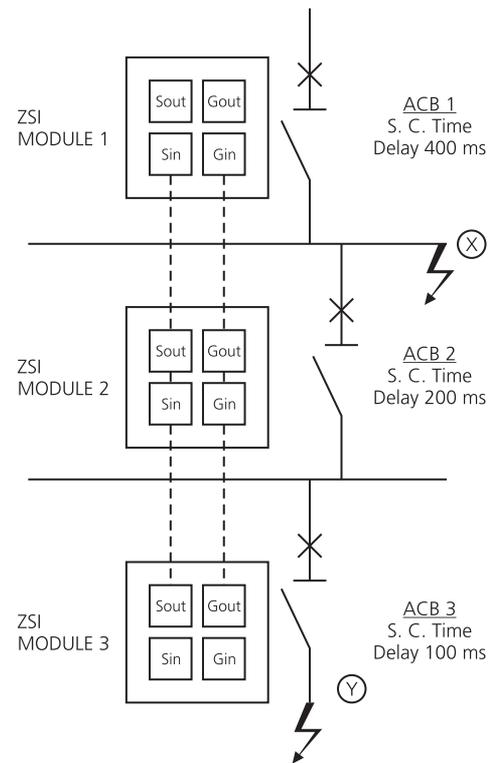
For ZSI feature, P&C units are hardwired as shown and they communicate with each other through restraining signals. In ZSI active mode, time delays in short circuit and earth fault are set progressively higher towards the main incomer ACB.

In the given diagram, ACB 1 has the highest delay of 400ms for short circuit. ACB 2 and ACB 3 are having delays 200ms, 100ms respectively. For fault at Y, ACB3 will send restraining signal to ACBs 1 & 2 and hence pre-set delays are honored. ACB 3 will trip in 100ms and the fault will be cleared.

ACB 2, ACB 3 will remain closed, for faults at immediate locations like X, there will be no restraining signal from feeder breakers ACB 2, ACB 3 and hence ACB 1 will trip in 60ms instead of pre-set 400ms delay.

### ZSI module comprises:

- Discrimination for short-circuit & EF protection
- CAN Bus protocol for communication
- Support 20 downstream & 3 upstream U-Power Omega
- Provision for self-diagnosticsTest



ZSI Cable Specification	
<b>Description</b>	PVC sheathed shielded twisted pair wire
<b>Size</b>	7/0.2 tinned copper
<b>Shield</b>	Braided tinned copper ID: 4.6 max
<b>Impedance</b>	Approx. 76 Ohm/km at 200 MHZ
<b>No. of Twists</b>	Approx. 11 twists / ft.

## EARTH LEAKAGE (EL) MODULE

In industrial installations, the current leakage can happen to earth because of the following main reasons:

- i) Current leakage through phase to earth insulations
- ii) Leakage of current through phase to earth leakage capacitance

Due to the high insulation resistance the leakage current magnitude remains low in terms of milliamps or micro amps. Assuming that the phase-to-earth insulation resistance in an LV network is just 1 Mega-ohm(\*), then the leakage current to earth will be  $(240V/1 \text{ Mega-ohm})$  240 microamperes. But, generally the phase-to-earth insulation resistance would be much higher than just 1Mega-ohm, normally a few tens or even hundreds of Mega-ohms. Thus, the leakage current to earth will be a further fraction of the micro-ampere or even nano-amperes. As human body's sensible current is more than 1 milli-ampere, this remains un-sensed by a human being coming in contact with the earthed frame of an LV electrical installation.

Any leakage current above 300mA can result into fire in electric installations. In Industrial areas especially in mining application the earth leakage protection becomes critical for the fire safety.

U-Power Omega Matrix Earth Leakage module has Earth leakage current monitoring range of 300mA to 30A. The EL module communicates on CAN bus with the Matrix releases which can be set in Alarm, Trip or "Both" mode.

### Some more features on EL module:

- "NO" contact for external indications (24V DC/240V AC, 6A)
- Standalone module
- Dip switches for configuring pickup and delay settings
- Self-diagnostic check for module healthiness check



*\*As per Indian Electricity rule, 1956, Rule No. 48(ii) For Medium & Low Voltage Installations, Voltage at a pressure of 500 V applied between each live conductor and earth for a period of one minute, the insulation resistance of medium and low voltage installations shall be at least 1 Mega ohm.*



## DIGITAL INPUT OUTPUT (DIO) MODULE

Matrix DIO module is provided with 4 digital inputs and 4 digital outputs for the implementation of various Boolean logic equations into the system.

Some features of DIO module

- Up to 4 DIO modules can be looped together to one MATRIX release
- Dip switches on the Module facia for setting the node address
- 16 different logic equations can be assigned
- Self-diagnostic test provision

Contact Ratings	
<b>Input contacts</b>	24V DC or 240V AC
<b>Output Contacts</b>	24V DC or 240V AC, 6A (resistive load)

## TRIP CIRCUIT SUPERVISION (TCS) MODULE

TCS module of Matrix Releases continuously monitors the healthiness of the shunt trip coil irrespective of the breaker operational position. Protection can be set in both, trip or alarm mode in the release unit.

- Detects circuit breakage, contact degeneration in connections, resistance increase in wires, contacts and coils of the supervised shunt release
- Complete range of rated voltage (24-415V) either AC or DC
- Standalone module
- Self-diagnostic test provision



## POWER SUPPLY (PS) MODULE

PS module is used to power ON other supplementary modules of OMEGA Matrix release family as well as to communicate on the CAN bus through RJ45 shielded cable.

Specifications	AC	DC
<b>Input</b>	85-265V	125-300V
<b>Output 1</b>	-	650mA @ 24V DC
<b>Output 2*</b>	-	200mA @ 24V DC

**Note:** For VA burden details of modules & optimal usage of PS modules refer U-Power Matrix User's manual

\* For using Output 2, Output 1 should be loaded

## Modbus:

Modbus Module is used for the Configuration, Monitoring and Control of Matrix releases and its supplementary modules.

It offers Client/Server communication in RTU mode.

## Configuration function:

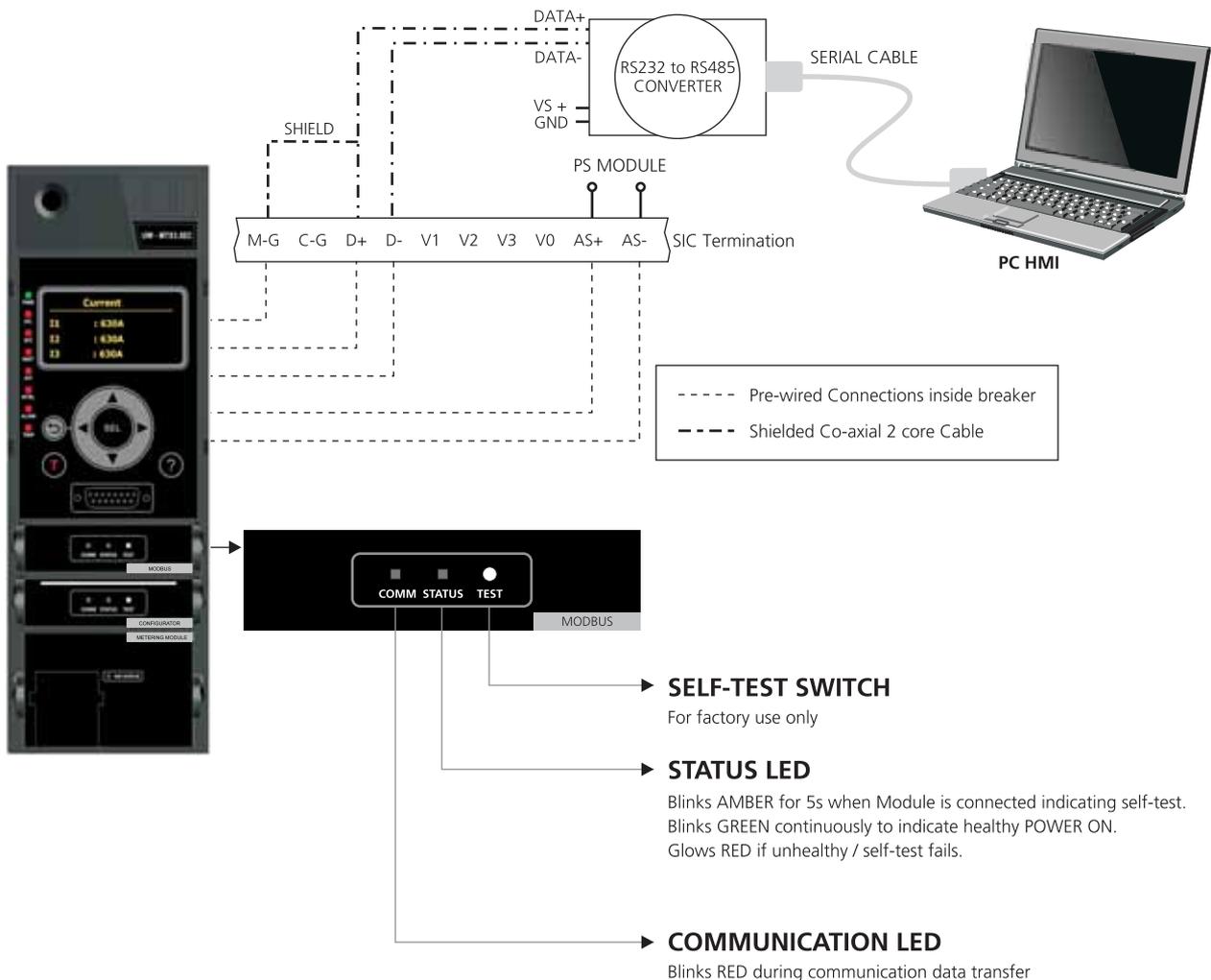
- 1) Unit Settings
- 2) System Settings
- 3) Protection Settings Group 1
- 4) Protection Settings Group 2
- 5) Module Settings

## Monitoring function:

- 1) Metering Data – Voltage, Current, Power, Energy, Power Factor, Online Module Status
- 2) Status Data – Alarm & Trip Status, Digital Input Output Module & Relay Module Status
- 3) Record Data – Trip Records, Event Records, Maintenance Records

## Control function:

- 1) Commands for Set group Change, Restore Factory Defaults, Clear Maximum Demand
- 2) Maximum Current value, Maximum Voltage Value and Energy, Open and Close Circuit
- 3) Breaker, Maintenance Acknowledgement and Earth Fault (EF) test



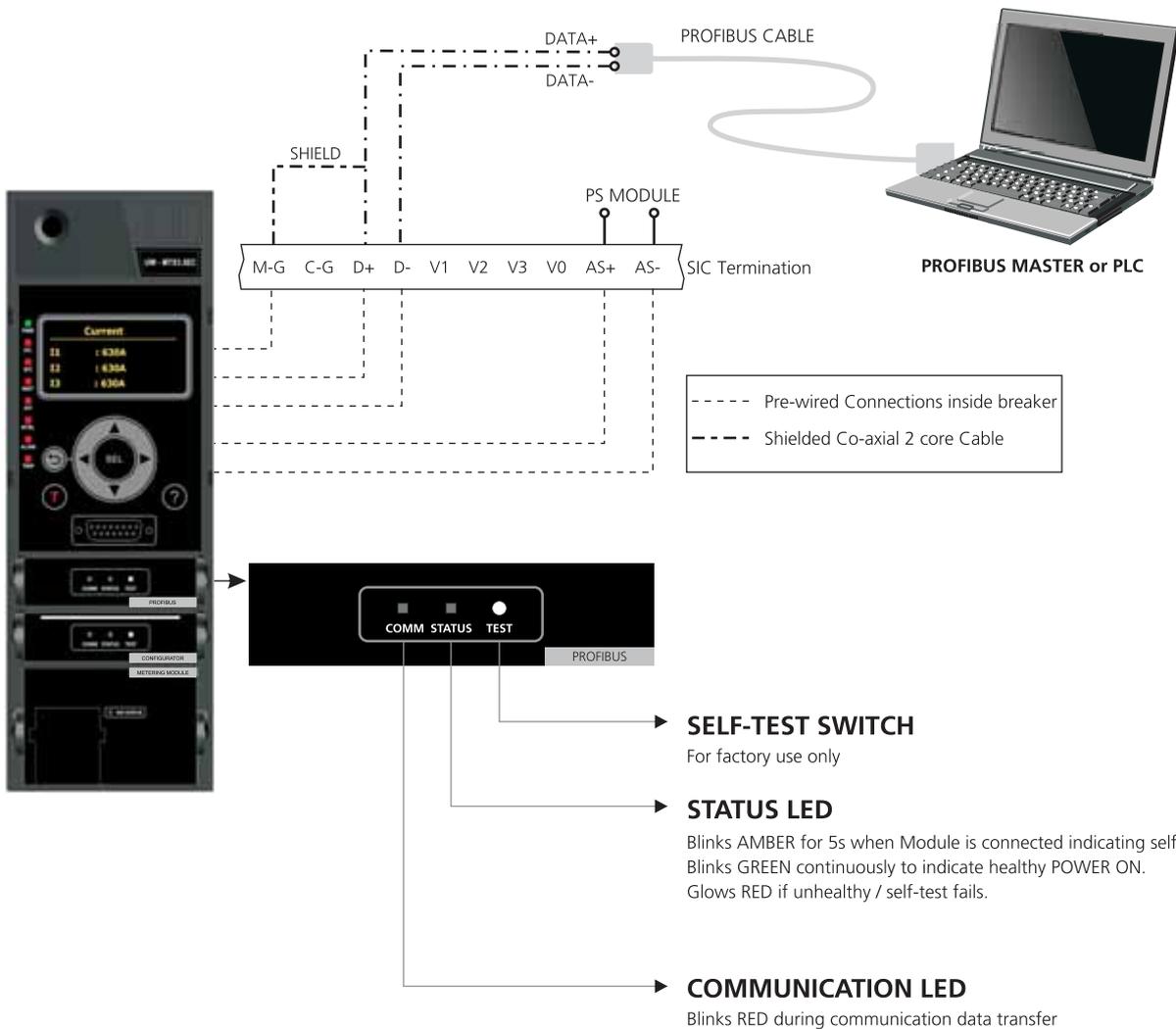
## Profibus:

Profibus Module supports PROFIBUS DP V0 slave protocol. This module communicates with PROFIBUS Class 1 and/or Class 2 Master.

GSD file should be used/loaded in PROFIBUS master for understanding the device functions. Network termination switch is provided at the rear end of the module. Thus this module can be used as end node in the network.

It communicates on baud-rates 9.6Kbps, 19.2Kbps, 45.45Kbps, 93.75Kbps, 187.5Kbps, 500Kbps, 1.5Mbps, 3Mbps, 6Mbps, 12Mbps. It automatically detects the baud-rate selected by PROFIBUS master for communication.

PROFIBUS module is used to monitor critical status parameters of Matrix Release like Pick-up, Alarm and Trip status.



## Zigbee:

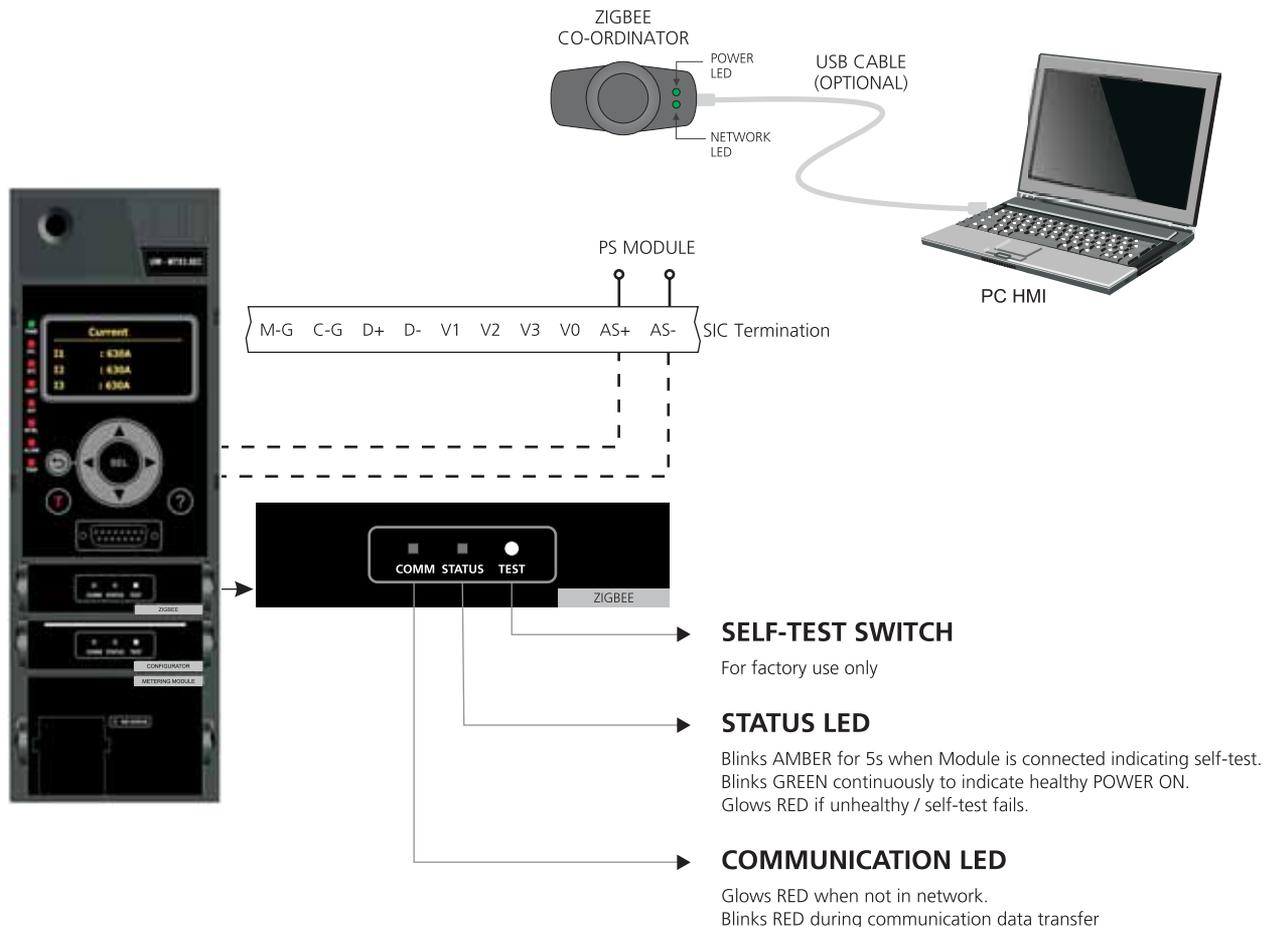
Our innovative Matrix releases are designed to let consultants & system designers help their customers & end-users gain greater control of, and improve their everyday business & industrial processes by means of "ZigBee wireless communication" capability.

UW-MTX3.5/3.5EC/4.5 provides Wireless Communication using ZigBee protocol formulated under IEEE 802.15.4 standard for Wireless Personal Area Network (WPANs). Zigbee operates in ISM radio bands of 2.4GHz.

The Communication range is 200m Line Of Sight (LOS) with over the air data rates upto 250 Kbps. Zigbee module is used for Monitoring parameters of Matrix releases and its supplementary modules.

## Monitoring function:

- 1) Metering Data – Voltage, Current, Power, Energy, Power Factor, Online Module Status
- 2) Status Data – Alarm & Trip Status, Digital Input Output Module & Relay Module Status
- 3) Record Data – Trip Records, Event Records, Maintenance Records



## Note:

- 1) It is necessary to first switch on the Co-ordinator module and form a network. Co-ordinator Module can be directly plugged in the PC USB port or USB cable can be used.
- 2) Power LED on Co-ordinator Module will glow GREEN when connected to the port. Network LED on Co-ordinator module will glow GREEN when it forms a network.
- 3) Zigbee Module should be now inserted in the Matrix P&C unit .

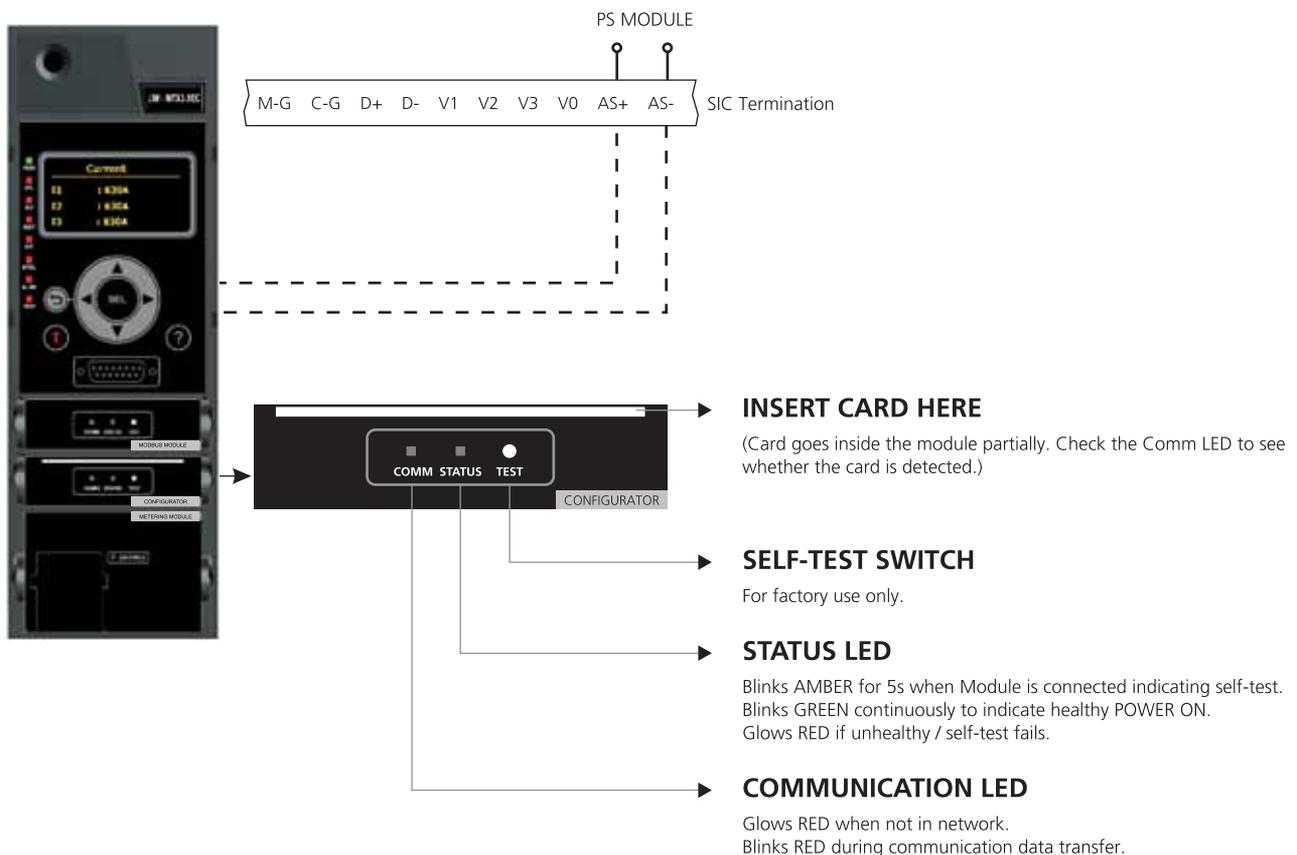
## Smart Configurator:

UW-MTX3.5/3.5EC/4.5 has an optional Smart Configurator Module which is used for easy parameterisation of the release. In large electrical installations, where many ACBs are in use; one can copy the release protection parameters setting on smart card and then copy the parameters on various releases. Smart Configurator Module in MTX releases with its ease of use can reduce the gestation period of electrical installation.

Smart Configurator works on the principle of RF interface at 106kbps between the module and the Smart Card.

The following operations can be performed on the Smart Card:

- 1) Write File: Copy files from the release to the card
- 2) Read File: Copy files from the card to the release
- 3) Delete File: Delete selected file from the card
- 4) Format Card: Delete all the files from the card and format it



## Trip Oscillograph

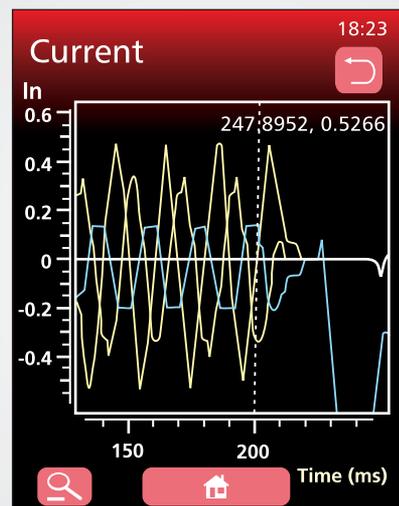
MTX 4.5 gives user the unique advantage of analyzing the post fault waveforms of the system. After the fault, the system waveform gets captured in the release with the trip timing and the waveform deformation of voltage and current of the individual phases. The data remain stored in the memory of the release so as to empower the user to check the speed and the correctness of the protection system, as well for further power system analysis.

Some of the unique points of the MTX4.5 Trip Oscillograph are:

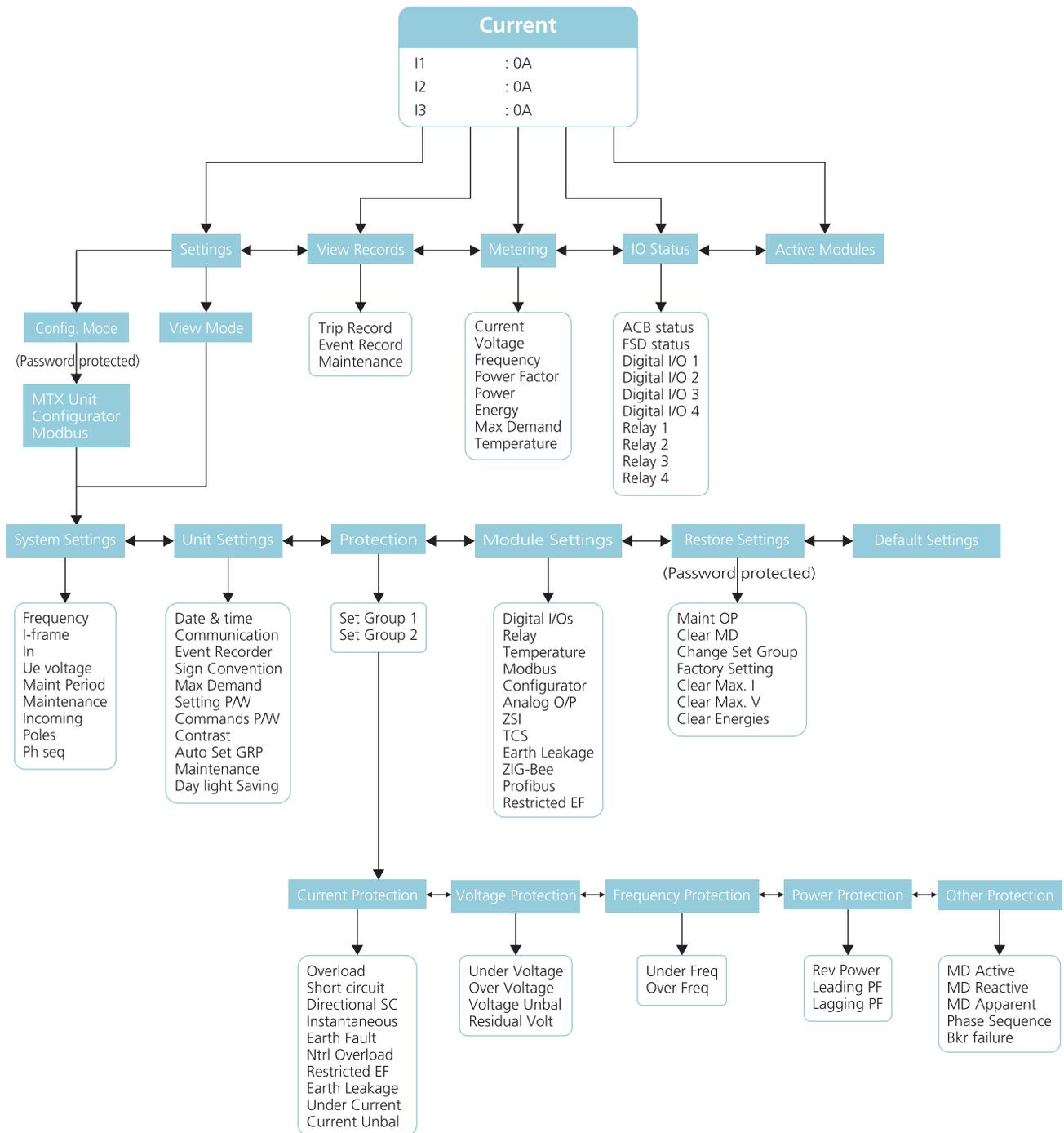
- 300ms record with 10 cycles before and 5 cycles after the trip/pickup of fault
- 15 cycle record useful to monitor and analyze the current and voltage disturbances
- 4x zoom



MTX4.5

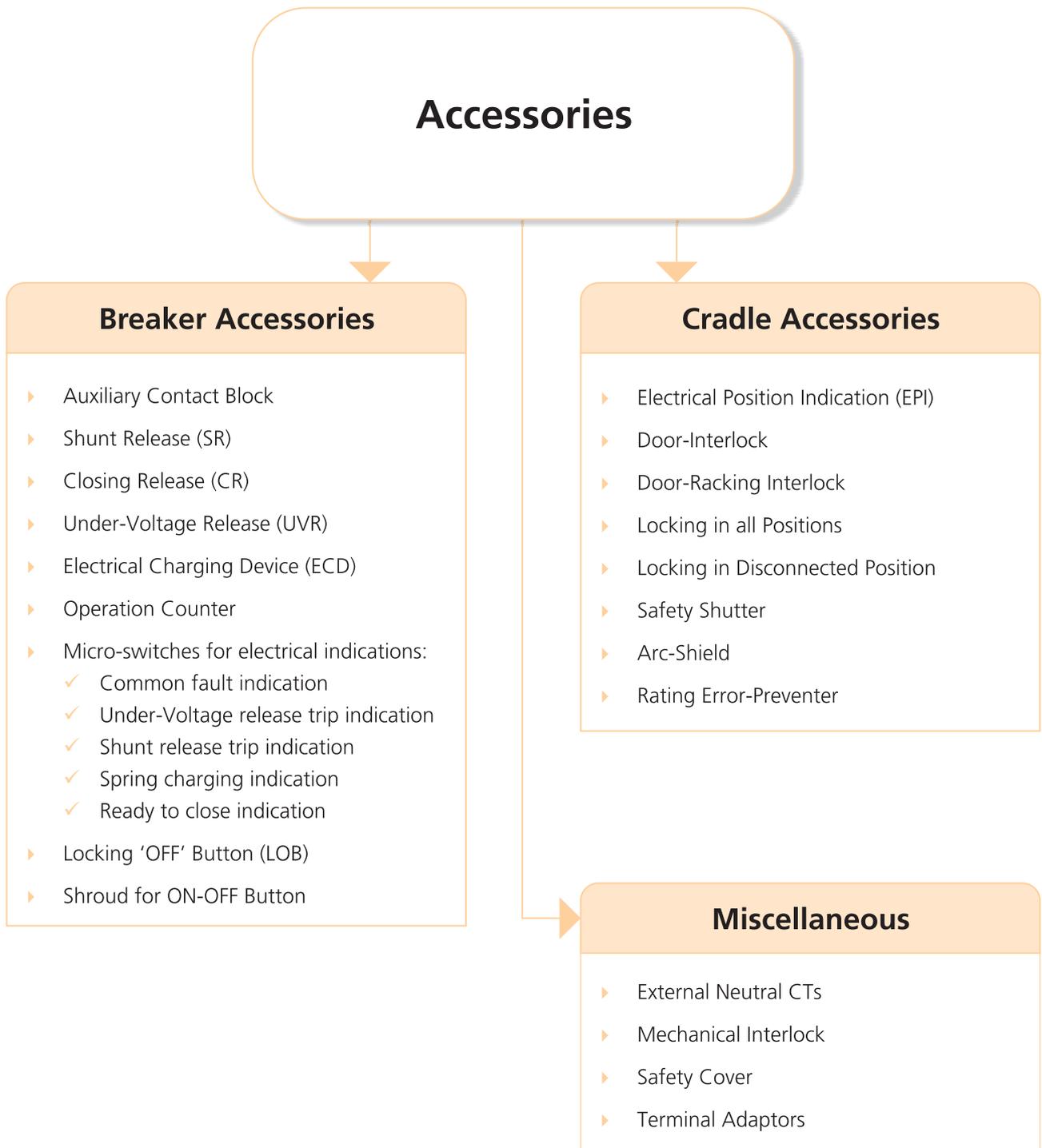


## Menu Navigation Overview for UW-MTX2.5/2.5G/3.5/3.5EC



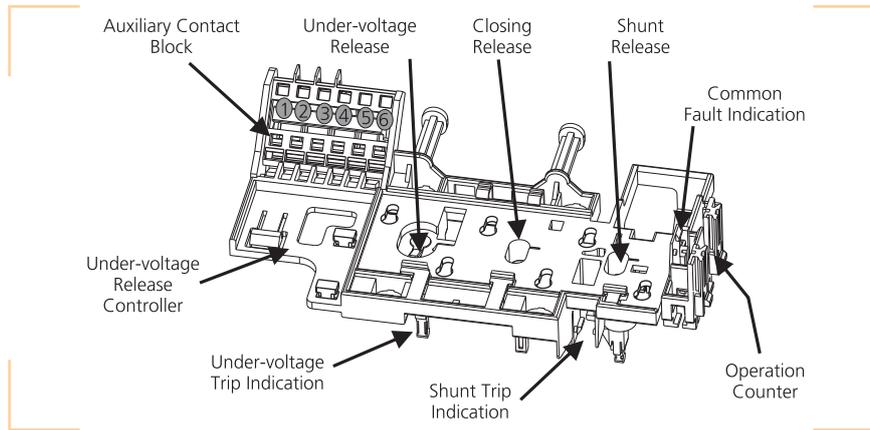
**Breaker  
Accessories**

**Cradle  
Accessories**



### Breaker Accessories:

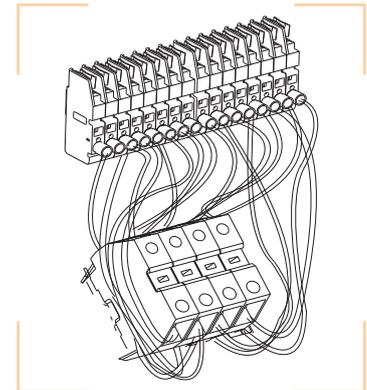
Modularity, the key design aspect of OMEGA ACBs facilitates the quick fixing & removal of several breaker mounted accessories such as CR, SR, UVR, Auxiliary contact blocks & various indicating micro-switches. These accessories are located on the front top-side of breaker mechanism & have specified positions.



**1) Auxiliary Contact Block:** Auxiliary Contact Block contains the change-over switch contacts in combination of 4 units of 1NO+1NC each. Auxiliary contact block reflects the breaker ON/OFF state in control circuit.

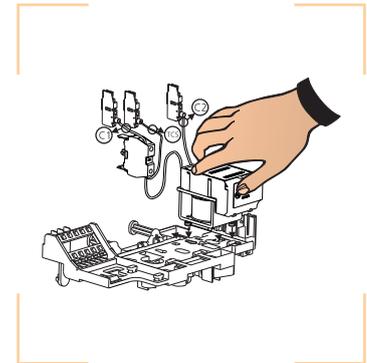
Operational voltage (Ue)	upto 24V	110V	220/230V	400V
In (AC-12) at 50/60 Hz	10A	10A	10A	10A
In (AC-15) at 50/60 Hz	6A	6A	6A	4A

Operational voltage (Ue)	24V	40V	110V	220V
In (DC-12)	10A	8A	3.5A	1A
In (DC-13)	10A	4A	1.2A	0.4A



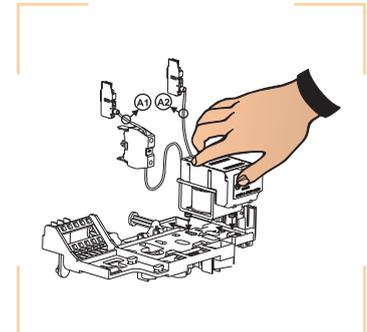
**2) Shunt Release (SR):** Shunt Release when energized opens the breaker instantaneously. Omega ACBs offer two versions of Shunt Releases; a general purpose Shunt Release & a unique wide operating band Shunt Release (SRW), which can reliably trip the Circuit Breaker if operation voltage drops to a substantially low value.

Operational voltage (Ue)	Power consumption	Operating range
110, 240, 415V AC at 50/60Hz	200VA for 0.5 sec	70-110% of Ue
24, 30, 48, 60, 110, 125, 220, 250V DC	200VA for 0.5 sec	70-110% of Ue
240V AC , 415V AC (for SRW)	2300VA for 0.2 sec	10-130% of Ue



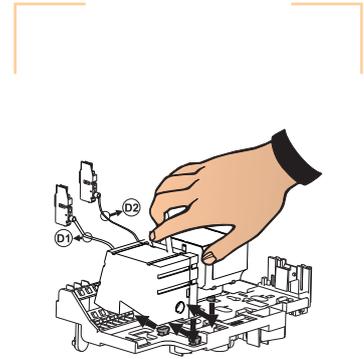
**3) Closing Release (CR):** Closing Release remotely closes the Circuit Breaker if the spring mechanism is already charged. Closing Releases in Omega Air-circuit breakers come with inbuilt Electrical anti-pumping feature. Inbuilt electrical anti-pumping feature prevents auto-reclosing of Circuit Breaker on faults. Anti-pumping relay cancels the persistent closing signal after successful completion of the closing operation.

Operational voltage (Ue)	Power consumption	Operating range
110, 240, 415V AC at 50/60Hz	200VA for 0.5 sec	85-110% of Ue
24, 30, 48, 60, 110, 125, 220, 250V DC	200VA for 0.5 sec	85-110% of Ue



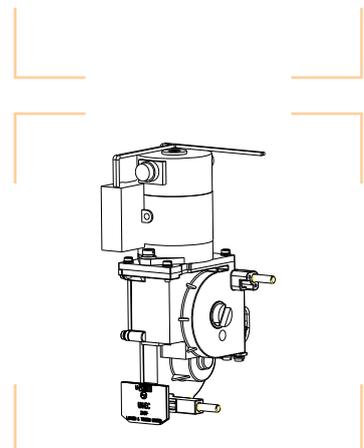
**4) Under-voltage Release + Delay Module (UVR):** The Under-voltage Release causes the Circuit Breaker to open if the operational voltage falls to a value between 35% and 70% of its rated voltage or not applied. UV Release mechanically locks the closing of breaker & it makes it impossible to close the Circuit breaker, either manually or electrically. The Circuit breaker can be closed with operation voltage of 85-110% of its rated value.

UV Release can be used for monitoring the voltage in the primary (power circuit) or secondary (control circuits) circuits or can be used for electrical interlocking scheme (for DG synchronization, paralleling of transformers etc). In order to avoid the nuisance tripping of the circuit breaker during short voltage dips, UV release comes with the UV-delay module. Operation of UVR can be delayed between 0 to 5 secs. in steps of 0-1-3-5 sec.



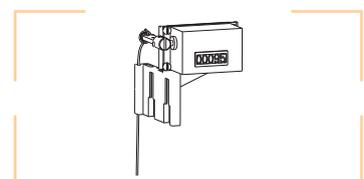
Operational voltage (Ue)	Power consumption	Operating range
240 & 415V AC at 50/60Hz	200VA for 3.0 sec	85-110% of Ue
24V DC	200VA for 3.0 sec	85-110% of Ue

**5) Electrical Charging Device (ECD):** Electrical Charging Device automatically charges the closing springs of the circuit breaker operating mechanism. After Circuit Breaker closing operation, the geared motor immediately recharges the closing spring. Thus instantaneous re-closing of the circuit breaker is possible following opening operation. The closing springs can also be charged manually (using the spring-mechanism charging handle) in the event of an auxiliary power supply failure or during maintenance work.



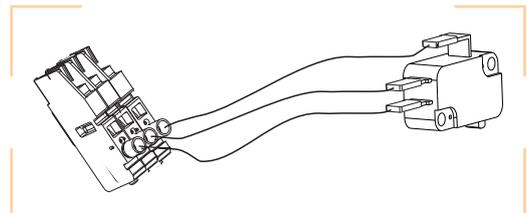
Operational voltage (Ue)	Power consumption	Operating range
110, 240, 415V AC at 50/60Hz	300VA for 1 sec	85-110% of Ue
24, 30, 110, 220, 250V DC	300VA for 1 sec	85-110% of Ue

**6) Operation Counter:** The Operation Counter indicates the number of operating cycles the Circuit breaker has been subjected to and it is visible on the Circuit breaker front-facia. It is compatible with manual and electrical control functions. Counter readings serve as a guide for maintenance & inspection.

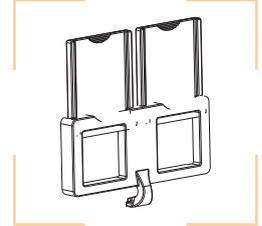


**7) Micro-switches for electrical indications:**

- a. Common Fault Indication (CFI):** CFI provides the electrical indication of circuit breaker tripping due to operation of protection & control unit.
- b. Under-Voltage Release Trip Indication:** Under-voltage Release Trip Indication micro-switch provides electrical indication of circuit breaker tripping with the operation of under-voltage release.
- c. Shunt Release Trip Indication:** Shunt Release Trip Indication micro-switch provides electrical indication of circuit breaker tripping with operation of shunt release.
- d. Spring Charging Indication:** Spring Charging Indication micro-switch provides the electrical indication whether main mechanism spring is charged or not.
- e. Ready-To-Close Indication (RTC):** RTC takes into account all the safety parameters that are part of the control & monitoring system of electrical installation. OMEGA RTC allows the circuit breaker to close only if following conditions are met:
  - ✓ Main spring is charged
  - ✓ Circuit Breaker is OFF
  - ✓ Shunt release is de-energized
  - ✓ Under-Voltage release is energized
  - ✓ All Arc-chutes are properly placed
  - ✓ Mechanical trip indication lever on release is reset
  - ✓ Racking shutter is closed

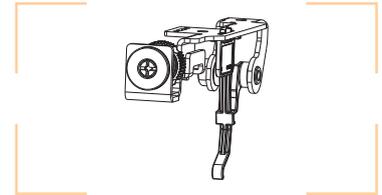
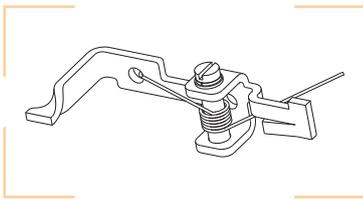


- 8) Locking 'OFF' Button (LOB):** LOB locks the breaker in OFF position by continuously pressing the OFF push button. Lock defeats all the positive closing signals (mechanical or electrical) coming to the breaker and thus prevents the nuisance closing of the breaker. Locking 'OFF' button (LOB) can be implemented using Castell/Ronis/Kirk/Profalux type of locks. The locks are designed in such a way that the keys cannot be removed until the breaker is locked (OFF button pressed). Locking of the breaker in OFF position ensures safety of the maintenance person working on downstream equipment. Locking 'OFF' button (LOB) can be used to design the interlocking schemes with other devices in the system.
- 9) Shroud for ON-OFF Button:** Transparent shroud blocks the access to the ON/OFF push-buttons used to open and close the breaker. It prevents inadvertent or unauthorized operation of the ON or OFF button. It's possible to independently lock the ON/OFF push button with the help of ON-OFF button shroud & mechanical lock. It can be pad-locked with lock hasp of 6mm diameter.



### Cradle Accessories:

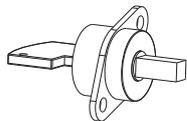
- 1) Electrical Position Indication (EPI):** Secondary Isolating Contact (SIC) blocks on ACB cradle assembly facilitates the electrical indication for the exact position of the breaker within the cradle. 3 SIC contacts electrically indicate the Connected / Test / Disconnected positions of breaker.
- 2) Door-interlock:** Door-interlock inhibits the opening of door if ACB is in Test or Service position. Door-interlock can be mounted on either side of the cradle (LHS or RHS).



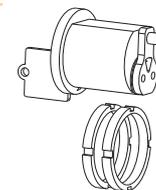
- 3) Door-racking interlock:** Door-racking interlock prevents the racking-in operation of the breaker if panel door is open.

- 4) Racking Shutter Pad-lock:** Racking Shutter Pad-lock inhibits the access to the racking mechanism such that racking handle cannot be inserted to rack-in/rack-out the breaker. Racking Shutter Pad-lock is an inbuilt feature with U-POWER Omega ACBs. It can be pad-locked with lock hasp of 6mm diameter.
- 5)** Any of Castell/Ronis/Kirk/Profalux locks can be used for locking the ACB in "Any position" / "Isolated position" & locking "OFF" push button, for interlocking with other electrical devices in the control scheme of the system.

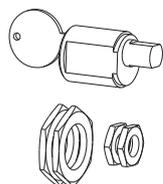
Castell



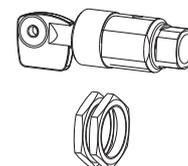
Kirk



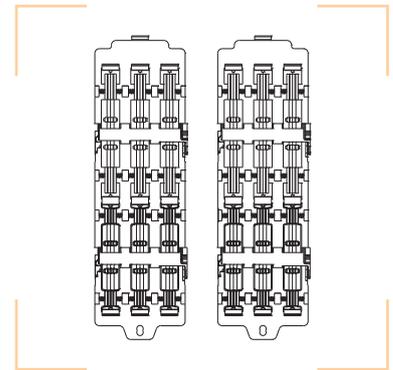
Ronis



Profalux



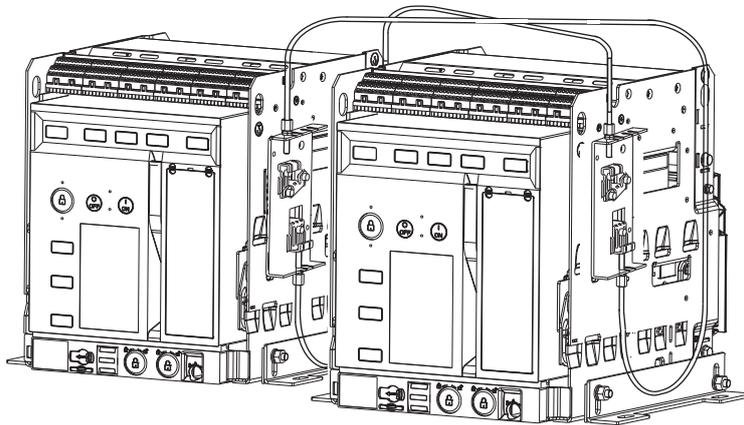
- 6) **Locking in Disconnected position:** Locking in Isolated/Disconnected position inhibits the undesirable racking-in operation of the breaker from the isolated position. Locking in isolated position can be implemented using Castell/Ronis/Kirk/Profalux type of locks. Locking of the breaker in disconnected position ensures safety of the maintenance person working on downstream equipment. The locks are designed in such a way that the keys cannot be removed out till the breaker is locked, at the same time the breaker cannot be locked in "Service/Connected" or "Test" positions. Locking in Disconnected position can be used to design the interlocking schemes with other devices in the system.
- 7) **Locking in all positions:** Locking in all positions facilitates the locking of breaker in Connected/Test or isolated positions. Locking in all positions can be implemented using Castell/Ronis/Kirk/Profalux type of locks.
- 8) **Safety Shutter:** The fixed part (cradle) of withdrawable Circuit Breaker contains safety shutters for preventing inadvertent access to live terminals of Circuit Breaker when breaker is withdrawn from the cradle. Safety shutters can be locked in closed position using pad-lock devices.
- 9) **Arc-shield:** Arc-shield helps in reducing the vertical clearance between two ACBs in vertical tier panels from 300mm to mere 45mm. Arc-shield facilitates in compact design of switchboards & it comes as an inbuilt feature with Omega ACBs.
- 10) **Rating Error-Preventer:** Rating Error-Preventer ensures that the breaker of proper rating goes with the cradle of corresponding rating. It is made up of two sub-assemblies one on the cradle and other one on the breaker. Rating Error-Preventer offers distinct combination for a particular breaking capacity version within a particular rating of the breaker. Rating Error-Preventer comes as an inbuilt feature with Omega ACBs.
- 11) **Cover:** Using Cover, panel door can be covered during maintenance at site to prevent the entry of dust or foreign material in the panel enclosure and cradle. The same can be fitted on the bezel without any tool and is common for fix and draw-out version of OMEGA ACB.



### Mechanical Interlock

Mechanical Interlock is used for interlocking breakers as per the desired control scheme. It can interlock up to three Omega ACBs of Fixed/Draw-out/Mixed version. The breakers can be interlocked in Vertical or Horizontal configuration.

**Cable length:** 2/3/5 meter, minimum radius at cable bend: 70mm



#### Possible mounting arrangements:

Type of Interlock	Typical Circuit	Interlocks Possible	Schematic Diagram																					
Two Incomers (2 I/C)		<table border="1"> <tr><td>A</td><td>B</td></tr> <tr><td>O</td><td>O</td></tr> <tr><td>I</td><td>O</td></tr> <tr><td>O</td><td>I</td></tr> </table>	A	B	O	O	I	O	O	I														
A	B																							
O	O																							
I	O																							
O	I																							
Three Incomers (3 I/C)		<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>O</td><td>O</td><td>O</td></tr> <tr><td>I</td><td>O</td><td>O</td></tr> <tr><td>O</td><td>I</td><td>O</td></tr> <tr><td>O</td><td>O</td><td>I</td></tr> </table>	A	B	C	O	O	O	I	O	O	O	I	O	O	O	I							
A	B	C																						
O	O	O																						
I	O	O																						
O	I	O																						
O	O	I																						
Two Incomers & One Standby (2 I/C + 1 S/B)		<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>O</td><td>O</td><td>O</td></tr> <tr><td>I</td><td>O</td><td>O</td></tr> <tr><td>O</td><td>I</td><td>O</td></tr> <tr><td>O</td><td>I</td><td>O</td></tr> <tr><td>O</td><td>O</td><td>I</td></tr> </table>	A	B	C	O	O	O	I	O	O	O	I	O	O	I	O	O	O	I				
A	B	C																						
O	O	O																						
I	O	O																						
O	I	O																						
O	I	O																						
O	O	I																						
Two Incomers & One BusCoupler (2 I/C + 1 B/C)		<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>O</td><td>O</td><td>O</td></tr> <tr><td>I</td><td>O</td><td>O</td></tr> <tr><td>O</td><td>I</td><td>O</td></tr> <tr><td>O</td><td>O</td><td>I</td></tr> <tr><td>I</td><td>I</td><td>O</td></tr> <tr><td>I</td><td>O</td><td>I</td></tr> </table>	A	B	C	O	O	O	I	O	O	O	I	O	O	O	I	I	I	O	I	O	I	
A	B	C																						
O	O	O																						
I	O	O																						
O	I	O																						
O	O	I																						
I	I	O																						
I	O	I																						

O - Breaker Open    I - Breaker Closed

## Terminal Adaptors

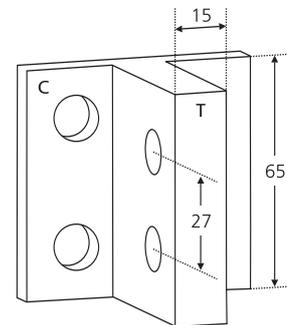
U-POWER OMEGA ACBs offer wide variety of terminal adaptors for both Fixed & Draw-out versions. Terminal Adaptors facilitate ease of termination of both Copper & Aluminium busbars.

### Terminal Adaptor for OMEGA Draw-out ACBs

#### Frame-1 400-2000A & Frame-3 400-4000A

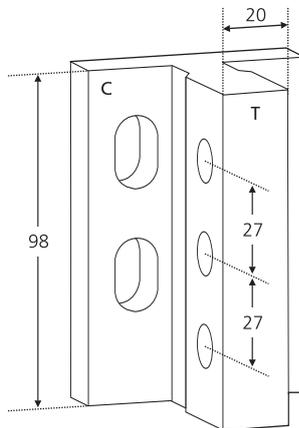
Cradle side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
36 x 36	8	4	27	15	2

Frame size	Configuration	Length / Width
Fr-1	400 - 2000A	Vertical / Horizontal
Fr-3	400 - 4000A	Vertical / Horizontal



All dimensions are in mm  
For ordering cat nos please refer page no.74

#### Frame-1 2500A, Frame-2 400-3200A & Frame-3 5000A



Cradle side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
36 x 36	15	4	27	20	3

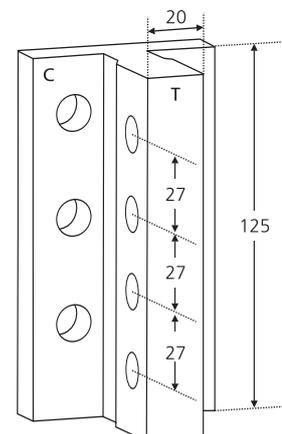
Frame size	Configuration	Length / Width
Fr-1	2500A	Vertical
Fr-2	400 - 3200A	Vertical / Horizontal
Fr-3	5000A	Vertical

All dimensions are in mm  
For ordering cat nos please refer page no.74

#### Frame-3 6300A

Cradle side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
36 x 36 x 36	15	6	27	20	4

Frame size	Configuration	Length / Width
Fr-3	6300A	Vertical



All dimensions are in mm  
For ordering cat nos please refer page no.74

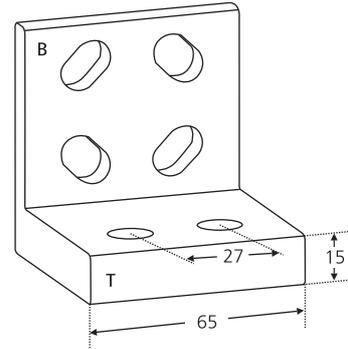
## Terminal Adaptor for OMEGA Fixed version ACBs

### Frame-1 400 - 1600A N/S

Breaker side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
36 x 24	8	4 (oblong)	27	15	2

Frame size		Configuration	Length / Width
Fr-1	800 - 1600A	Vertical / Horizontal	65

All dimensions are in mm  
For ordering cat nos please refer page no.74

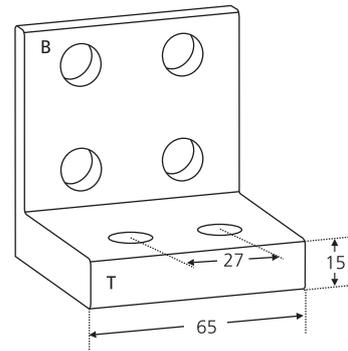


### Frame-1 400 - 2000A H, 2000A S & Frame-3 400 - 4000A H/V

Breaker side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
31 x 31	8	4	27	15	2

Frame size		Configuration	Length / Width
Fr-1 S	2000A	Vertical / Horizontal	65
Fr-1 H	400 - 2000A	Vertical / Horizontal	65
Fr-3 H/V	400 - 4000A	Vertical / Horizontal	65

All dimensions are in mm  
For ordering cat nos please refer page no.74

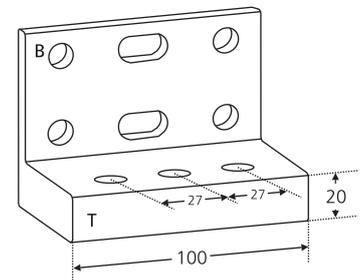


### Frame-1 2500A S/H & Frame-3 6300A H/V

Breaker side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
30 x 32	8	6	27	20	3

Frame size		Configuration	Length / Width
Fr-1 S/H	2500A	Vertical	100
Fr-3 H/V	6300A	Vertical	100

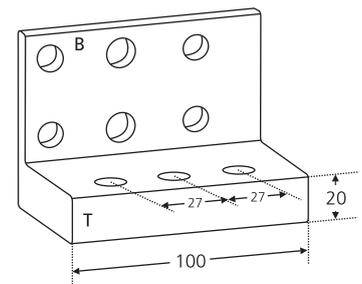
All dimensions are in mm  
For ordering cat nos please refer page no.74



## Frame-2 400 - 3200A

Breaker side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
29.5, 31.5 32, 31	8	6	27	20	3

Frame size	Configuration	Length / Width
Fr-2 H/V	400 - 3200A	Vertical / Horizontal
		100

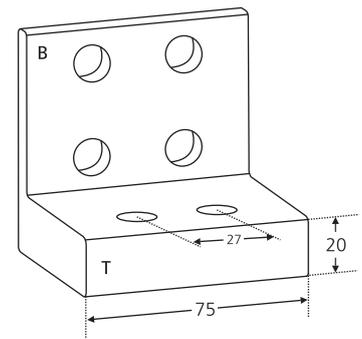


All dimensions are in mm  
For ordering cat nos please refer page no.74

## Frame-3 5000A H/V

Breaker side			Termination side		
Hole distance	Thickness	No. of holes	Hole distance	Thickness	No. of holes
30 x 32	8	4	27	20	2

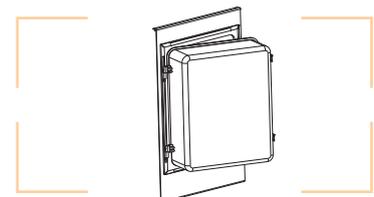
Frame size	Configuration	Length / Width
Fr-3 H/V	5000A	Vertical / Horizontal
		75



All dimensions are in mm | **B**: Breaker side | **T**: Termination side | **C**: Cradle side  
For ordering cat nos please refer page no.74

### Safety cover:

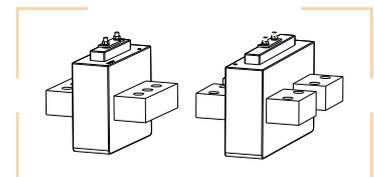
A transparent safety cover mounted on the door-sealing frame on panel door increases the Ingress Protection (IP) of the ACB from IP40 to IP54. Safety cover can be mounted in Left hinge / Right hinge combinations.



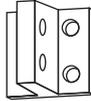
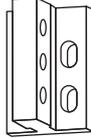
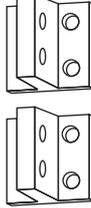
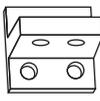
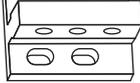
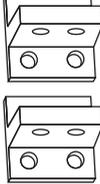
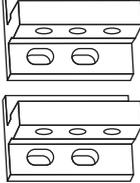
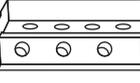
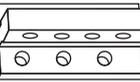
### External neutral CTs:

In 3-phase 4-wire distribution system external neutral CTs are installed on the neutral conductor with 3-pole ACBs for:

- ✓ Overload protection of the neutral conductor
- ✓ Earth-fault protection of the system



Draw Out OMEGA

Fr	Frame 1		Frame 2		Frame 3	
	400-2000	2500	400-3200	400-4000	5000	6300
Horizontal		Vertical termination recommended			Vertical termination recommended	
	Width : 65 mm CL609630000		Width : 98 mm CL609640000	Width : 65 mm CL907470000		
Vertical						
	Height : 65 mm CL609630000	Height : 98 mm CL609640000	Height : 65 mm CL907470000	Height : 98 mm CL907480000 (1EA)	Height : 125 mm CL609650000 (1EA)	

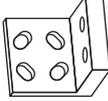
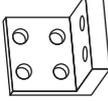
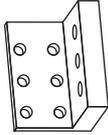
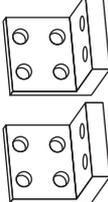
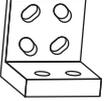
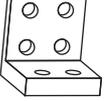
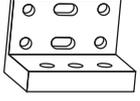
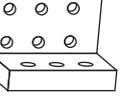
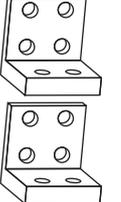
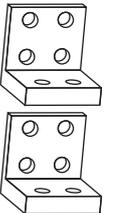
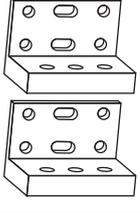
Following table consists of the total nos of the terminal adaptors required for individual breaker (TOP & bottom side included)

D/O	Rating	3P	4P	Orientation
Frame 1	400-2000A	6	8	any
	2500A	6	8	Vertical
Frame 2	400-3200A	6	8	any
	400-4000A	12	16	any
Frame 3	5000A	12	16	Vertical
	6300A	12	16	Vertical

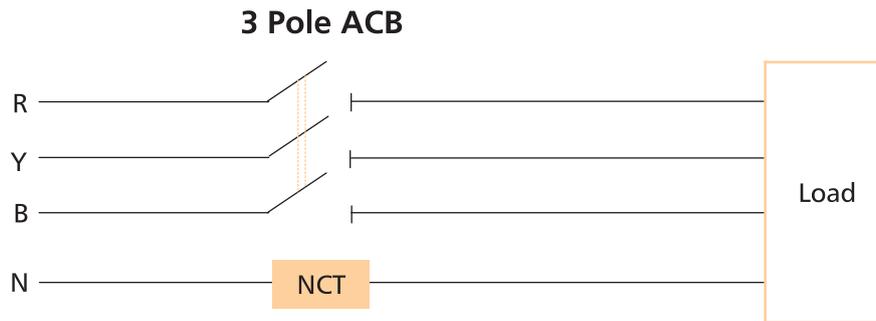
  

Fix	Rating	3P	4P	Orientation
Frame 1	400-2000A	6	8	any
	2500A	6	8	Vertical
Frame 2	400-3200A	6	8	any
	400-4000A	12	16	any
Frame 3	5000-6300A	6	8	Vertical

Fix Omega

Fr	Frame 1		Frame 2		Frame 3		
	N/S	H	S/H	S/H	H/V	H/V	
A	400-1600	400-2000	2500	400-3200	400-4000	5000	6300
			Vertical termination recommended			Vertical termination recommended	
Width : 65 mm CL609670000 (1EA)	Width : 65 mm CL609680000 (1EA)	Width : 100 mm CL609770000 (1EA)		Width : 65 mm CL906680000 (1EA)			
Horizontal							
	Height : 65 mm CL609670000 (1EA)	Height : 65 mm CL609680000 (1EA)	Height : 100 mm CL609760000 (1EA)	Height : 100 mm CL609770000 (1EA)	Height : 65 mm CL906680000 (1EA)	Height : 75 mm CL609820000 (1EA)	Height : 100 mm CL906690000 (1EA)

## EF protection in TPN system



In case of TPN system, NCT must be used to avoid nuisance tripping of the three pole ACB under unbalanced load condition.

In case of current unbalance,

$$I_R + I_Y + I_B + I_N = 0, \text{ but}$$

$$I_R + I_Y + I_B \neq 0$$

In absence of NCT, the EF enabled Protection & Control Unit will follow the second equation resulting in false indication of EF, and will trip if it exceeds threshold value, causing undesirable interruptions in the Electrical system and deterioration of ACB life.

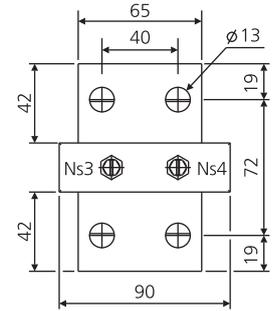
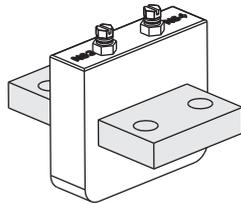
Installation of NCT can also be used for Neutral Overload Protection for sensing overcurrent flowing through the neutral conductor.

For Earth fault protection and protection of Neutral against overloads, Neutral CT is required. For 4-Pole breakers, the CT is provided inside the breaker, to be used on 4 wire system whereas for 3-pole breakers, external CT is available separately.

It is important that with OMEGA System of breaker, special neutral CTs supplied by L&T are used.

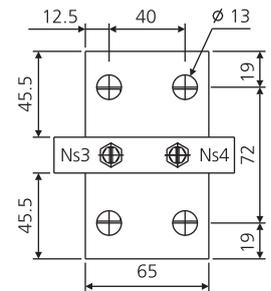
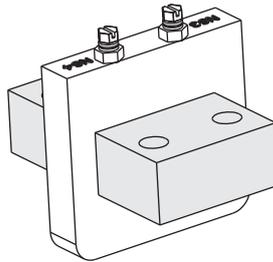
Frame Size	Rating
1, 2 & 3	400/630/800/ 1000/1250/1600
1, 2 & 3	1000/1250/1600

(ref. Page 14 for Frame size details)  
TERMINAL THICKNESS 15 mm.



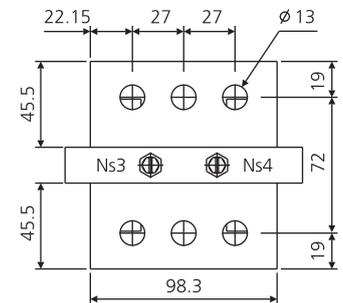
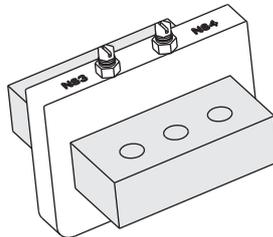
Frame Size	Rating
1	2000/2500

(ref. Page 14 for Frame size details)  
TERMINAL THICKNESS 30 mm.



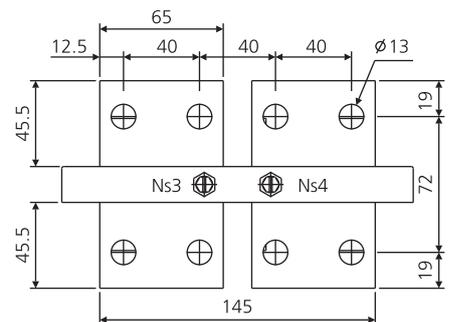
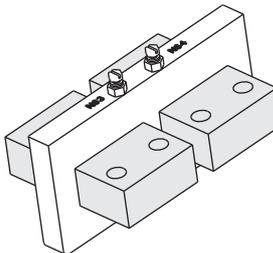
Frame Size	Rating
2 & 3	2000/2500/ 3200/4000

(ref. Page 14 for Frame size details)  
TERMINAL THICKNESS 30 mm.



Frame Size	Rating
3	5000/6300

(ref. Page 14 for Frame size details)  
TERMINAL THICKNESS 30 mm.



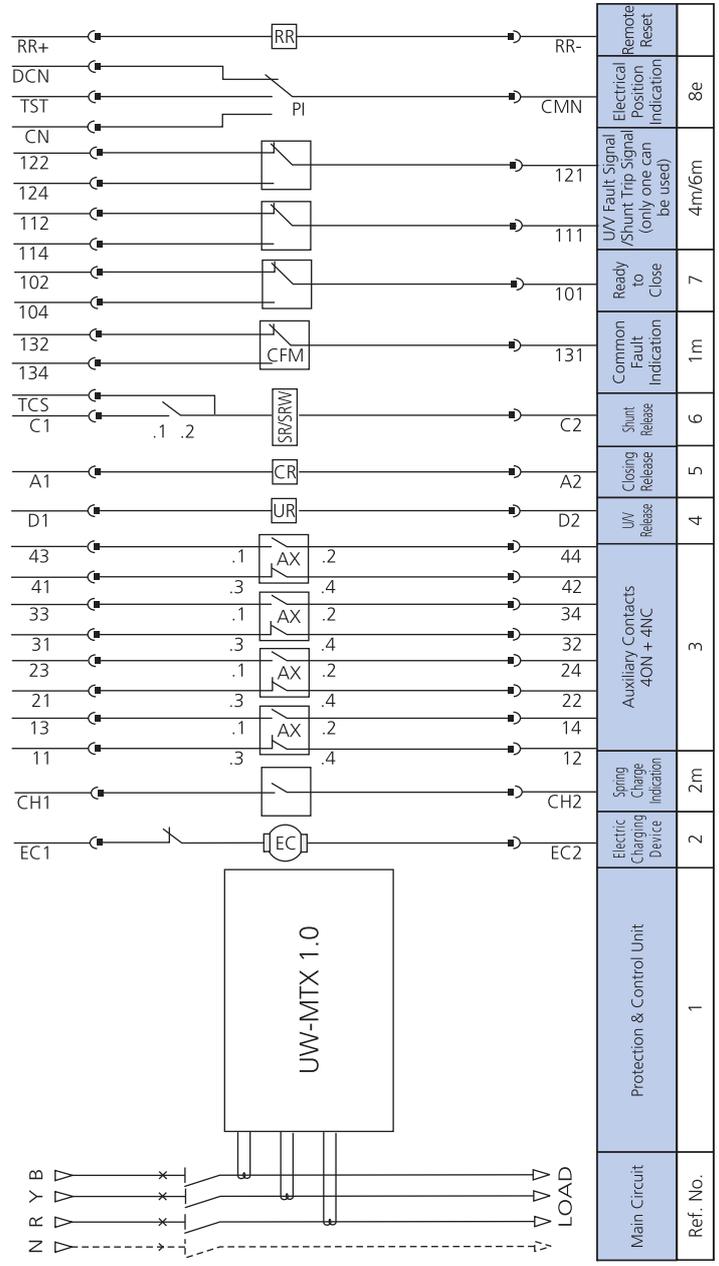
M12 / Equivalent bolts to be used for links termination.  
Tightening torque: 3.2 kgfm  
All Dimensions in mm

# Control Circuit Wiring

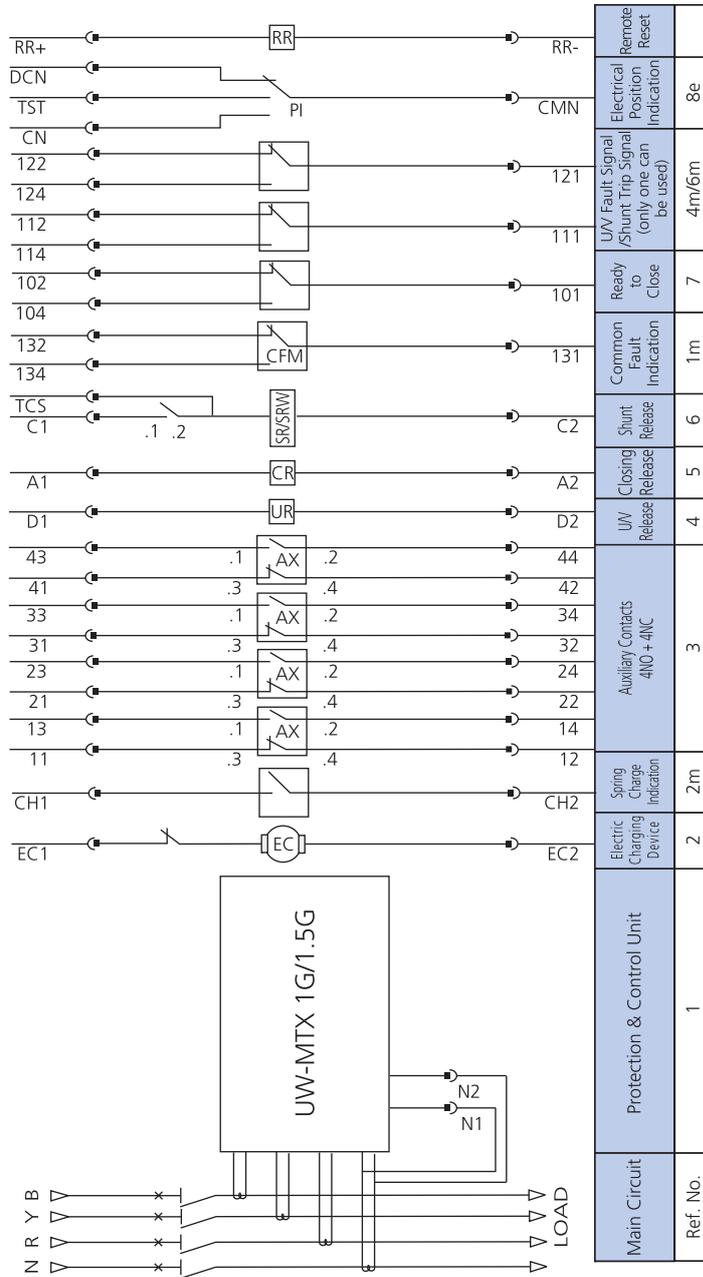




Connection Details

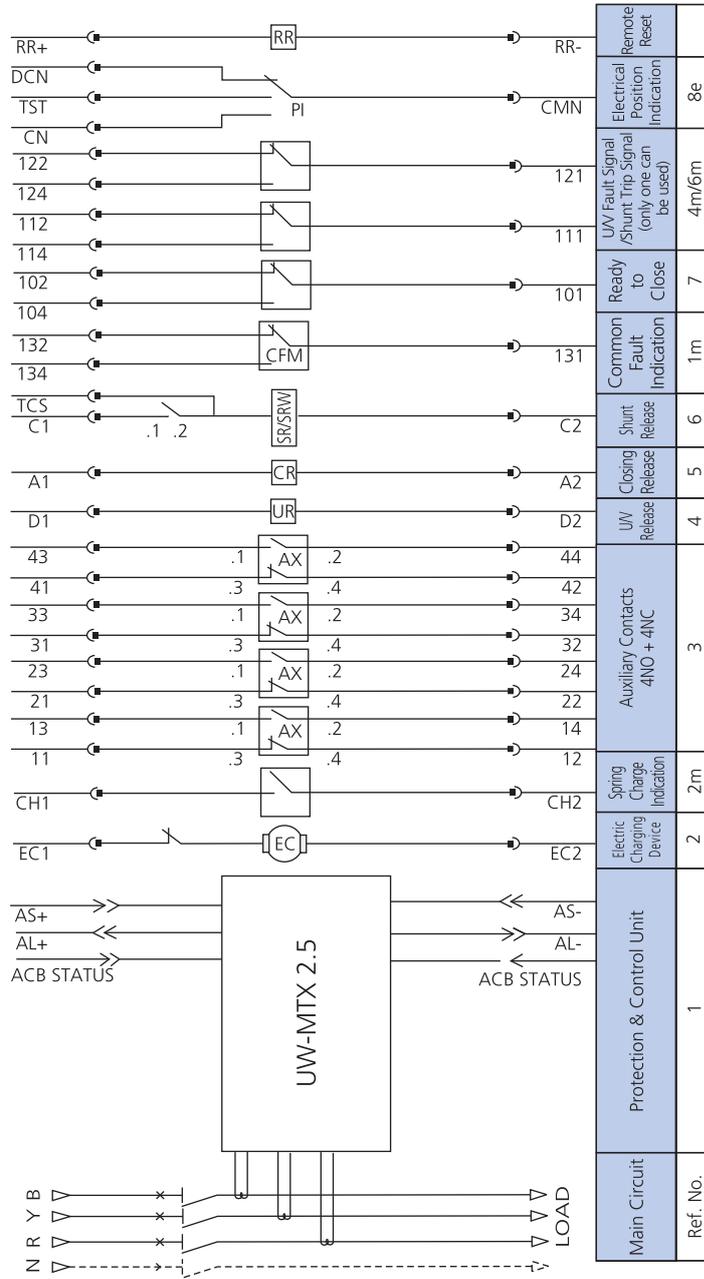


Connection Details



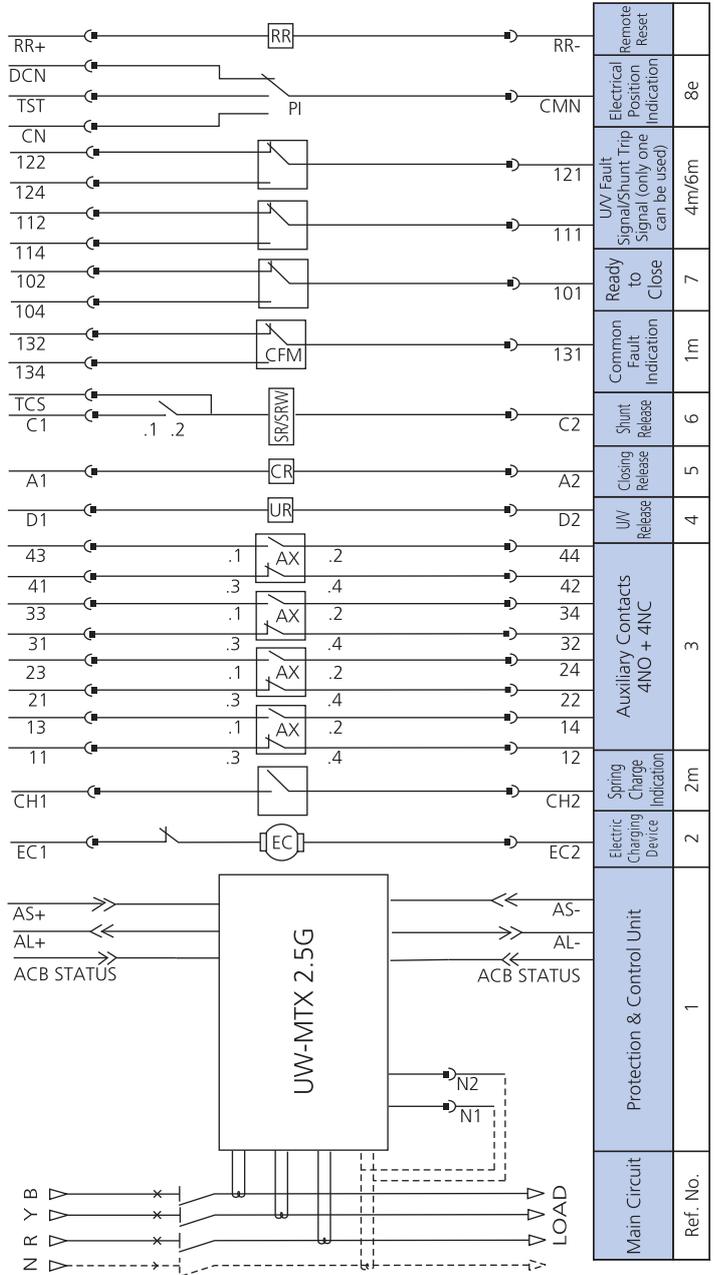
N1, N2: External Neutral CT

Connection Details



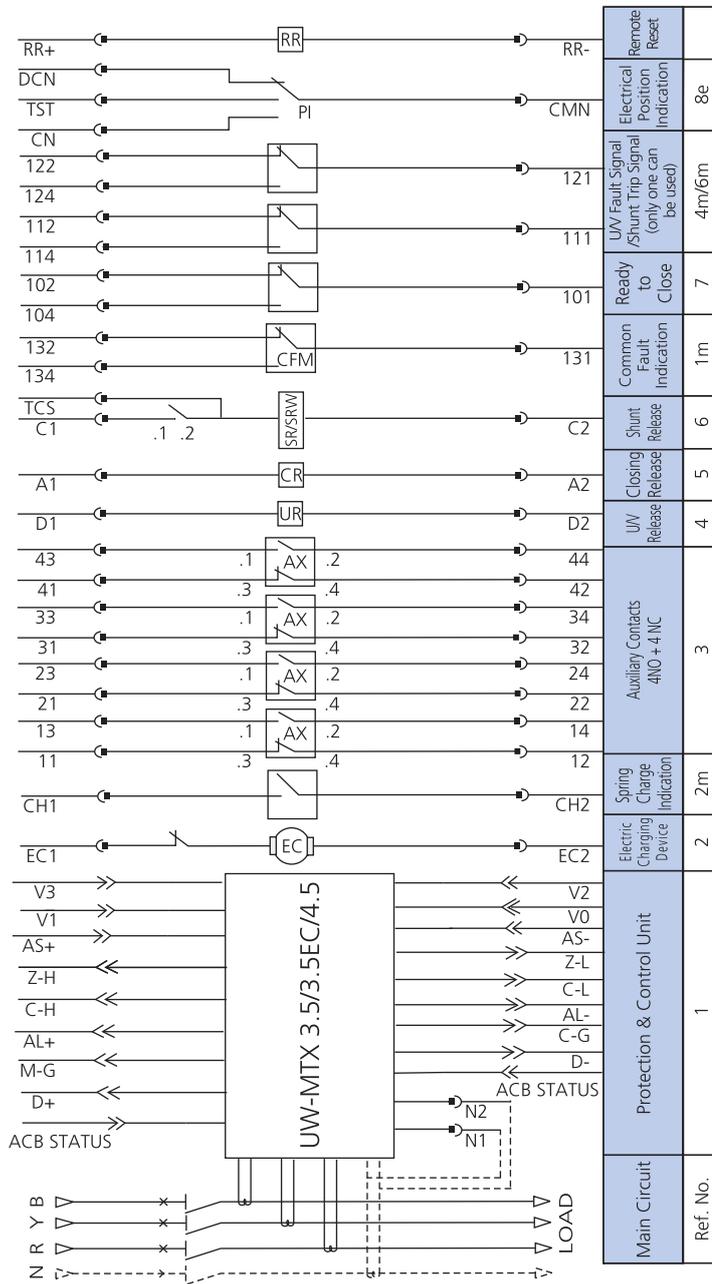
AS+, AS- : 24V DC Power Supply  
 AL+, AL- : TRIP ALARM +, TRIP ALARM-  
 This output can be connected to 5V-30 V DC 150 mA relay or any other indicating device which can give alarm for Short circuit and Earth Fault trip.

Connection Details

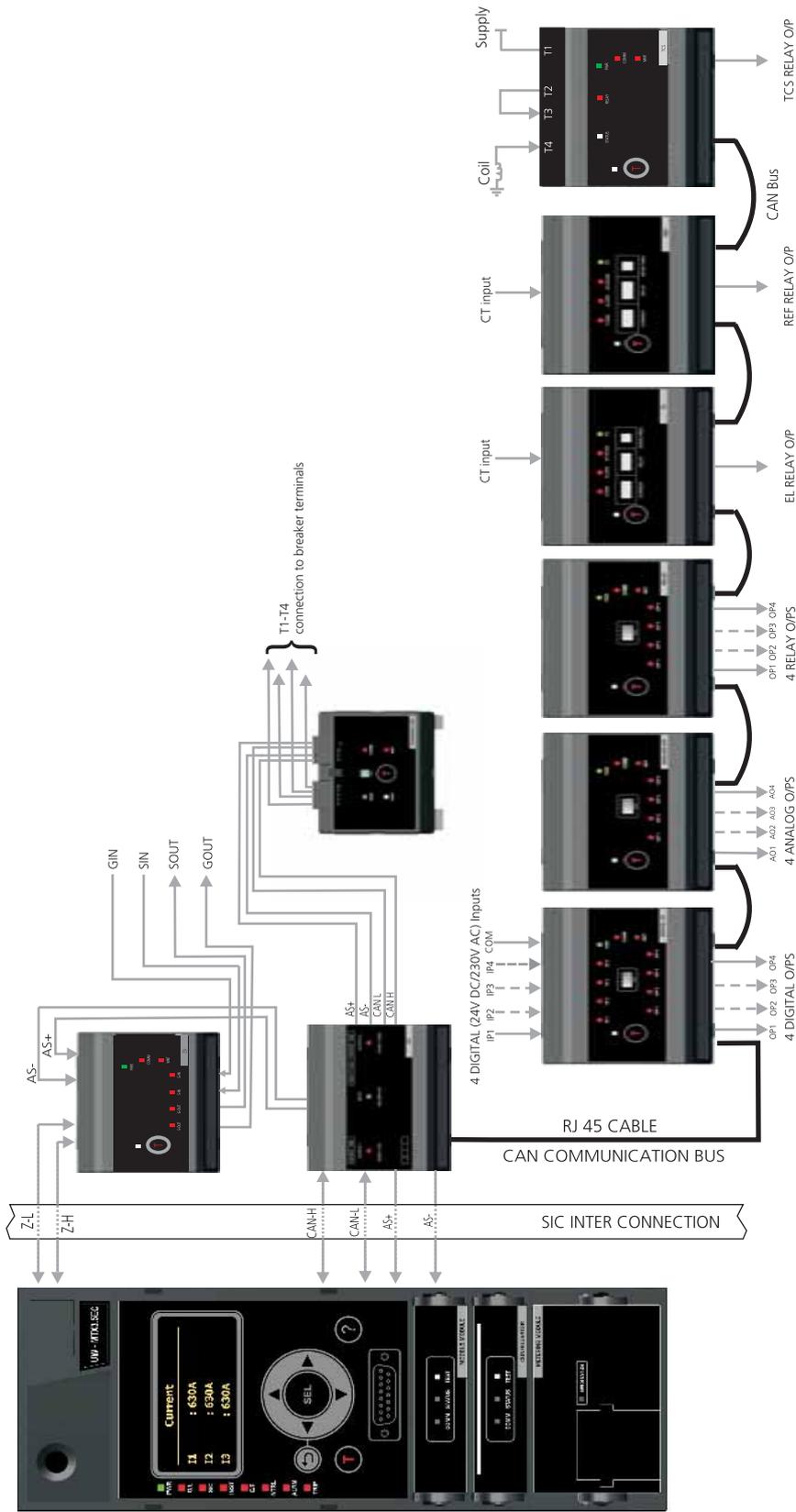


AS+, AS- : 24V DC Power Supply  
 AL+, AL- : TRIP ALARM +, TRIP ALARM- .  
 This output can be connected to 5V-30 V DC 150 mA relay or any other indicating device which can give alarm for Short circuit and Earth Fault trip.  
 N1,N2 : External Neutral C.T.

## Connection Details



- AS+, AS- : 24V DC Power Supply
- AL+ : TRIP ALARM+, TRIP ALARM-
- AL- : This output can be connected to 5V-30V dc 150 mA relay or any other indicating device which can give alarm for Short circuit and Earth Fault trip .
- C-L : CAN-Low
- C-H : CAN-High
- M-G : MOD-GND
- C-G : CAN-GND
- V0, V1, V2, V3 : N, R, Y, B, VOLTAGE I/P.
- D+ : MOD A
- D- : MOD B
- N1 : External Neutral CT
- N2 : External Neutral CT
- Z-L : ZSI CAN-Low
- Z-H : ZSI CAN-High



- AS+ : Auxiliary 24V DC
- AS- : Ground
- SOUT : S/C Output
- SIN : S/C Input
- GOUT : E/F Output
- GIN : E/F Input
- T1-T4 : Thermistor Inputs

- Z-L : ZSI CAN-Low
- Z-H : ZSI CAN-High
- CAN-H : CAN-High
- CAN-L : CAN-Low

**Note:** One Power Supply module can be connected to maximum 5 modules

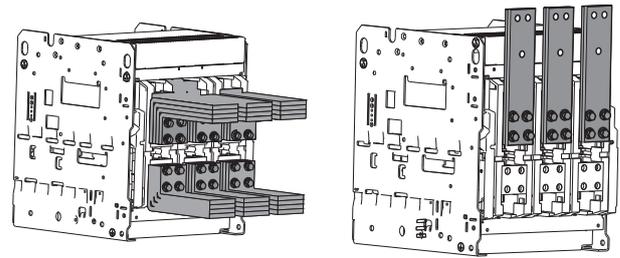


## Mounting & Termination

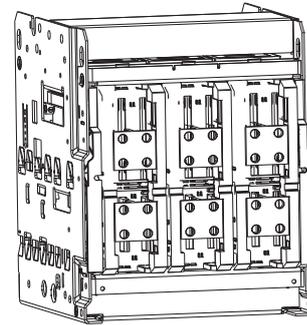
### Termination on Draw-out Breakers

OMEGA System of ACB terminals offer more contact area to accept Aluminium links.

OMEGA System of ACBs Universal Flat terminals greatly facilitate termination. These terminals directly support all commonly used types of termination as shown in adjoining figure.

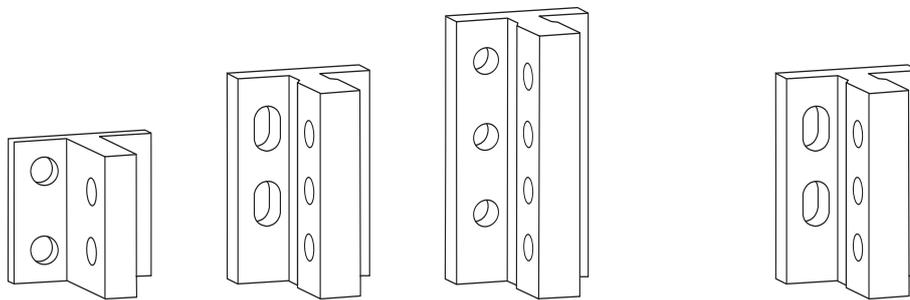


OMEGA System of ACB's are having inbuilt nutplates (M12 Threading) in Cradle terminal, to facilitate termination.



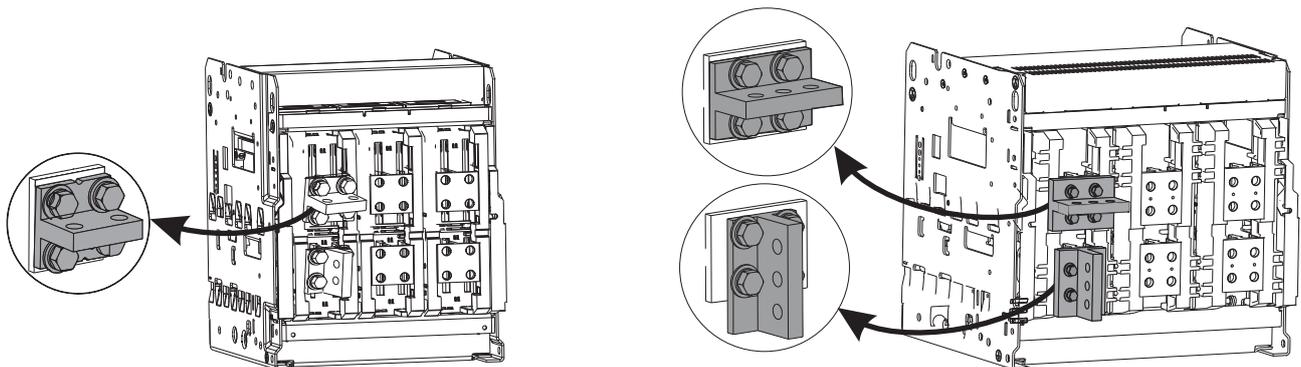
### Terminal Adaptor:

If required, a Terminal adaptor is available as an accessory.



Vertical Adaptors for Frame 1 & 3

Horizontal & Vertical Adaptor For Frame 2

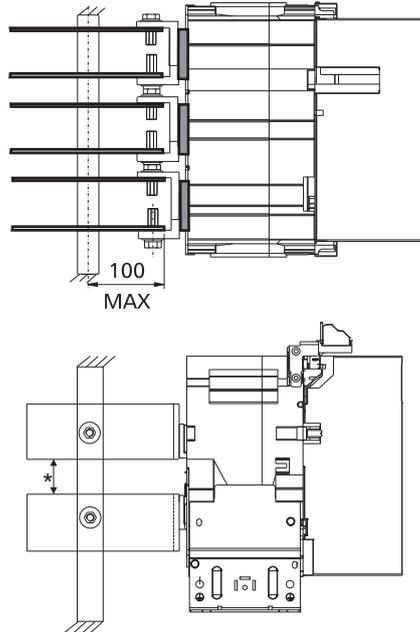


For Fr-1, Terminal Adaptor installation. In Fr-3 use equalizer for vertical & a single Adaptor for horizontal between two poles.

Installation of Terminal Adaptor For Frames 2

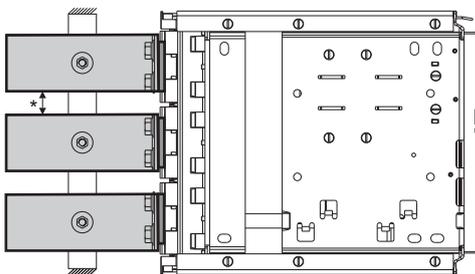
## Termination Methods For Fixed Breakers

**CAUTION:**  
Inadequate termination support may result in overheating & adversely affect performance during short circuit conditions.

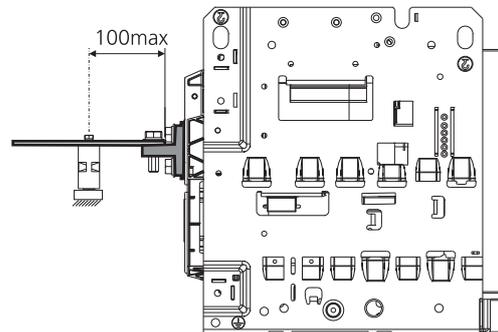
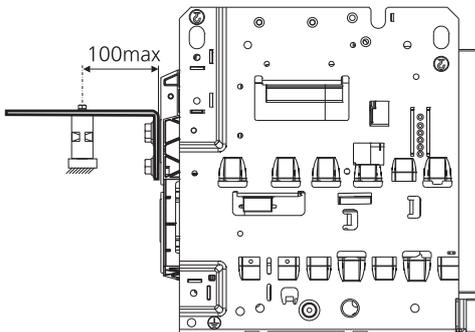
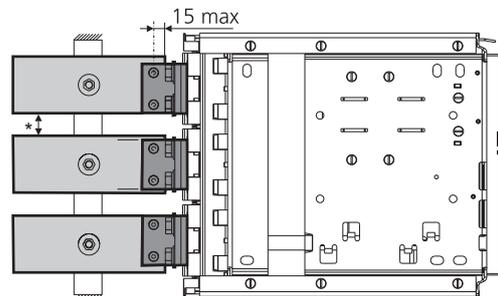


## For Draw-out Breakers

With Universal Terminals



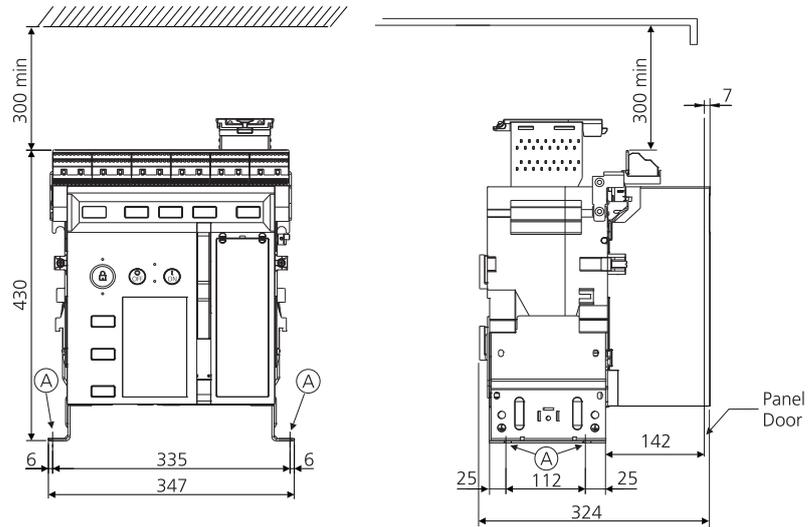
With Terminal Adaptor



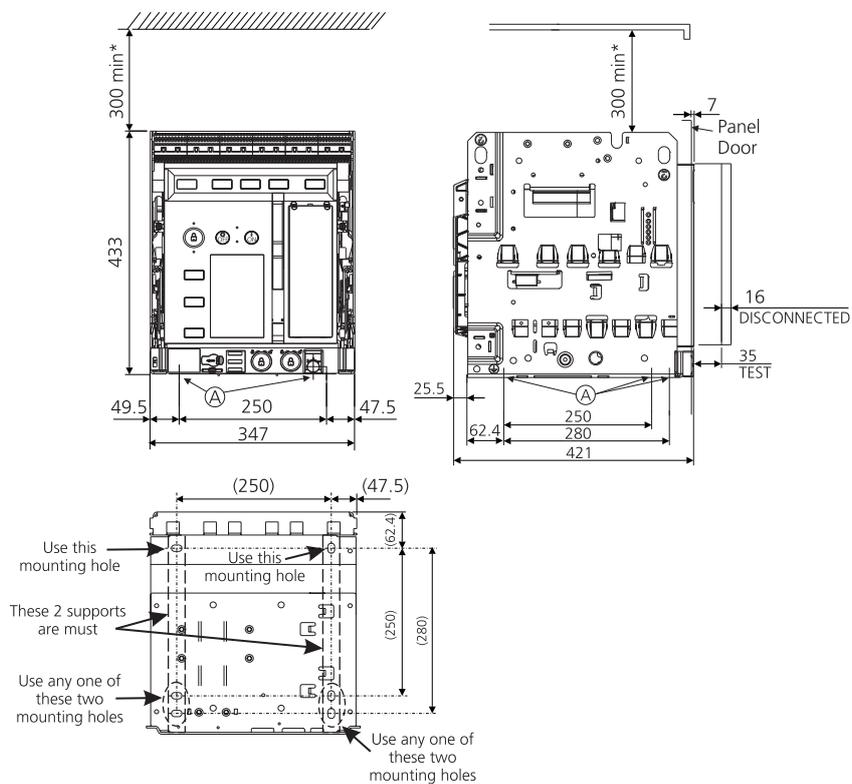
\* Maintain adequate clearance between links as applicable

### 400-1600A N & 400-2500A S/H Fr.1 3P

#### Fixed Circuit Breaker



#### Draw-out Circuit Breaker

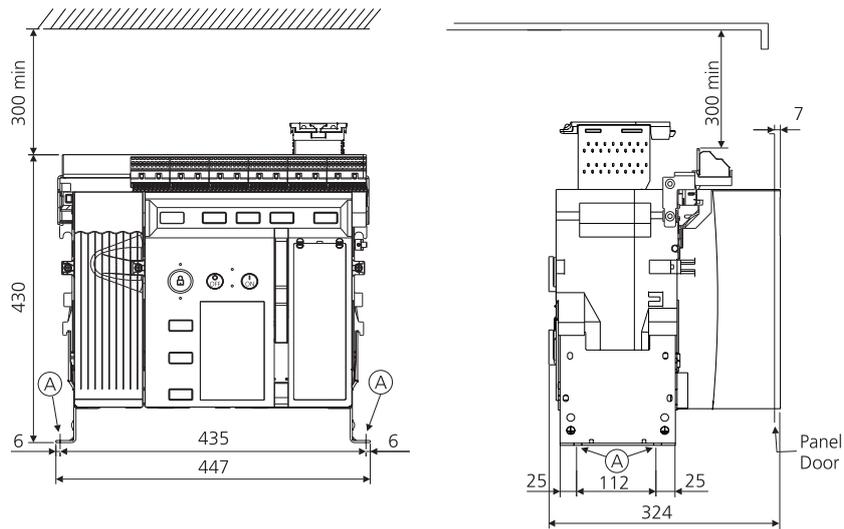


All Dimensions in mm

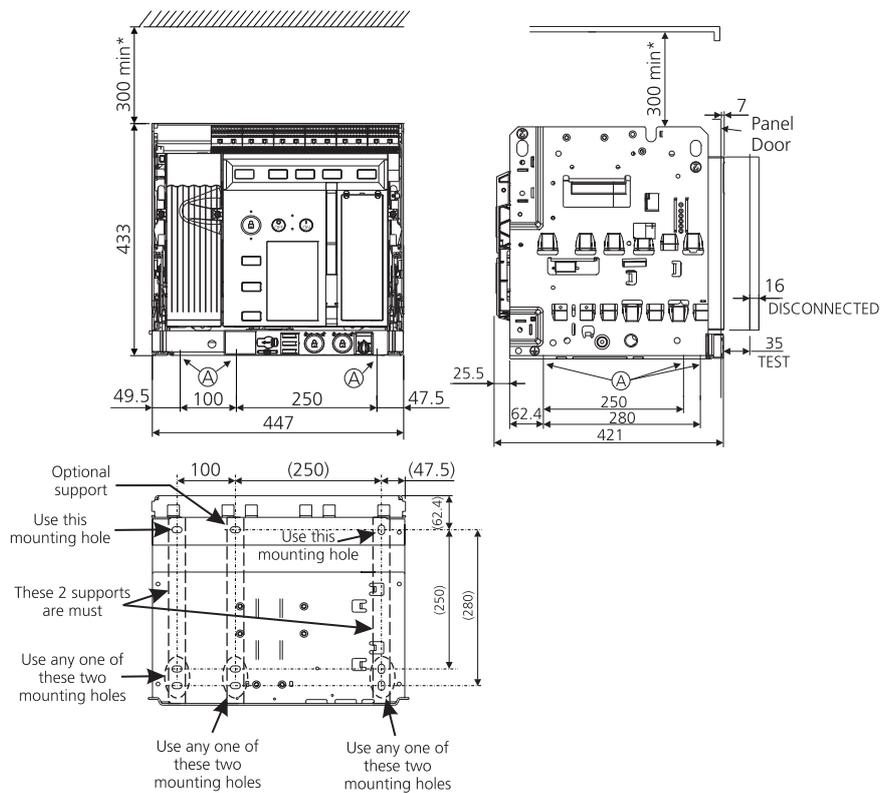
\* Lower clearance of 45 mm can be achieved for 'N' version with Arc-Shield

(A) Mounting holes suitable for M10 / Equivalent BS bolt

## 400-1600A N & 400-2500A S/H Fr.1 4P (100% N) Fixed Circuit Breaker



## Draw-out Circuit Breaker



Details of 4P (200%) on request

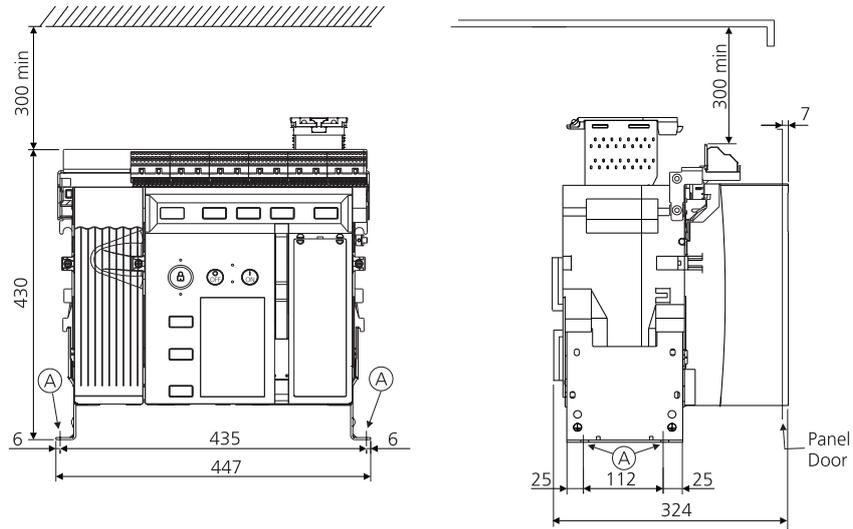
All Dimensions in mm

\* Lower clearance of 45 mm can be achieved for 'N' version with Arc-Shield

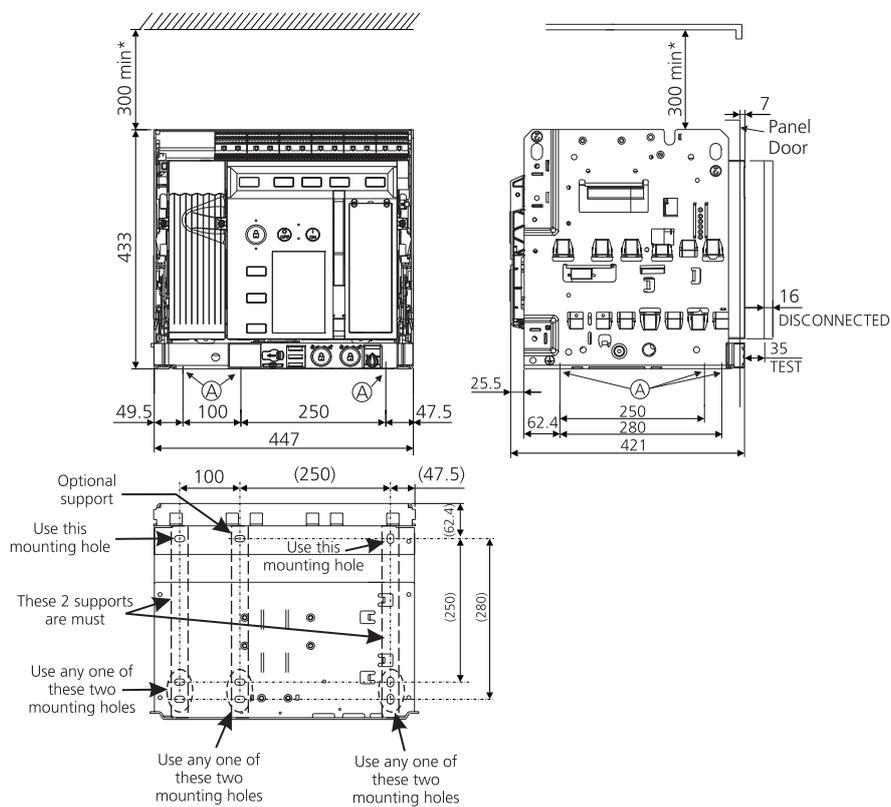
Ⓐ Mounting holes suitable for M10 / Equivalent BS bolt

### 400-3200A S/H Fr.2 3P

#### Fixed Circuit Breaker



#### Draw-out Circuit Breaker



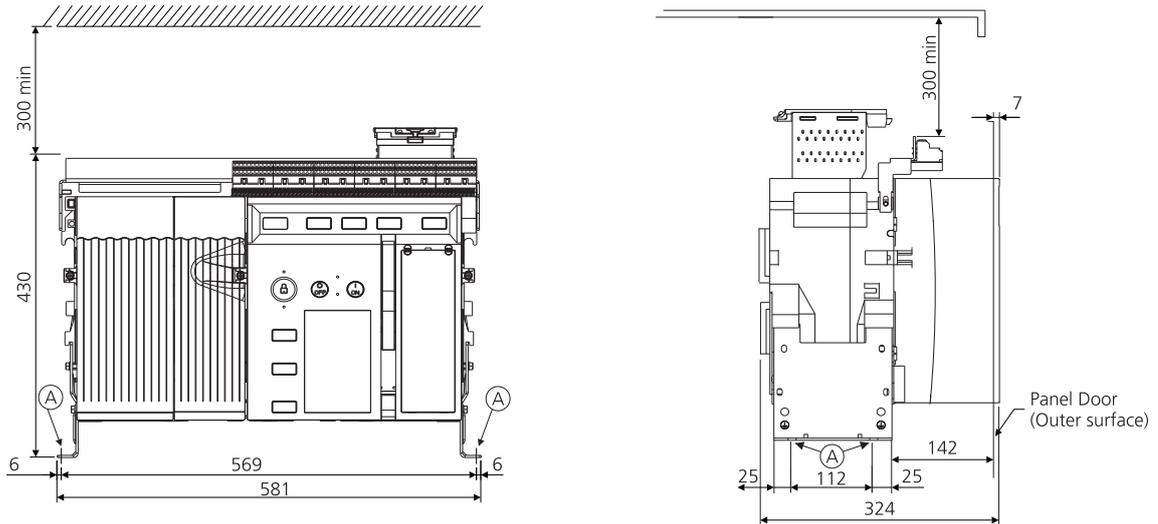
All Dimensions in mm

\* Lower clearance of 45 mm can be achieved for 'S' version with Arc-Shield

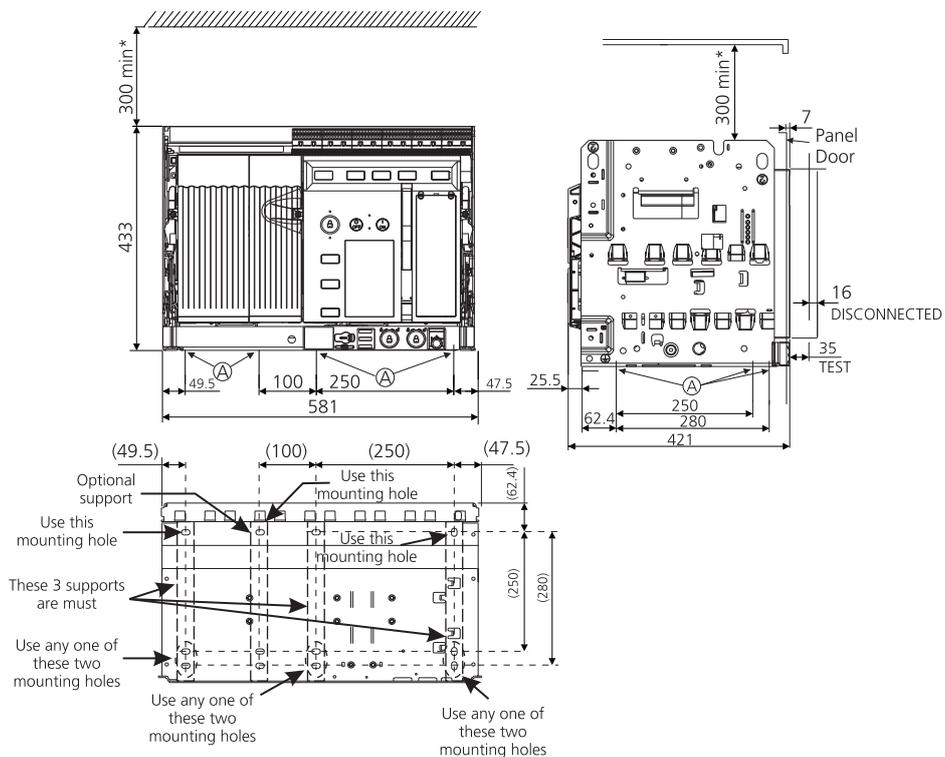
(A) Mounting holes suitable for M10 / Equivalent BS bolt

## 400-3200A S/H Fr.2 4P (100% N)

### Fixed Circuit Breaker



### Draw-out Circuit Breaker



Details of 4P (200% N) on request

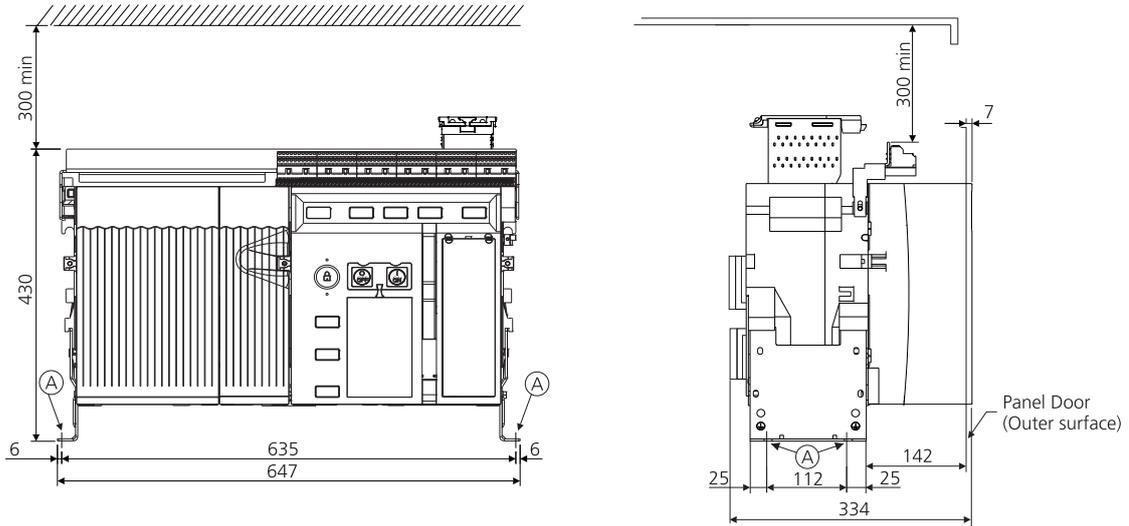
All Dimensions in mm

\* Lower clearance of 45 mm can be achieved for 'S' version with Arc-Shield

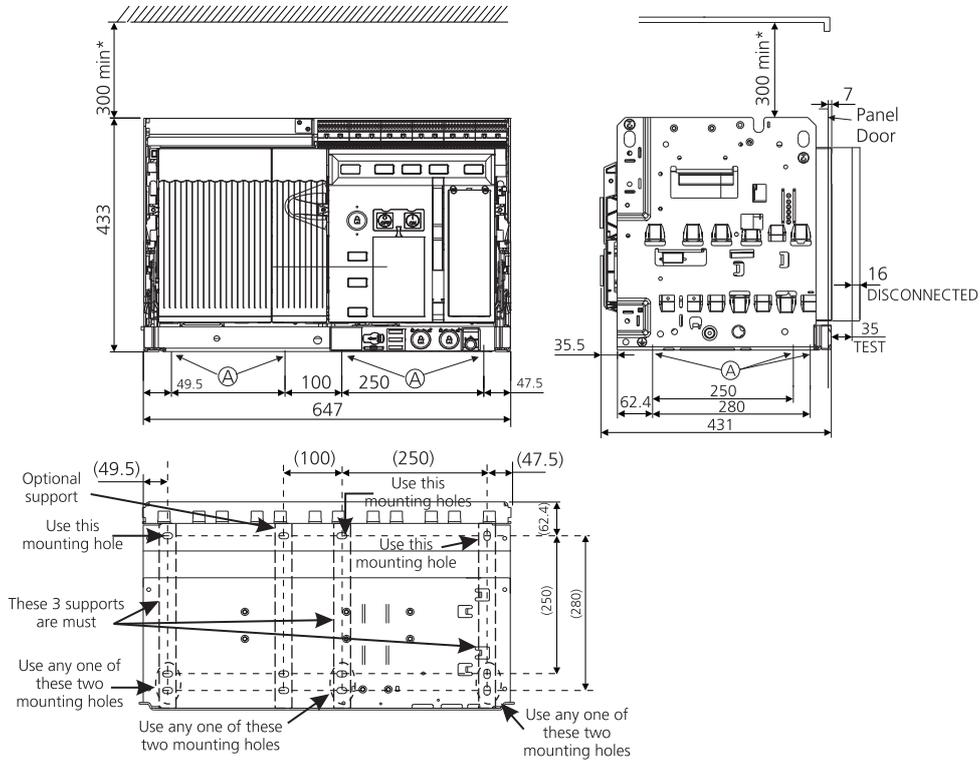
Ⓐ Mounting holes suitable for M10 / Equivalent BS bolt

### 400-6300A H/V Fr.3 3P

#### Fixed Circuit Breaker



#### Draw-out Circuit Breaker



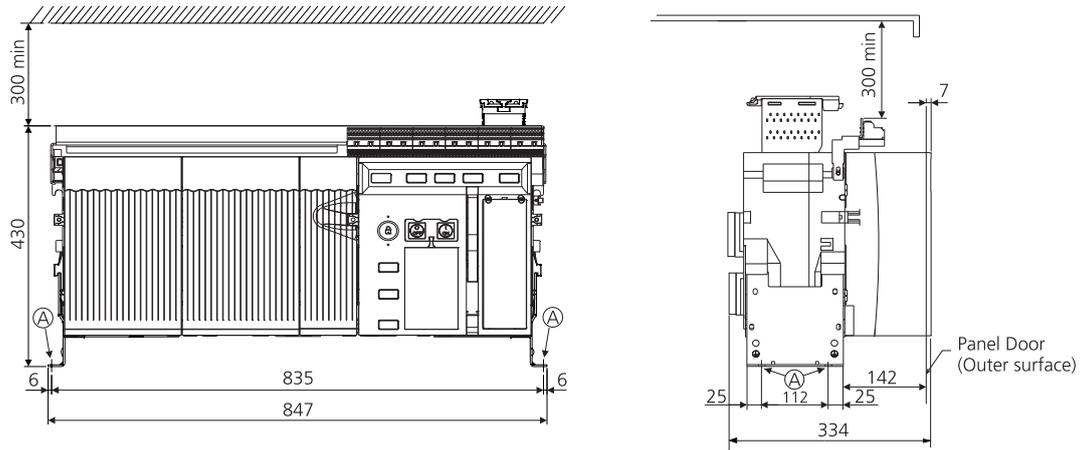
All Dimensions in mm

\* Lower clearance of 45 mm can be achieved for 'H' version with Arc-Shield

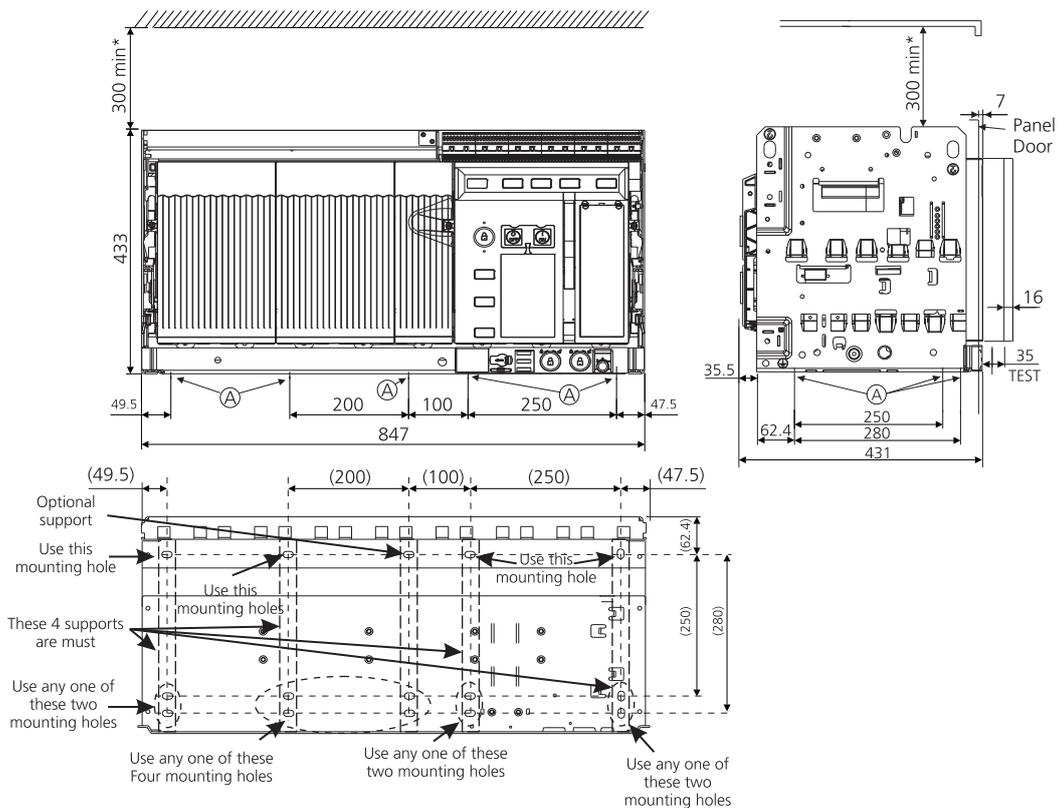
Ⓐ Mounting holes suitable for M10 / Equivalent BS bolt

## 400-6300A H/V Fr.3 4P (100% N)

### Fixed Circuit Breaker



### Draw-out Circuit Breaker



Details of 4P (50% N) on request

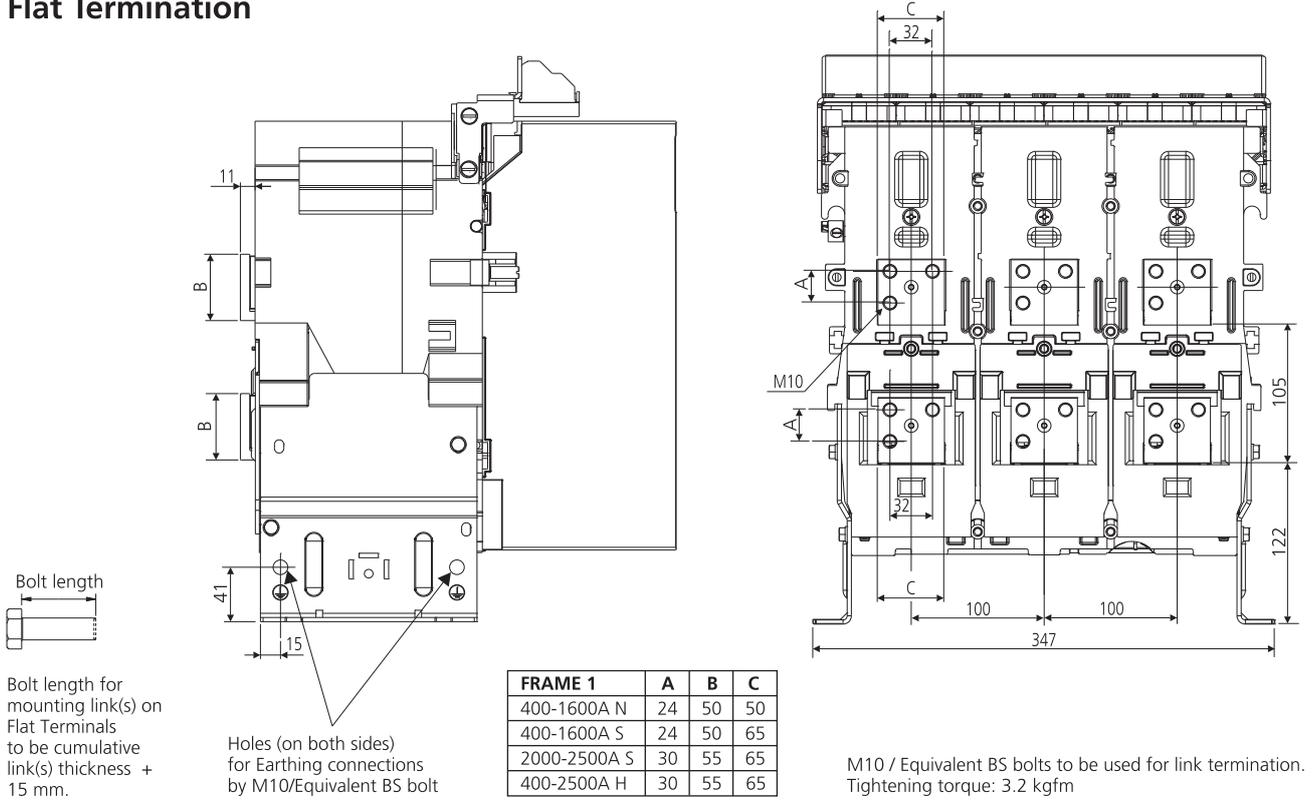
All Dimensions in mm

\* Lower clearance of 45 mm can be achieved for 'H' version with Arc-Shield

Ⓐ Mounting holes suitable for M10 / Equivalent BS bolt

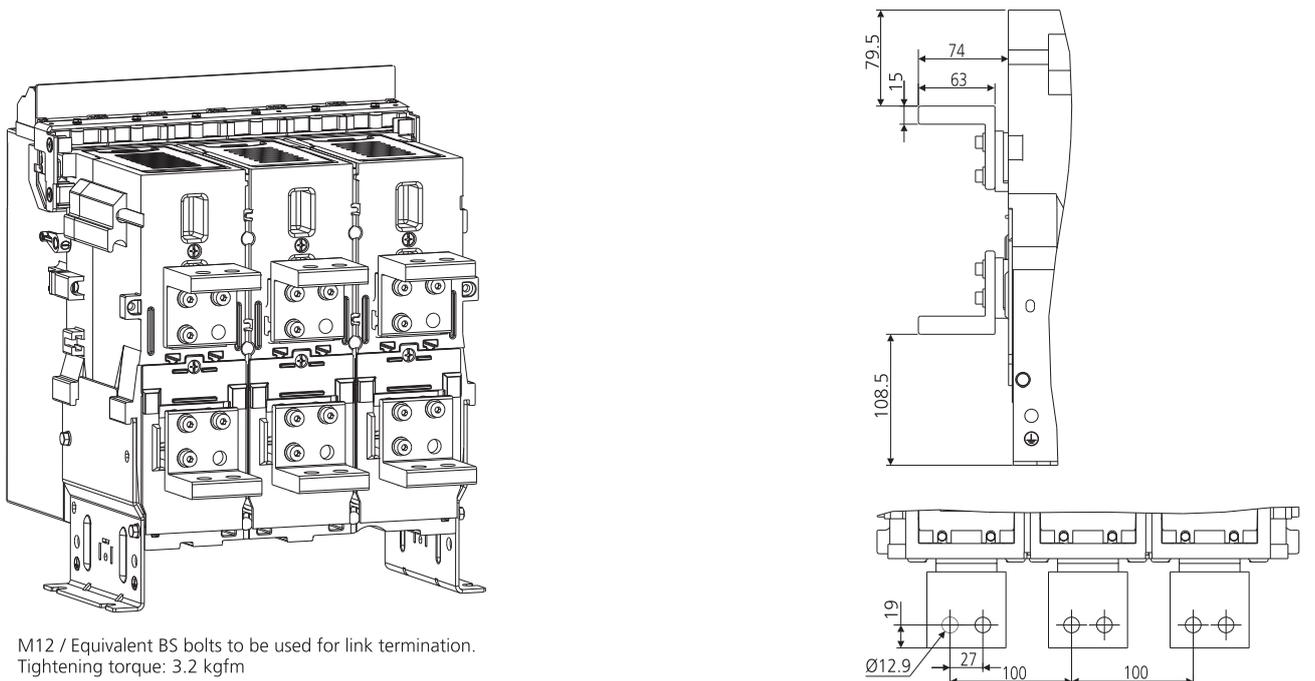
400-1600A N & 400-2500A S/H Fr.1 3P

Flat Termination



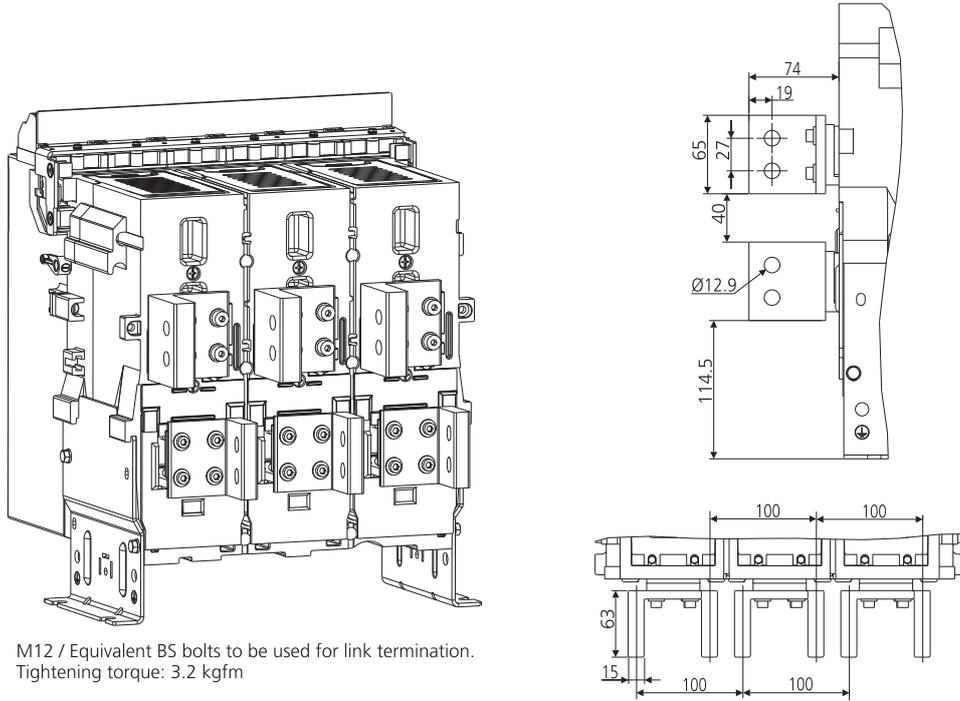
400-1600A N & 400-2000A S/H Fr.1 3P

Horizontal Termination



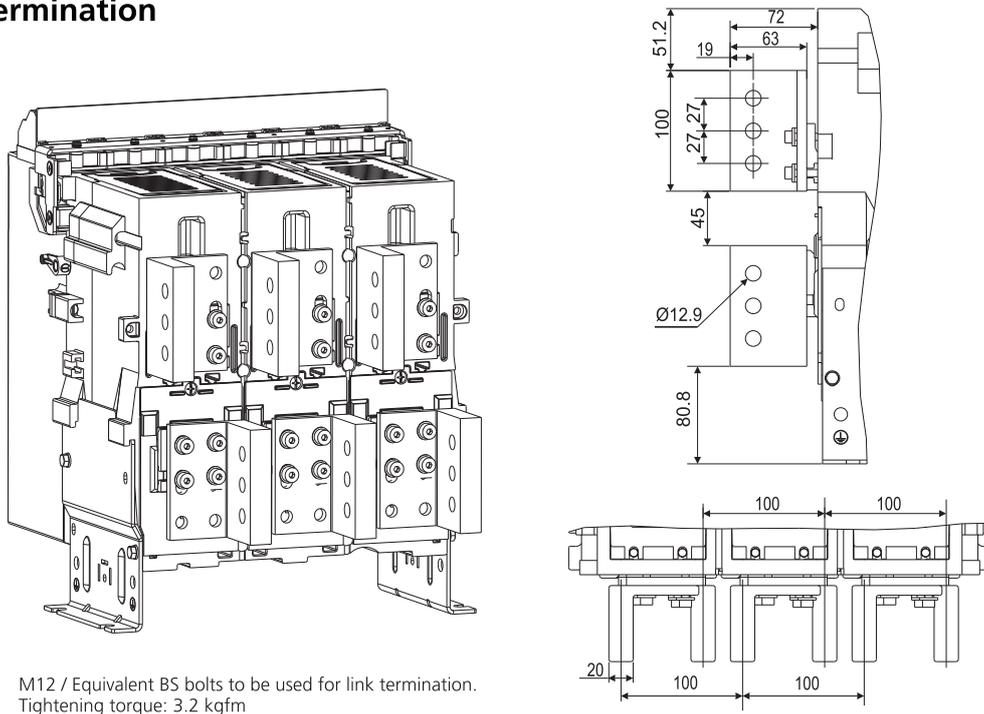
## 400-1600A N & 400-2000A S/H Fr.1 3P

### Vertical Termination



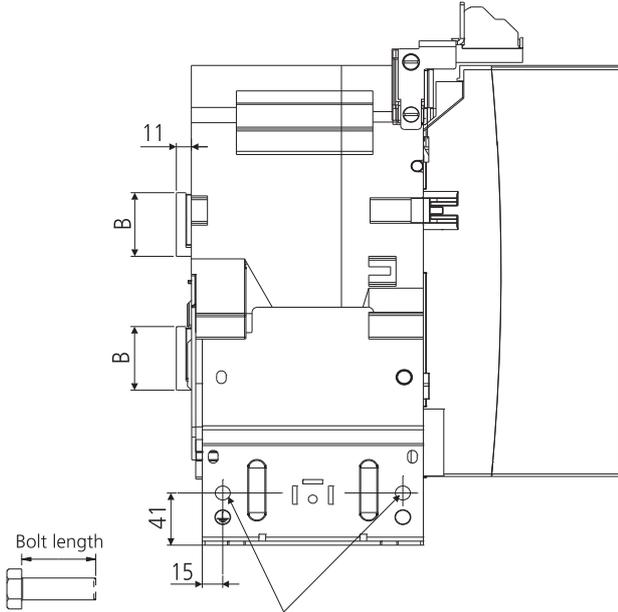
## 2500A S/H Fr.1 3P

### Vertical Termination



**400-1600A N & 400-2500A S/H Fr.1 4P**

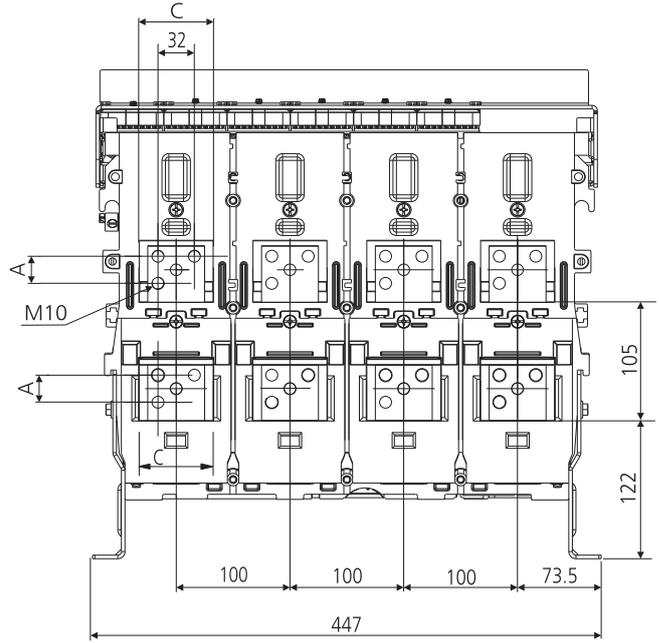
**Flat Termination**



Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness + 15 mm.

Holes (on both sides) for Earthing connections by M10/Equivalent BS bolt

FRAME 1	A	B	C
400-1600A N	24	50	50
400-1600A S	24	50	65
2000-2500A S	30	55	65
400-2500A H	30	55	65

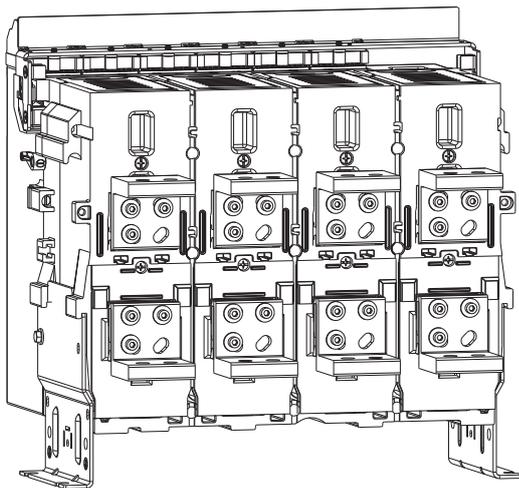


Details of 4P(200% N) on request  
All Dimensions in mm

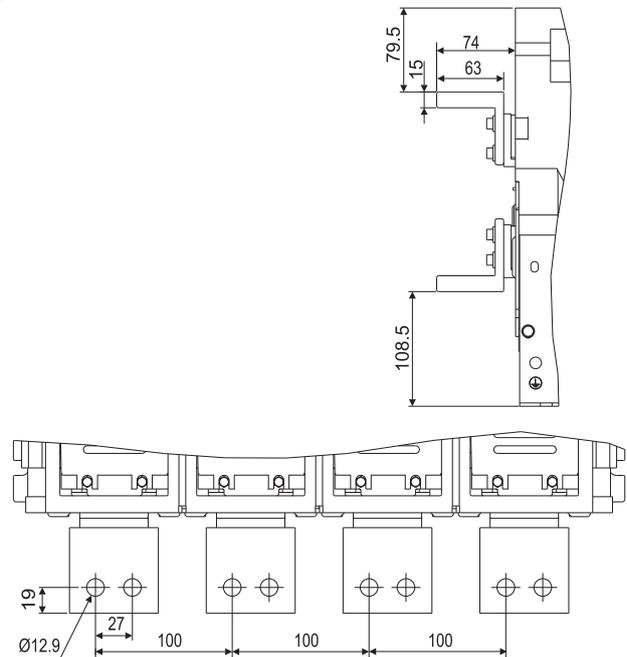
M10 / Equivalent BS bolts to be used for link termination.  
Tightening torque: 3.2 kgfm

**400-1600A N & 400-2000A S/H Fr.1 4P**

**Horizontal Termination**

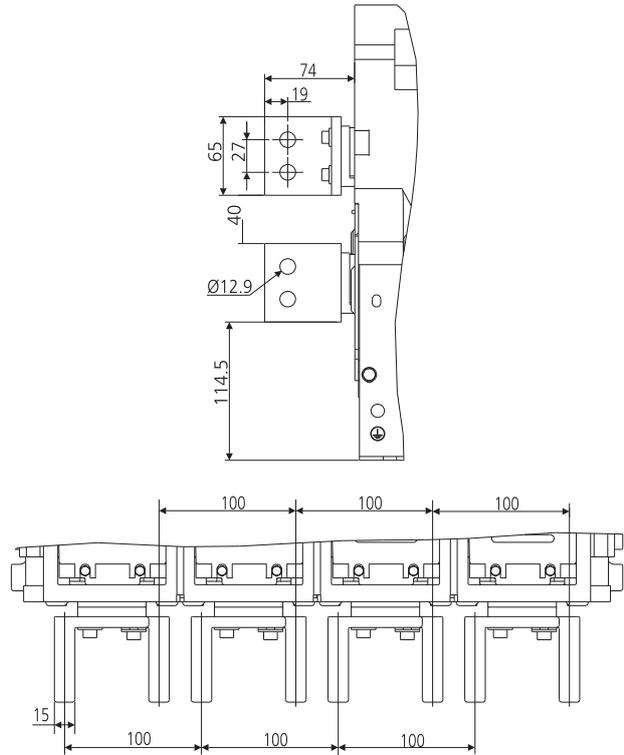
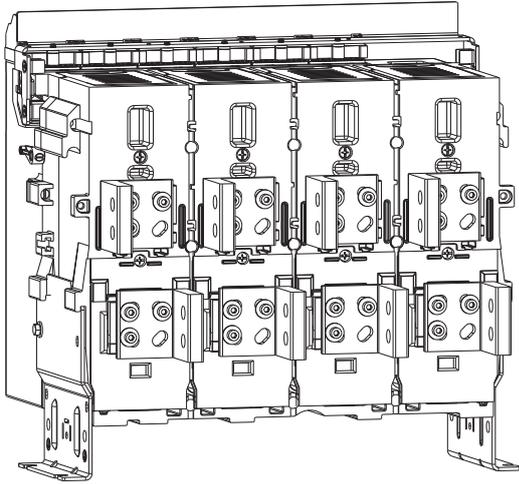


M12 / Equivalent BS bolts to be used for link termination.  
Tightening torque: 3.2 kgfm



## 400-1600A N & 400-2000A S/H Fr.1 4P

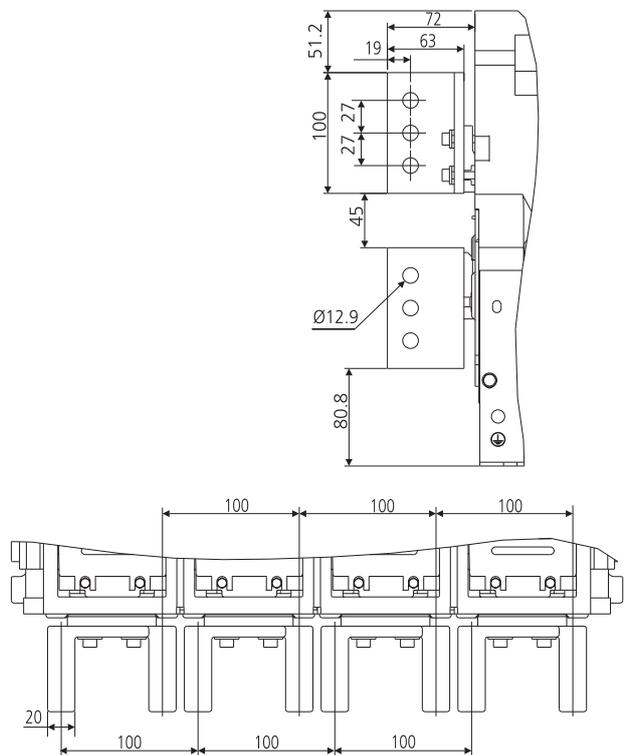
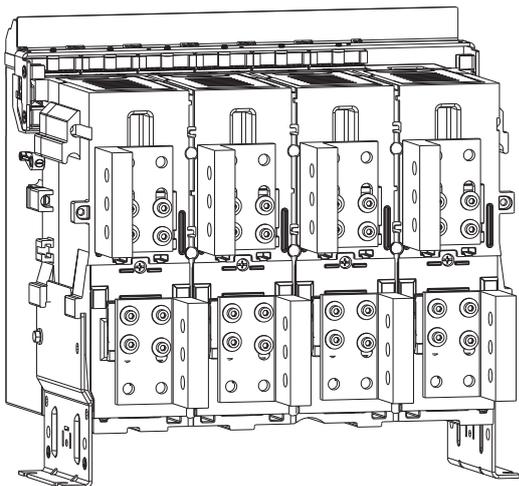
### Vertical Termination



M12 / Equivalent BS bolts to be used for link termination.  
Tightening torque: 3.2 kgfm

## 2500A S/H Fr.1 4P

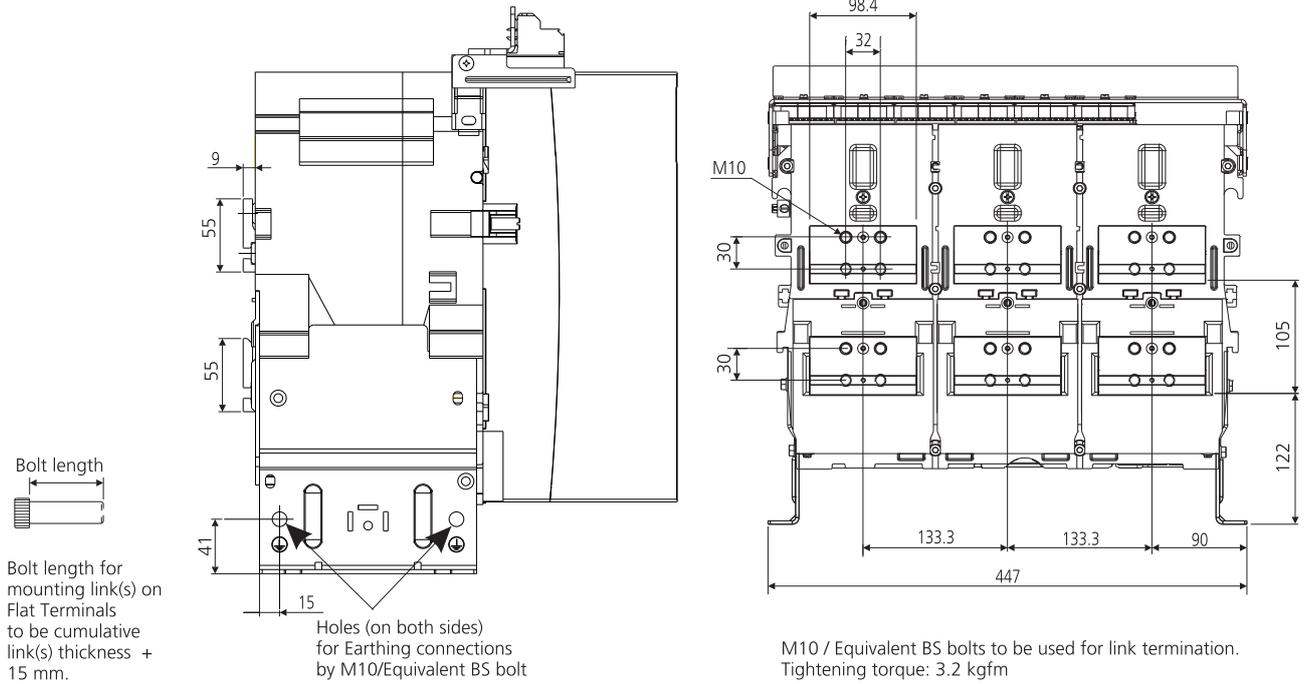
### Vertical Termination



M12 / Equivalent BS bolts to be used for link termination.  
Tightening torque: 3.2 kgfm

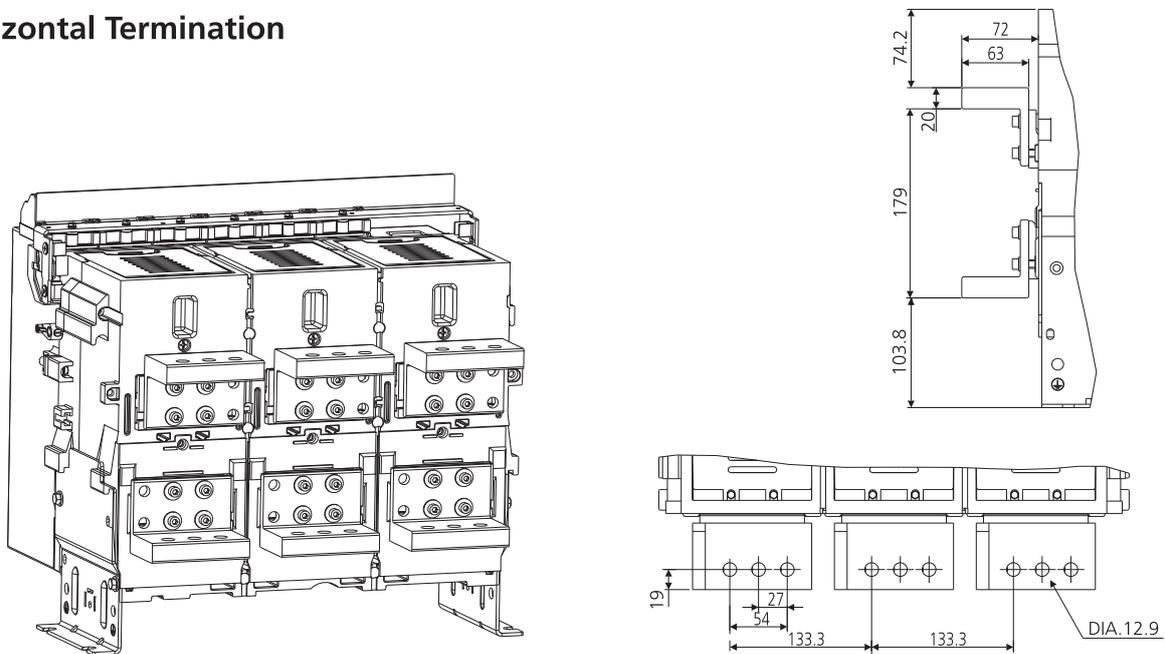
400-3200A S/H Fr.2 3P

Flat Termination



400-3200A S/H Fr.2 3P

Horizontal Termination

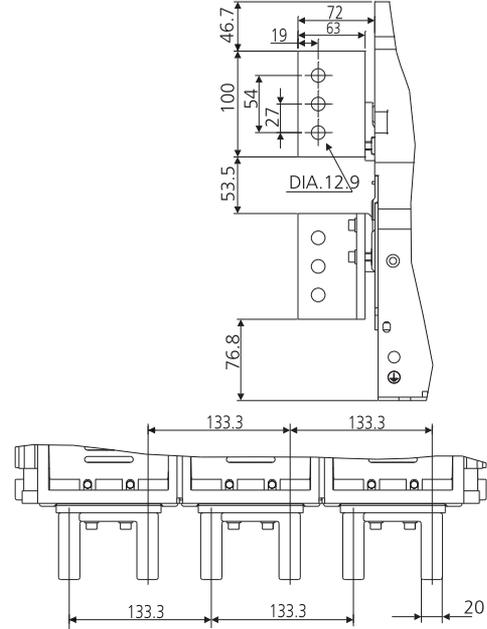
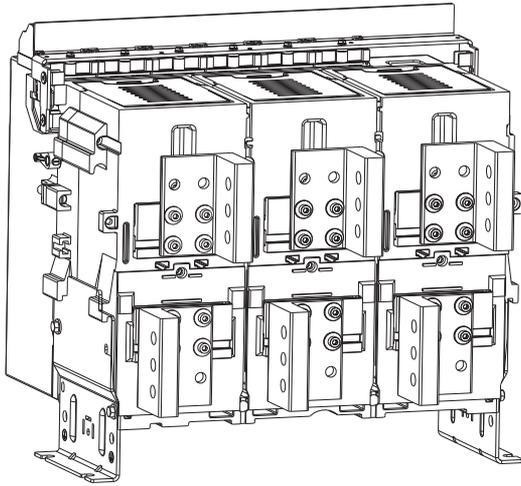


M12 / Equivalent BS bolts to be used for link termination. Tightening torque: 3.2 kgfm

Details of 4P(200% N) on request. All Dimensions in mm

## 400-3200A S/H Fr.2 3P

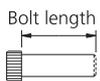
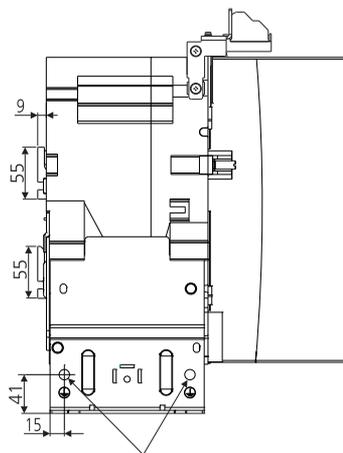
### Vertical Termination



M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm

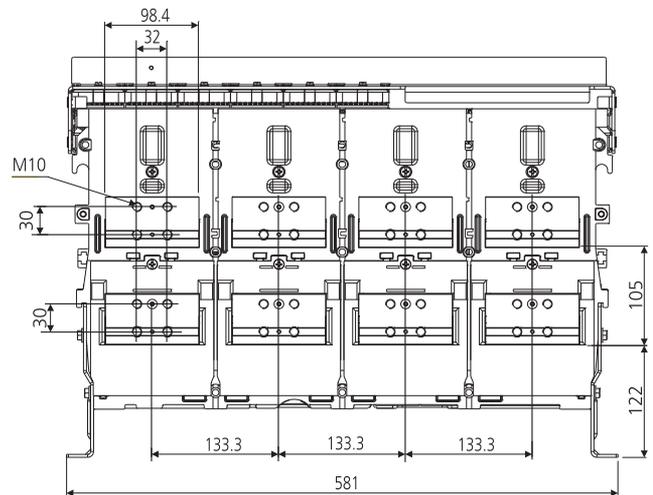
## 400-3200A S/H Fr.2 4P

### Flat Termination



Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness + 15 mm.

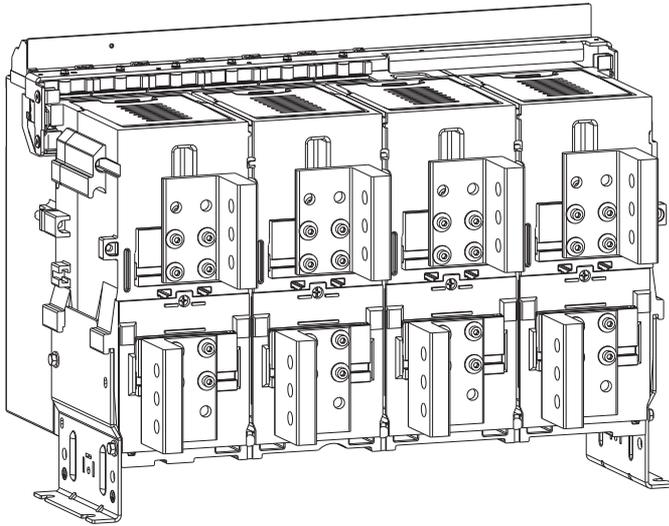
Holes (on both sides) for Earthing connections by M10/Equivalent BS bolt



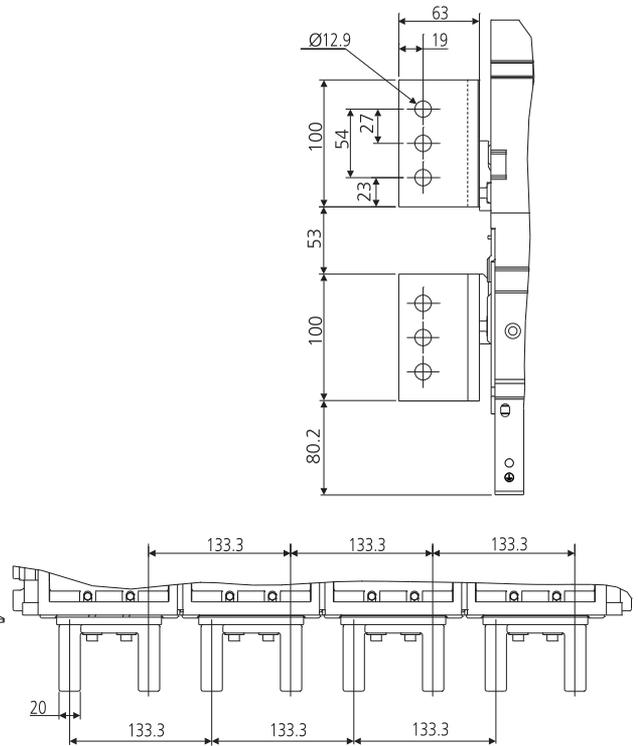
M10 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm

**400-3200A S/H Fr.2 4P (100% N)**

**Vertical Termination**

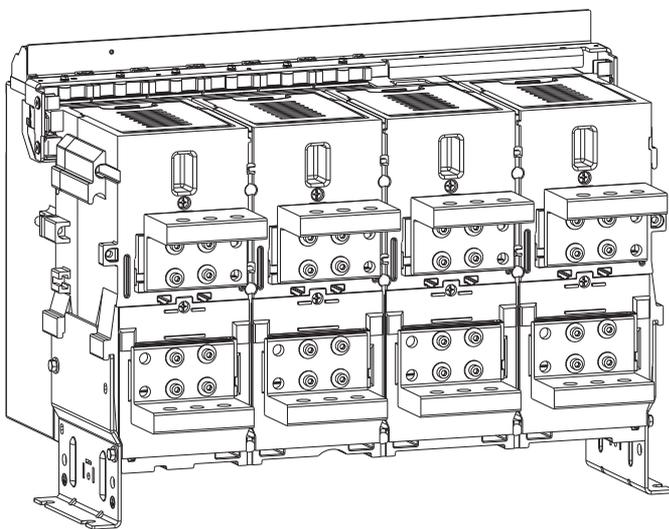


M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm

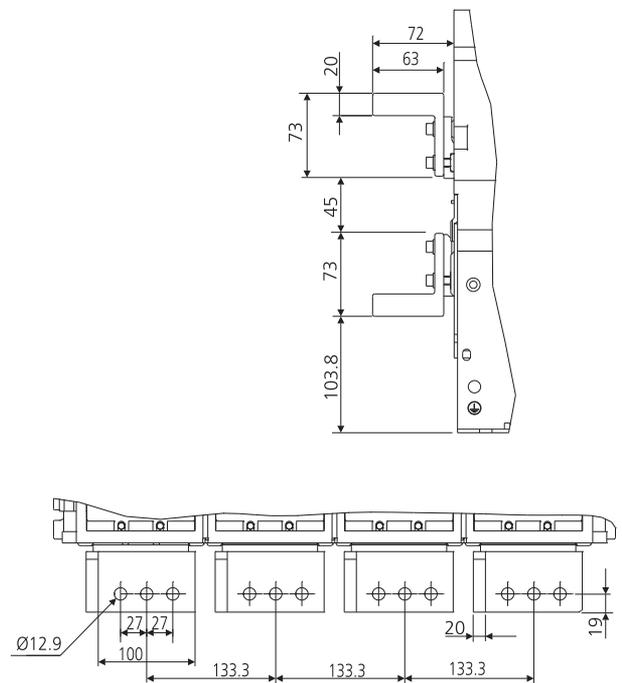


**400-3200A S/H Fr.2 4P**

**Horizontal Termination**



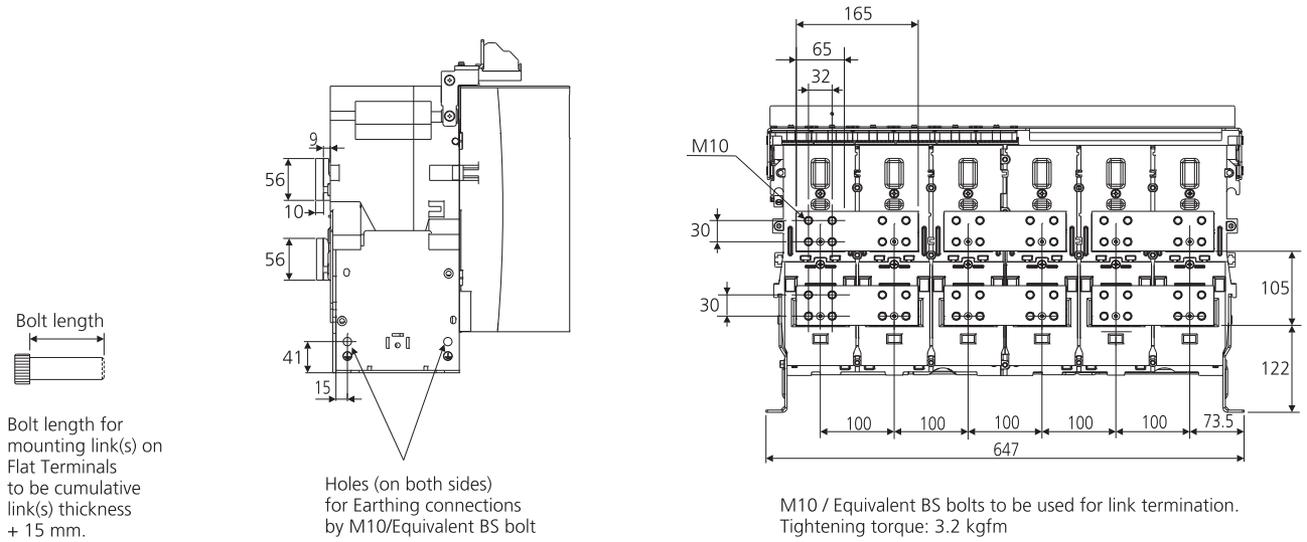
M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm



Details of 4P (200% N) on request.  
All Dimensions in mm

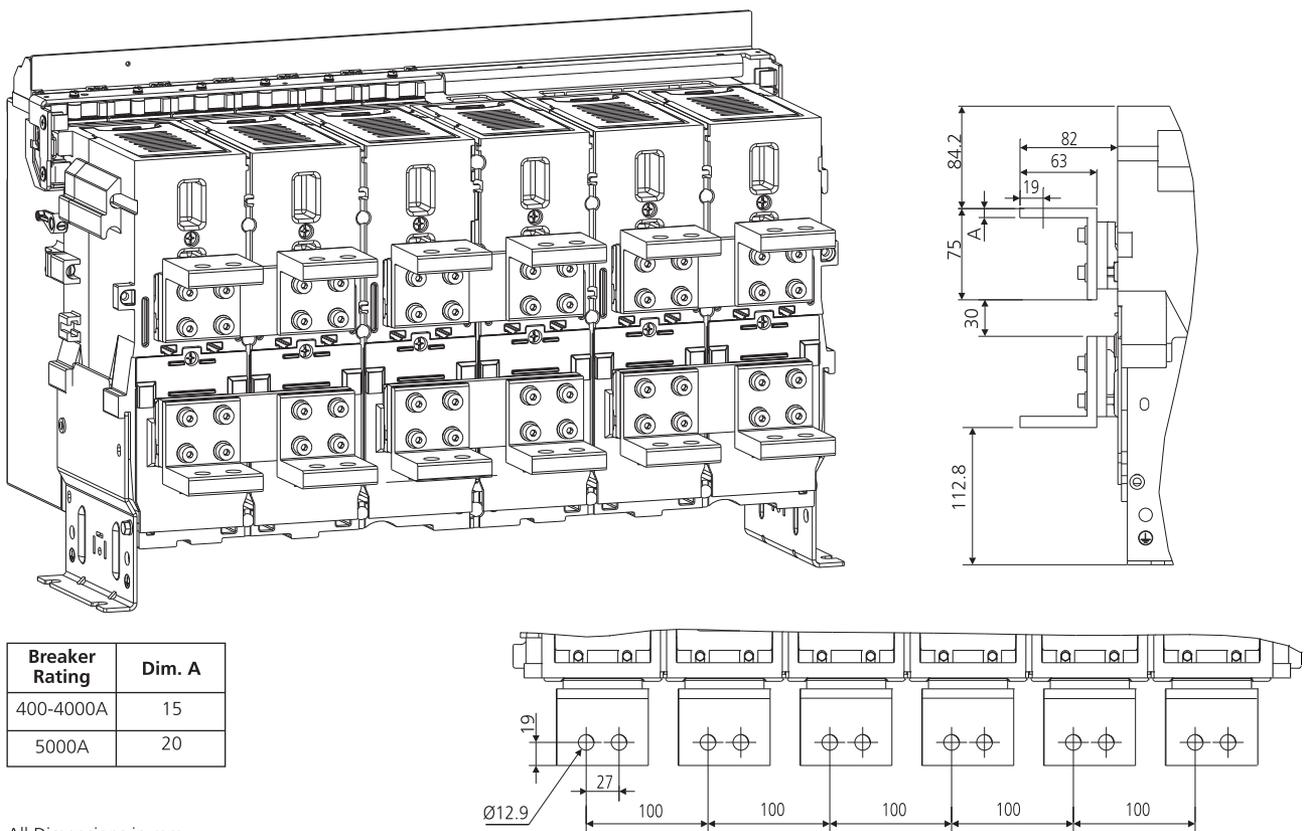
## 400-4000A H/V Fr.3 3P

### Flat Termination



## 400-4000A H/V Fr.3 3P

### Horizontal Termination



Breaker Rating	Dim. A
400-4000A	15
5000A	20

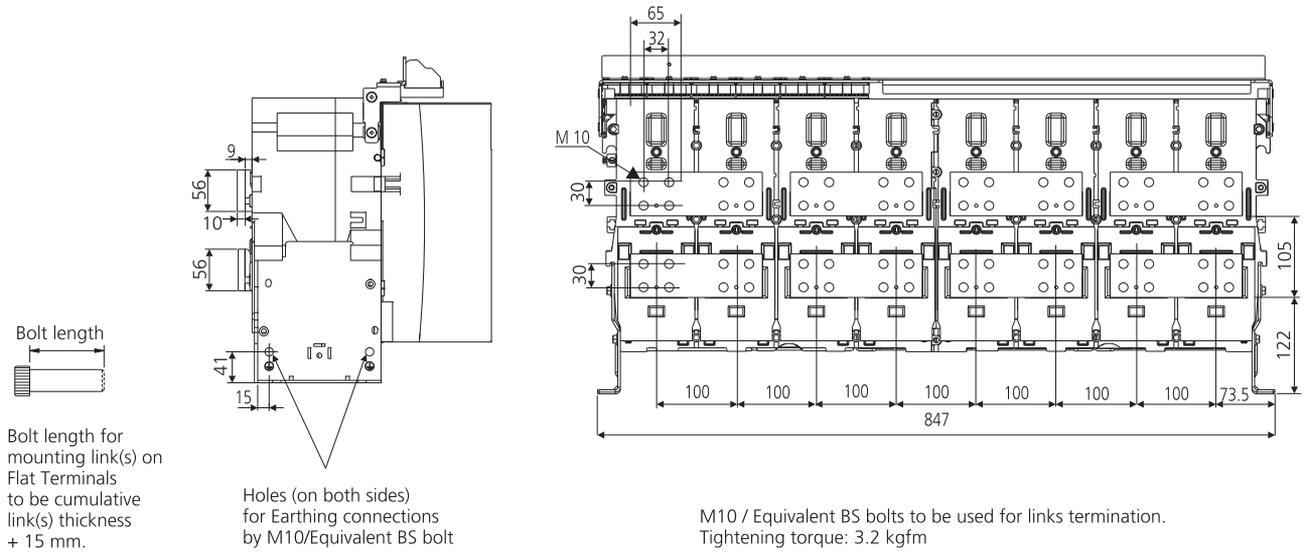
All Dimensions in mm

M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm



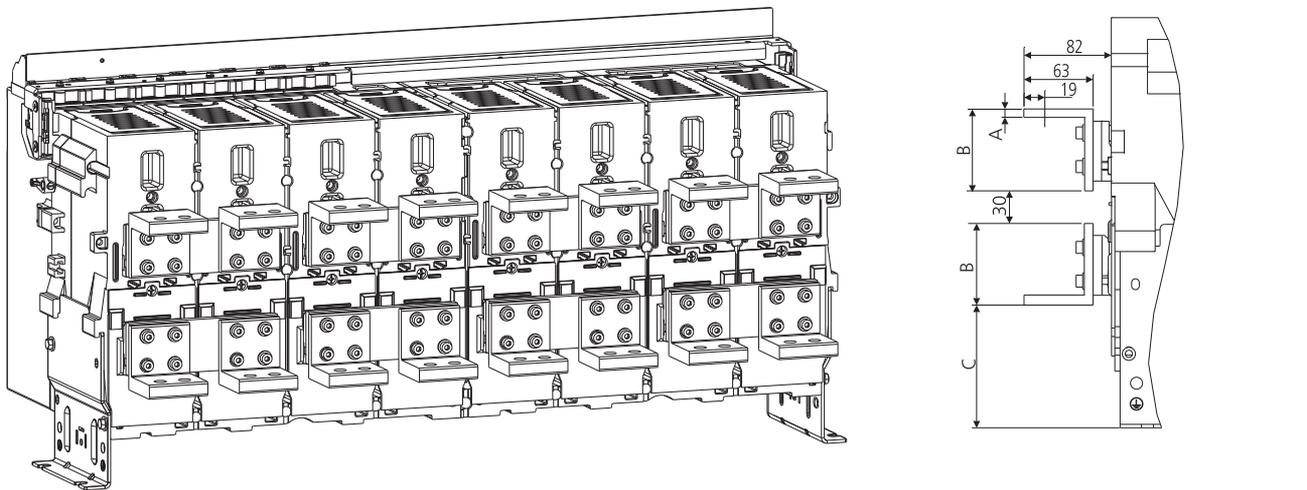
## 400-4000A H/V Fr.3 4P (100% N)

### Flat Termination



## 400-4000A H/V Fr.3 4P(100% N)

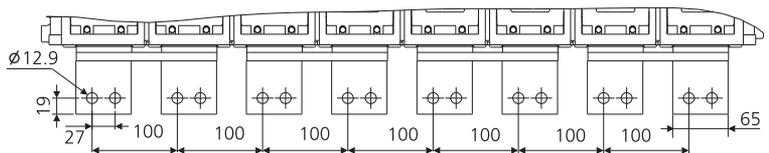
### Horizontal Termination



Breaker Rating	Dim. A
400-4000A	15
5000A	20

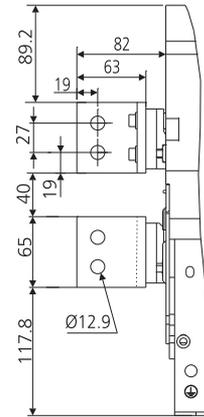
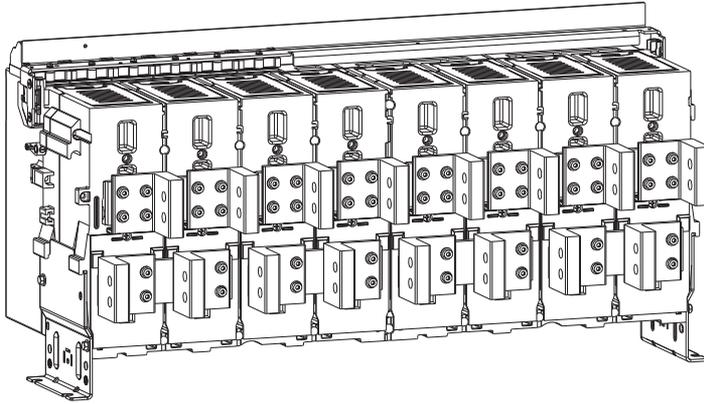
Details of 4P(50% N) on request.  
All Dimensions in mm

M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm



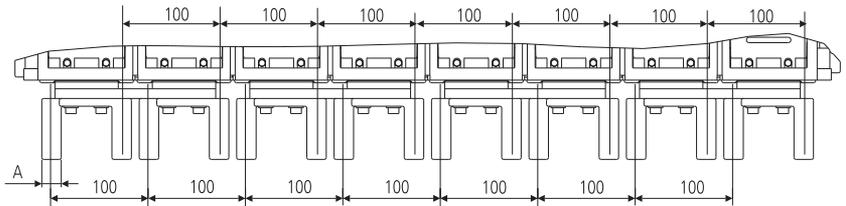
**400-5000A H/V Fr.3 4P (100% N)**

**Vertical Termination**



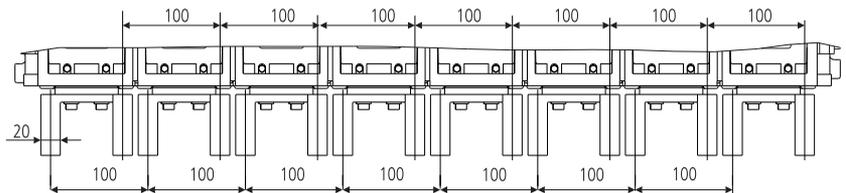
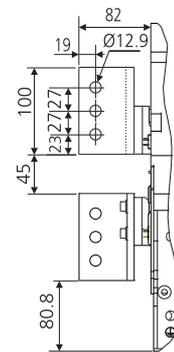
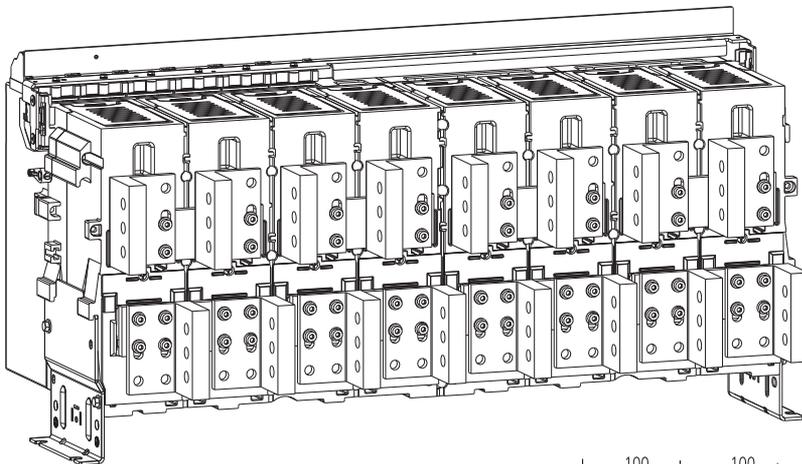
Breaker Rating	Dim. A
400-4000A	15
5000A	20

M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm



**6300A H/V Fr.3 4P (100% N)**

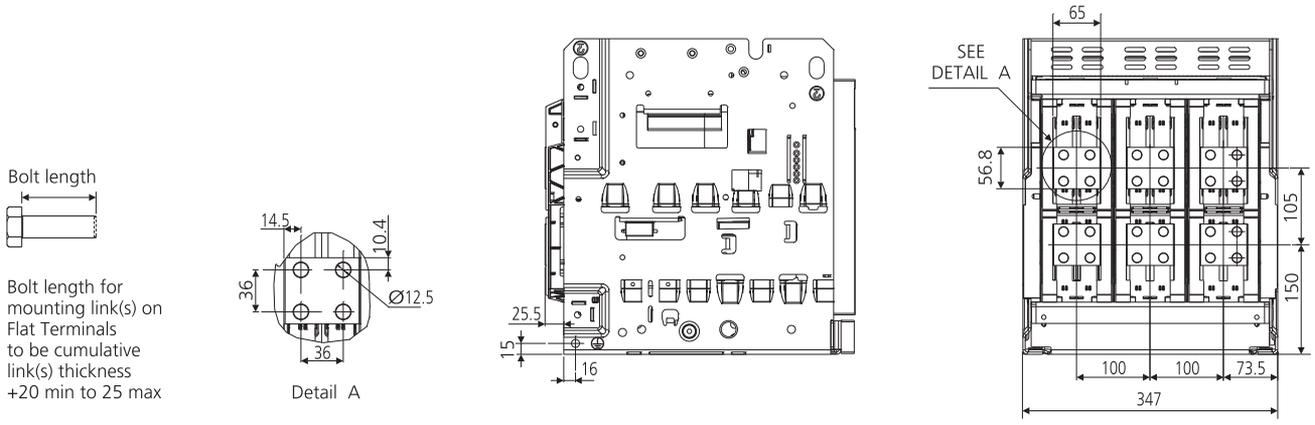
**Vertical Termination**



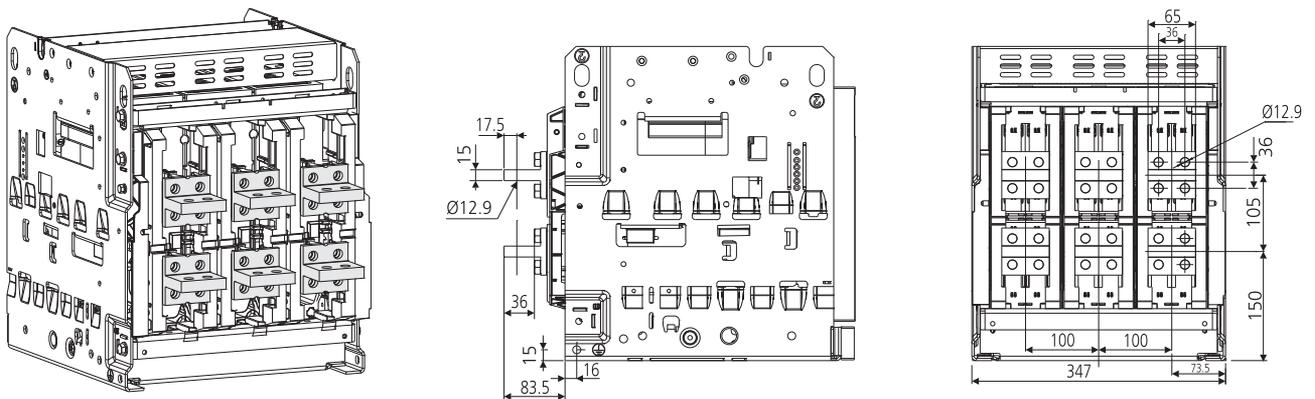
All Dimensions in mm

M12 / Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 kgfm

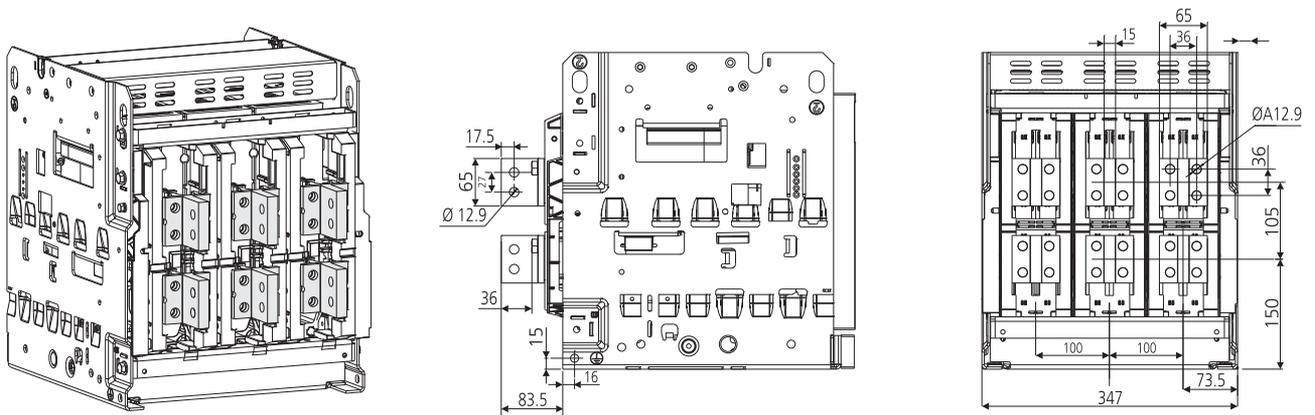
## 400-1600A N, 400-2500A S/H Fr.1 3P Flat Terminals



## Horizontal Terminals\*



## Vertical Terminals\*



\* Only for 400-2000A (for 2500A, Please consult nearest Branch Office)  
M12/Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 Hgfm

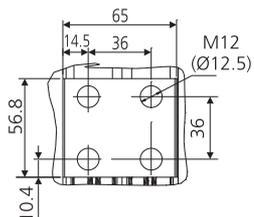
## 400-1600A N, 400-2500A S/H Fr.1 4P (100%N)

### Flat Terminals

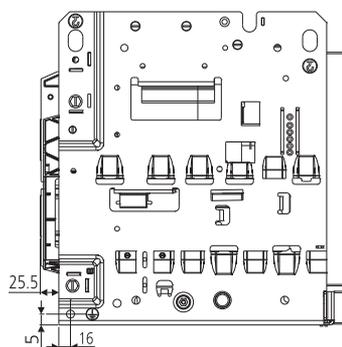
Bolt length



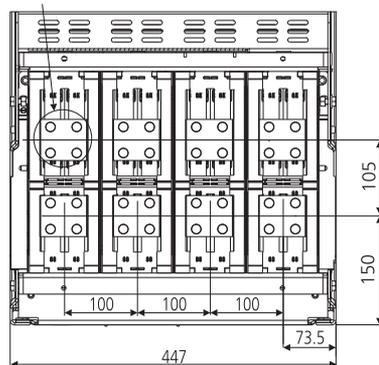
Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness +20 min to 25 max



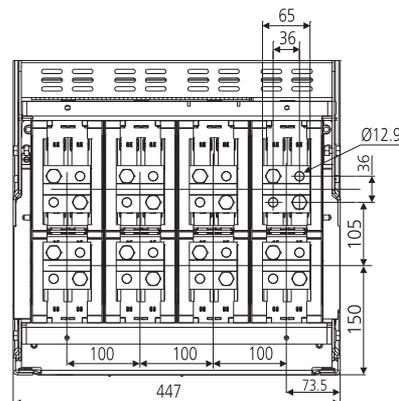
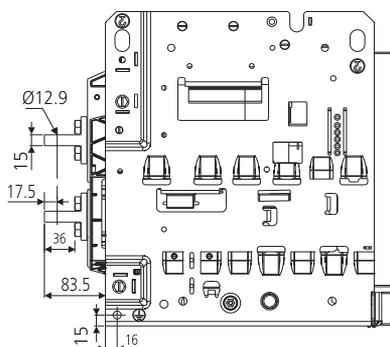
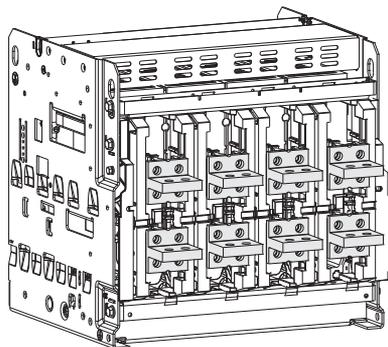
Detail A



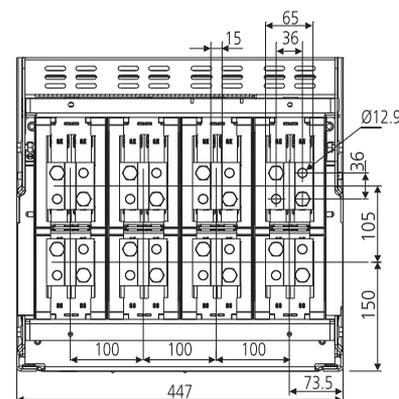
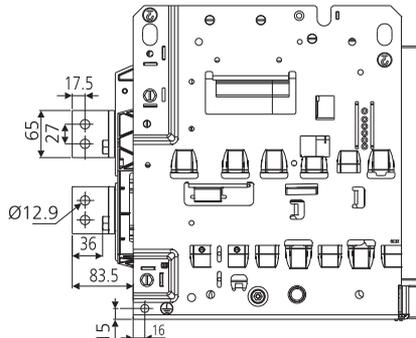
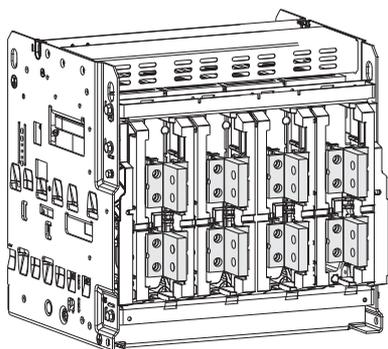
SEE DETAIL A



### Horizontal Terminals\*

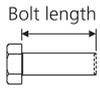


### Vertical Terminals\*

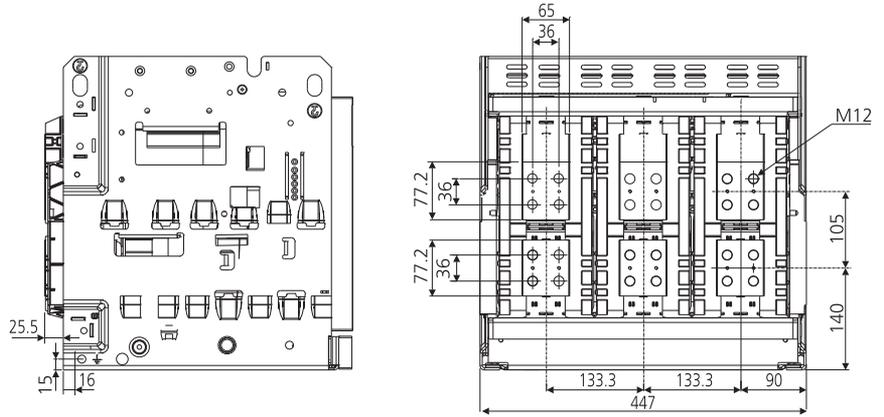


\* Only for 400-2000A (for 2500A, Please consult nearest Branch Office)  
M12/Equivalent BS bolts to be used for links termination.  
Tightening torque: 3.2 Hgfm

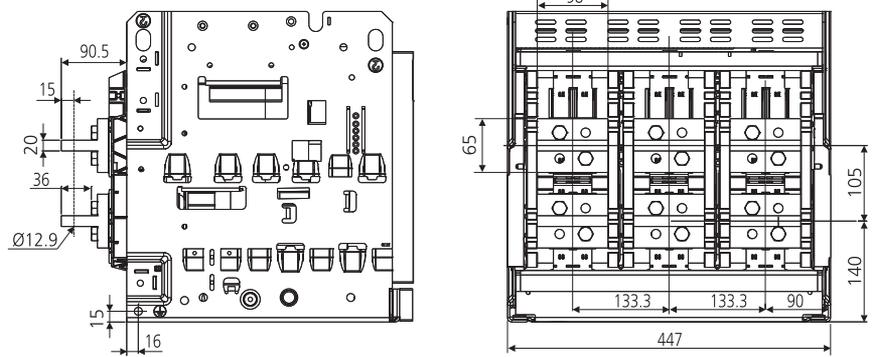
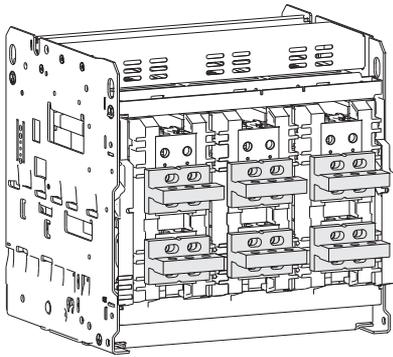
## 400-3200A S/H Fr.2 3P Flat Terminals 400-2500A



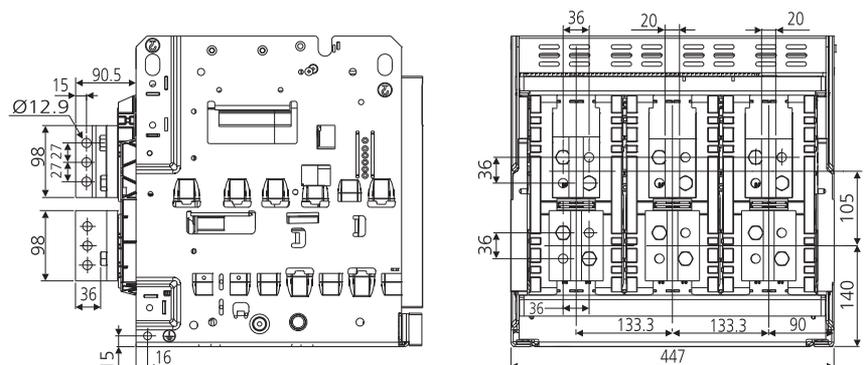
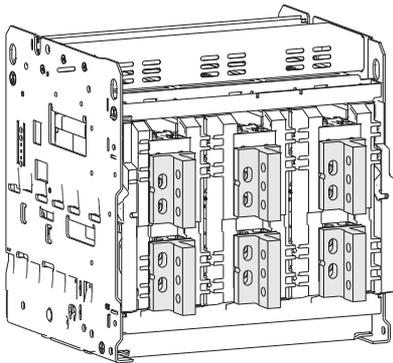
Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness +20 min to 25 max



## Horizontal Terminals 400-3200A



## Vertical Terminals 400-3200A



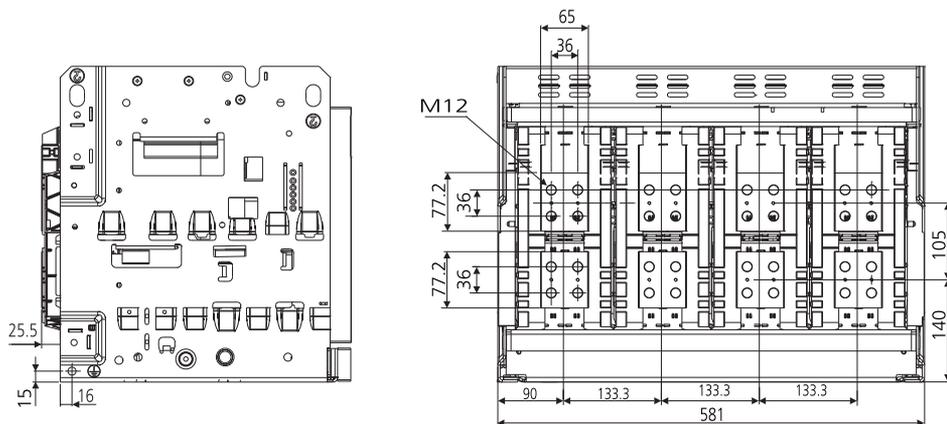
### 400-3200A S/H Fr.2 4P (100% N)

#### Flat Terminals 400-2500A

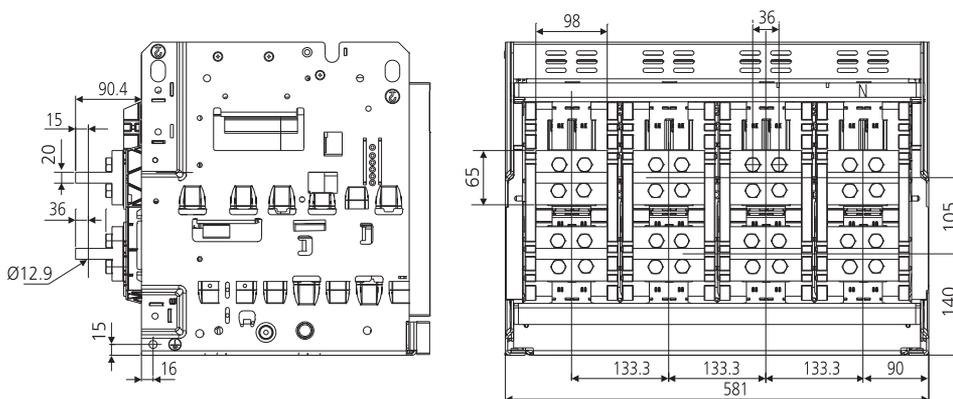
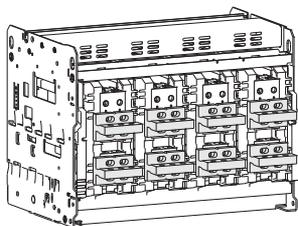
Bolt length



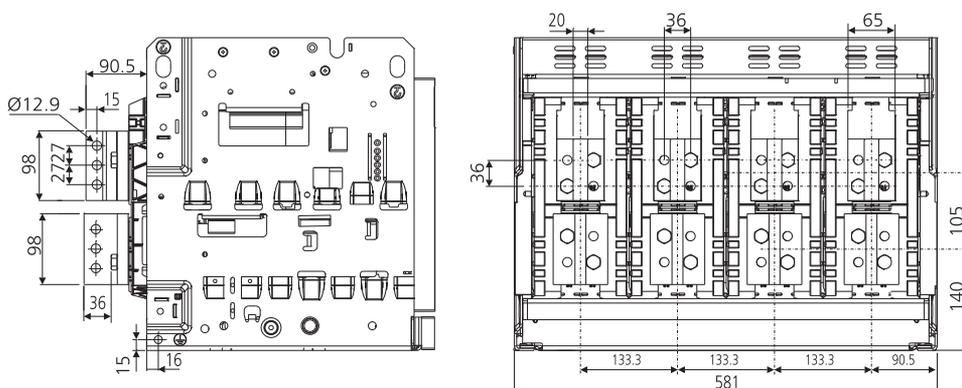
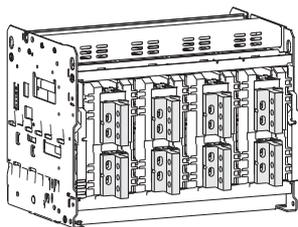
Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness +20 min to 25 max



#### Horizontal Terminals 400-3200A

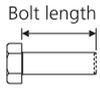


#### Vertical Terminals 400-3200A

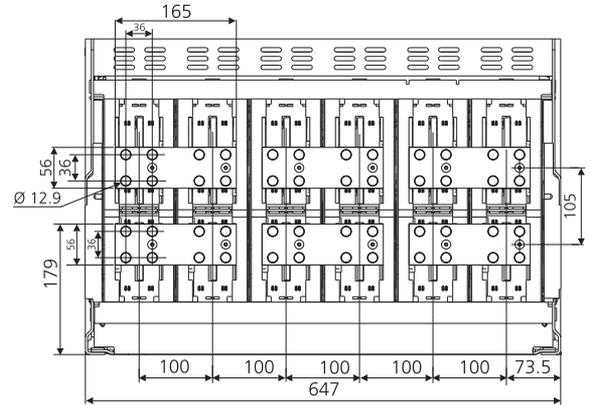
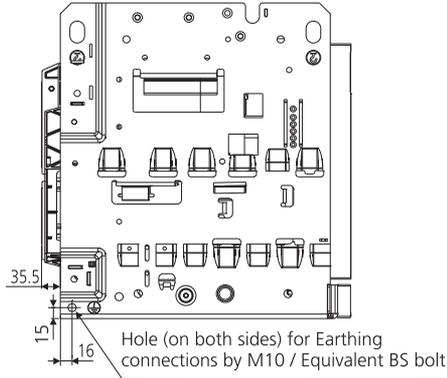


## 400-4000A H/V Fr.3 3P

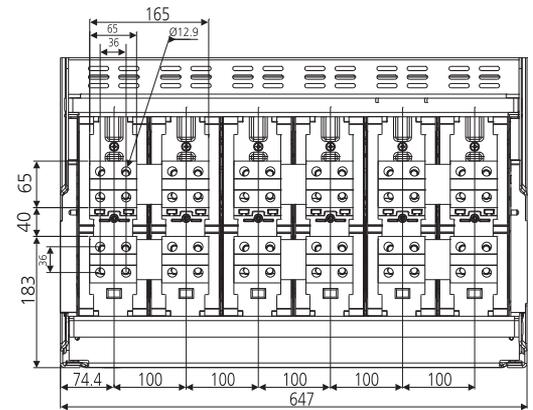
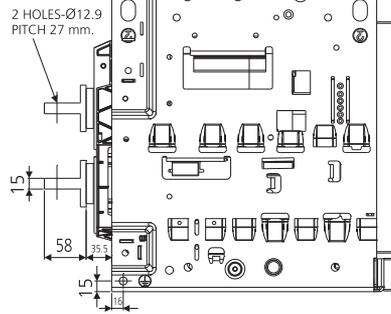
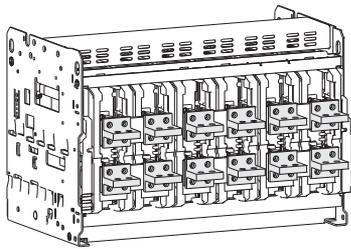
### Flat Terminals 400-2500A



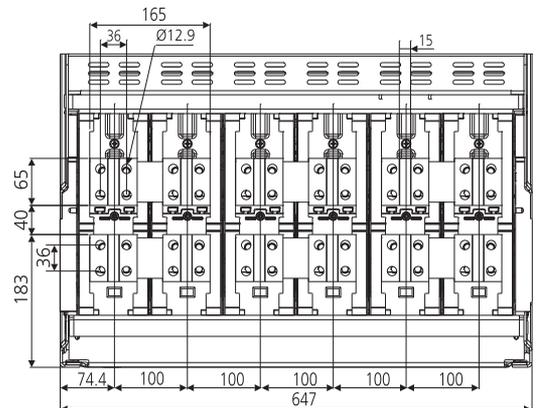
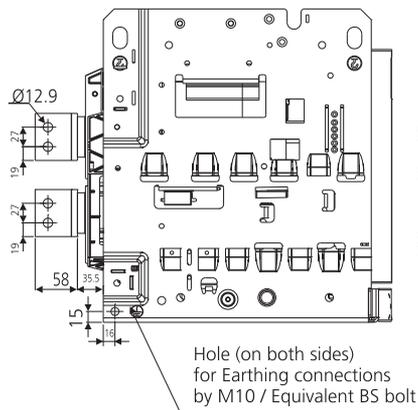
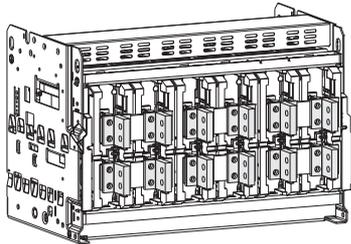
Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness +20 min to 25 max



### Horizontal Terminals 400-4000A



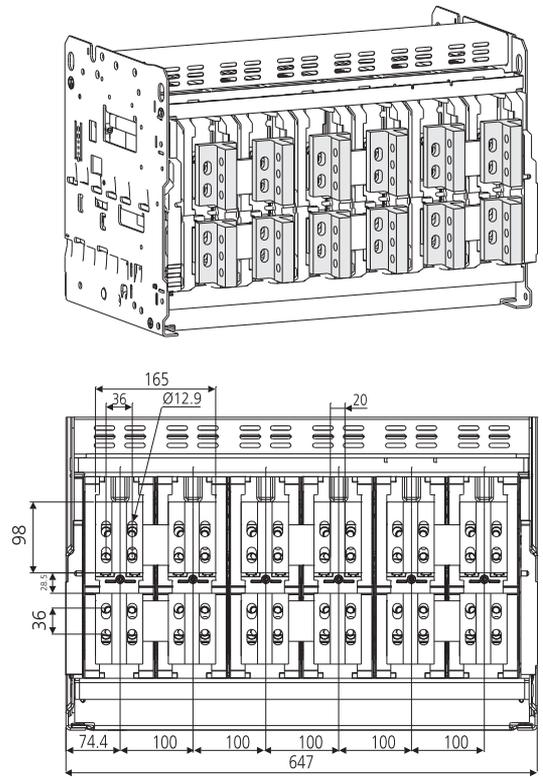
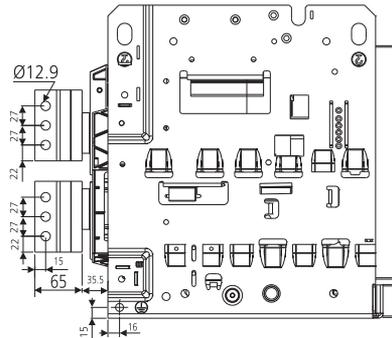
### Vertical Terminals 400-4000A



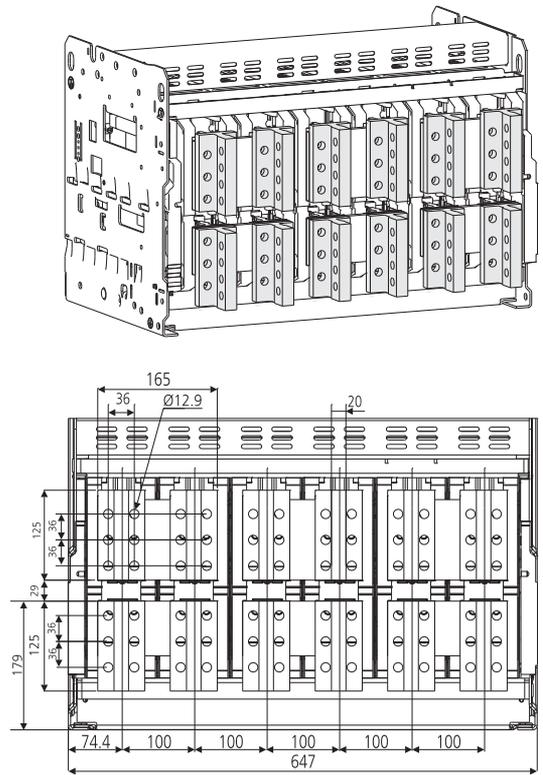
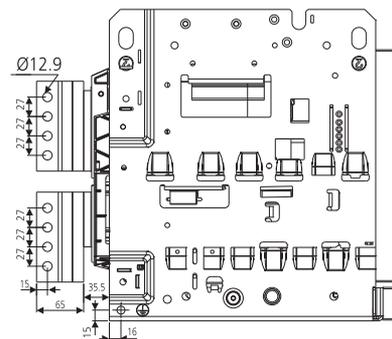
M12/Equivalent BS bolts to be used for links termination Tightening torque: 3.2 kgfm

5000-6300A H/V Fr.3 3P

Vertical Terminals 5000A



Vertical Terminals 6300A



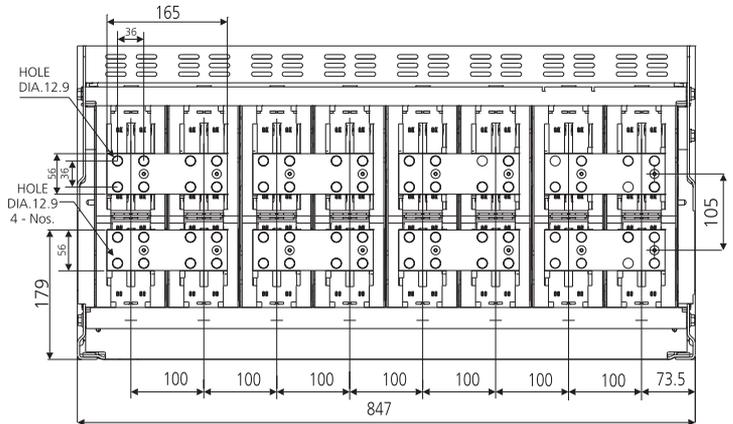
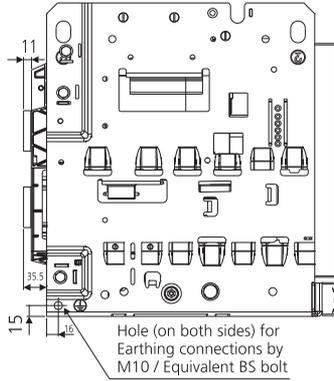
Bolt length  
  
 Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness +20 min to 25 max

## 400-4000A H/V Fr.3 4P (100% N)

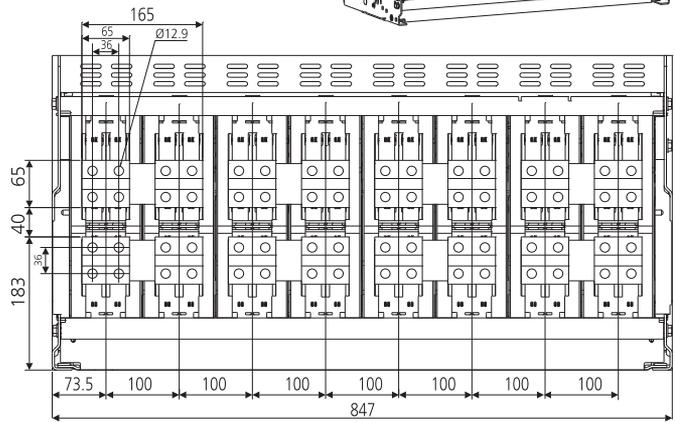
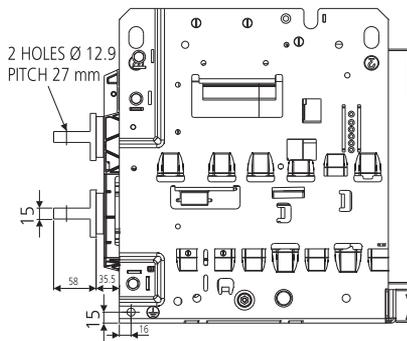
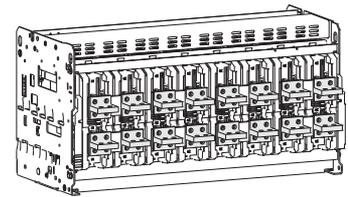
### Flat Terminals 400-2500A



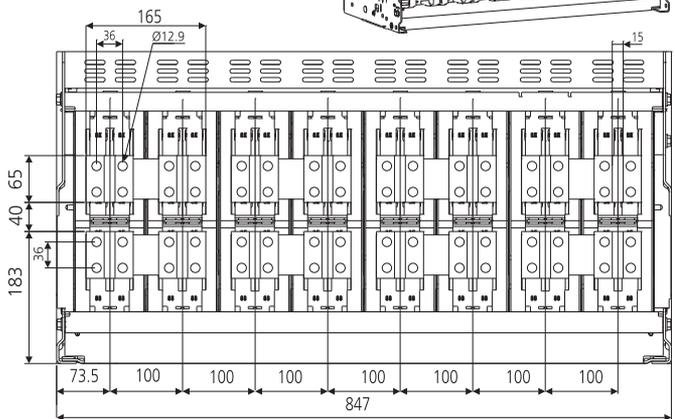
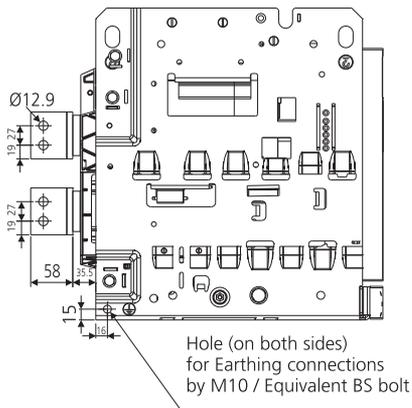
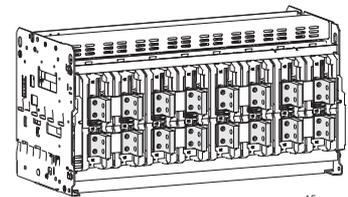
Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness +20 min to 25 max



### Horizontal Terminals 400-4000A



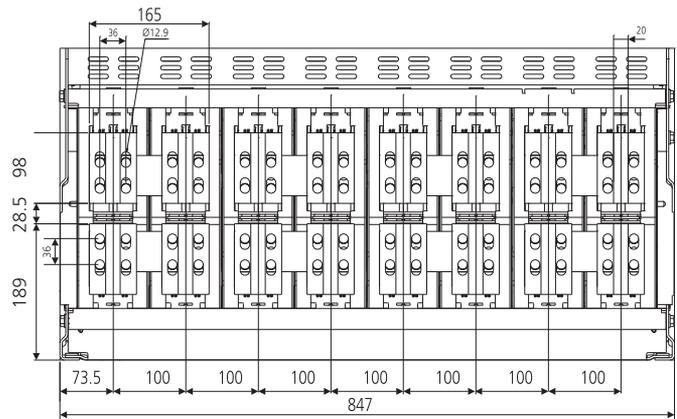
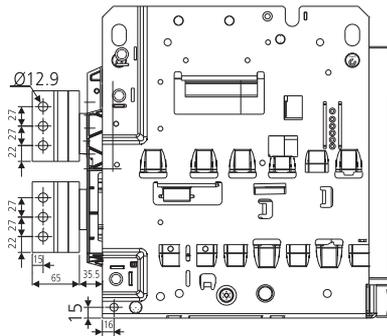
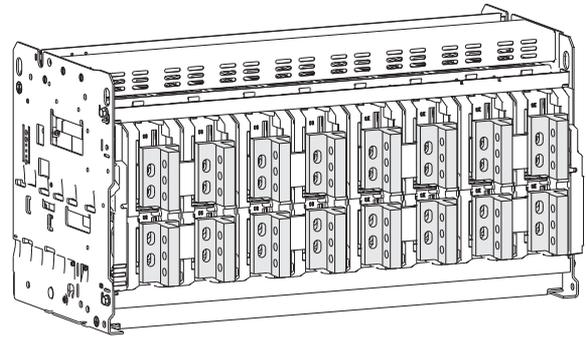
### Vertical Terminals 400-4000A



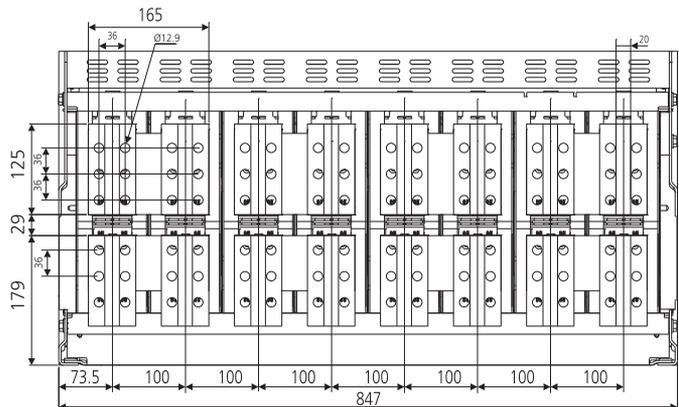
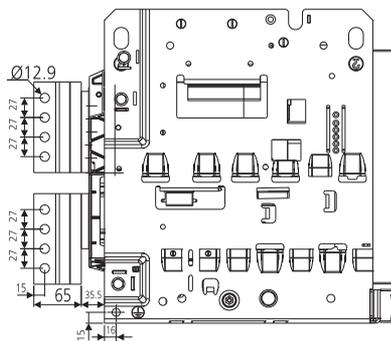
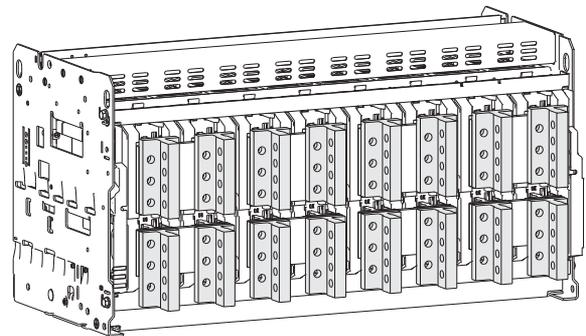
M12/Equivalent BS bolts to be used for links termination Tightening torque: 3.2 kgfm

400-6300A H/V Fr.3 4P (100% N)

Vertical Terminals 5000A



Vertical Terminals 6300A



Bolt length



Bolt length for mounting link(s) on Flat Terminals to be cumulative link(s) thickness + 20 min to 25 max

## Direct Aluminium termination

### Frame-1 : 400 - 1600A N/S/H & 2000A S/H

Frame Size	Rating (A)	Aluminium cross section as per IS/IEC (in sq. mm)	Popular Aluminium Termination								
			Flat			Horizontal (with Terminal adaptor)			Vertical (with Terminal adaptor)		
			6 mm	10 mm	12 mm	6 mm	10 mm	12 mm	6 mm	10 mm	12 mm
1	800	800	75 - 2 runs	-	-	75 - 2 runs 50 - 3 runs	-	-	75 - 2 runs 50 - 3 runs	-	-
	1000	1000	60 - 3 runs	-	-	60 - 3 runs	50 - 2 runs	-	60 - 3 runs	50 - 2 runs	-
	1250	1512	-	-	63 - 2 runs	63 - 4 runs	-	63 - 2 runs	63 - 4 runs	-	63 - 2 runs
	1600	1600	-	60 - 3 runs	75 - 2 runs	-	60 - 3 runs	75 - 2 runs	-	60 - 3 runs	75 - 2 runs
	2000	3000	-	-	-	-	75 - 4 runs	-	-	75 - 4 runs	-

Note: Above table is based on extensive study of popular bus-bar sizes used to terminate Air Circuit Breakers. However other bus-bar sizes (in terms of thickness & width) can also be used to achieve bus-bar cross section recommended by IS & IEC. De-rating of switchgear depends upon various factors such as cross section area, orientation and material of bus bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

### Frame-2 : 400 - 3200A S/H

Frame Size	Rating (A)	Aluminium cross section as per IS/IEC (in sq. mm)	Popular Aluminium Termination					
			Horizontal (with Terminal adaptor)			Vertical (with Terminal adaptor)		
			6 mm	10 mm	12 mm	6 mm	10 mm	12 mm
2	2500	4000	-	100 - 4 runs	-	-	100 - 4 runs	-
	3200	6000*	-	-	-	-	150 - 4 runs	-

Note: Above table is based on extensive study of popular bus-bar sizes used to terminate Air Circuit Breakers. However other bus-bar sizes (in terms of thickness & width) can also be used to achieve bus-bar cross section recommended by IS & IEC. De-rating of switchgear depends upon various factors such as cross section area, orientation and material of bus bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

**Frame-3 : 400 - 6300A H/V**

Frame Size	Rating (A)	Aluminium cross section as per IS/IEC (in sq. mm)	Popular Aluminium Termination					
			Horizontal (with Terminal adaptor)			Vertical (with Terminal adaptor)		
			6 mm	10 mm	12 mm	6 mm	10 mm	12 mm
3	4000	7200*	-	75 - 10 runs 60 - 12 runs	-	-	75 - 10 runs 60 - 12 runs	-
	5000	8000*	Copper termination recommended					
	6300	10000*	Copper termination recommended					

\*Not as per standard but generally followed

Note: Above table is based on extensive study of popular bus-bar sizes used to terminate Air Circuit Breakers. However other bus-bar sizes (in terms of thickness & width) can also be used to achieve bus-bar cross section recommended by IS & IEC. De-rating of switchgear depends upon various factors such as cross section area, orientation and material of bus bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

## Direct Copper termination or Aluminium terminations with Copper jumpers

**Frame-1 : 400 - 1600A N/S/H & 2000A S/H**

Frame Size	Rating (A)	Copper cross section as per IEC (in sq. mm)	Popular Copper Termination								
			Flat			Horizontal (with Terminal adaptor)			Vertical (with Terminal adaptor)		
			6 mm	10 mm	12 mm	6 mm	10 mm	12 mm	6 mm	10 mm	12 mm
1	800	500	-	60 - 1 run	-	-	50 - 1 run 60 - 1 run	-	-	50 - 1 run 60 - 1 run	-
	1000	600	-	60 - 1 run	-	-	60 - 1 run	-	-	60 - 1 run	-
	1250	800	75 - 2 runs	-	-	75 - 2 runs	-	-	75 - 2 runs	-	-
	1600	1000	60 - 3 runs	-	-	60 - 3 runs	-	-	60 - 3 runs	-	-
	2000	1500	-	-	-	-	75 - 2 runs	-	-	75 - 2 runs	-

Note: Above table is based on extensive study of popular bus-bar sizes used to terminate Air Circuit Breakers. However other bus-bar sizes (in terms of thickness & width) can also be used to achieve bus-bar cross section recommended by IS & IEC. De-rating of switchgear depends upon various factors such as cross section area, orientation and material of bus bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

## Frame-2 : 400 - 3200A S/H

Frame Size	Rating (A)	Copper cross section as per IEC (in sq. mm)	Popular Copper Termination					
			Horizontal (with Terminal adaptor)			Vertical (with Terminal adaptor)		
			6 mm	10 mm	12 mm	6 mm	10 mm	12 mm
2	2500	2000	-	100 - 2 runs	-	-	100 - 2 runs	-
	3200	3200*	-	80 - 4 runs	-	-	80 - 4 runs	-

Note: Above table is based on extensive study of popular bus-bar sizes used to terminate Air Circuit Breakers. However other bus-bar sizes (in terms of thickness & width) can also be used to achieve bus-bar cross section recommended by IS & IEC. De-rating of switchgear depends upon various factors such as cross section area, orientation and material of bus bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

## Frame-3 : 400 - 6300A H/V

Frame Size	Rating (A)	Copper cross section as per IEC (in sq. mm)	Popular Copper Termination					
			Horizontal (with Terminal adaptor)			Vertical (with Terminal adaptor)		
			6 mm	10 mm	12 mm	6 mm	10 mm	12 mm
3	4000	4000*	-	100 - 4 runs	-	-	100 - 4 runs	-
	5000	6000*	Vertical termination recommended			-	100 - 6 runs	125 - 4 runs
	6300	7200*	Vertical termination recommended			-	-	150 - 4 runs

\*Not as per standard but generally followed

Note: Above table is based on extensive study of popular bus-bar sizes used to terminate Air Circuit Breakers. However other bus-bar sizes (in terms of thickness & width) can also be used to achieve bus-bar cross section recommended by IS & IEC. De-rating of switchgear depends upon various factors such as cross section area, orientation and material of bus bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

## Temperature Derating of OMEGA ACBs

### Current carrying capacity at different temperatures

U-POWER Omega Air Circuit Breaker can operate at higher temperatures than the reference temperature of 40°C as prescribed in IS & IEC standards, under certain installation conditions. However in some cases current-carrying capacity needs to be reduced in order to follow temperature rise limits and safe working conditions.

The table below shows the current carrying capacity of U-POWER Omega ACB's, where T = temperatures measured around the rear connections of the Air Circuit Breaker.

### Current carrying capacity with copper as bus-bar material

Frame size & current rating	Versions	Current carrying capacity at different temperature (T)				
		40° C	50° C	55° C	60° C	70° C
UW1-08	N	800	800	800	800	800
	S	800	800	800	800	800
	H	800	800	800	800	800
UW1-10	N	1000	1000	1000	1000	1000
	S	1000	1000	1000	1000	1000
	H	1000	1000	1000	1000	1000
UW1-12	N	1250	1250	1250	1250	1250
	S	1250	1250	1250	1250	1250
	H	1250	1250	1250	1250	1250
UW1-16	N	1600	1600	1530	1450	1360
	S	1600	1600	1600	1550	1460
	H	1600	1600	1600	1600	1600
UW1-20	H	2000	2000	2000	2000	2000
UW2-20	S	2000	2000	2000	2000	2000
	H	2000	2000	2000	2000	2000
UW2-25	S	2500	2500	2500	2500	2500
	H	2500	2500	2500	2500	2500
UW2-32	H	3200	3200	3200	3200	3050
UW3-40	H	4000	4000	4000	4000	3850
UW3-50	H	5000	5000	5000	5000	4770
UW3-63	V	6300	6130	5840	5540	5230

Please refer to Pages 113-115 to get the corresponding bus-bar cross section area required with different current rating of Air Circuit Breaker.

**Note:** The values indicated in the above tables are for general guideline for product selection. These values have been extrapolated from test data and theoretical calculations. They cannot replace practical industrial application or a temperature rise test. However de-rating of switchgear depends on others factors such as cross section area, orientation and material of bus-bar, healthiness of bus-bar joints, panel construction, and ventilation, etc.

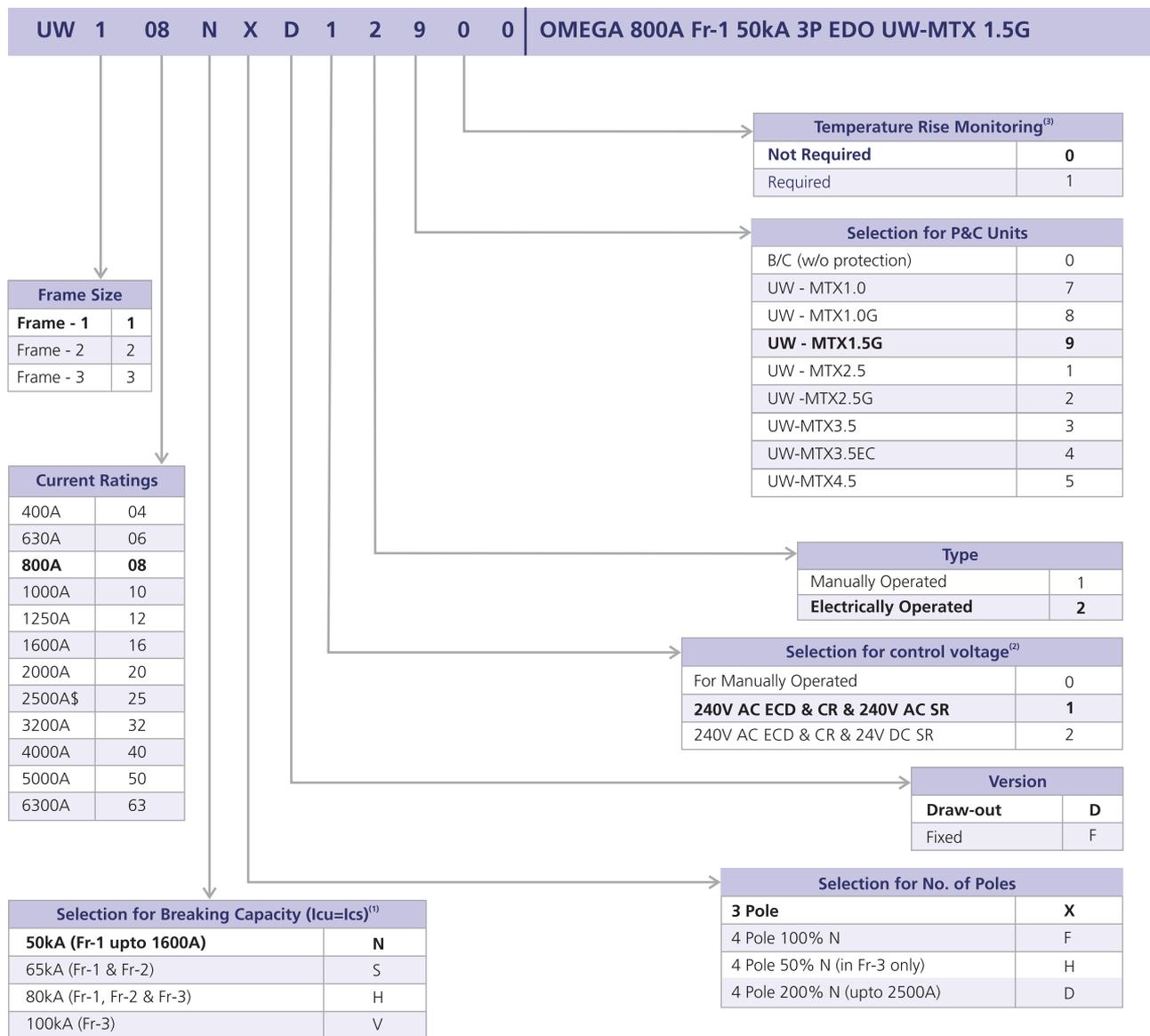
## Watt-loss Data of OMEGA ACBs

### Watt loss value

Watt loss plays an important role in the electrical performance of Air Circuit Breaker. Factors like overall dimension, rated current carrying capacity of Bus-bar and watt loss of apparatus attached to the Air Circuit Breaker also plays an important role in calculation of watt loss data.

Total watt loss value is measured at rated current (In) of a 3 pole Air Circuit Breaker at 50/60 Hz. ( $W = 3 \times I_n^2 \times R$ ), where R is the resistance measured across the upper & lower terminals of ACB at cold state.

Frame Size & Current Rating	For draw-out ACB ( Watt)			
	N	S	H	V
UW1-08	100	50	35	
UW1-10	160	65	50	
UW1-12	210	100	65	
UW1-16	325	160	100	
UW1-20			220	
UW2-20		200	200	
UW2-25		465	465	
UW2-32			600	
UW3-40			500	500
UW3-50			750	750
UW3-63			1000	1000



**Please Note :**

- (1) For Icw values please refer page no.14
- (2) Other options of control voltage are available as accessory
- (3) Temperature protection is available in UW-MTX3.5/3.5EC/4.5

**OMEGA ACBs are offered with following standard features:**

**Draw-out version** : OMEGA ACBs with UW-MTX release will have inbuilt- Current Metering (MTX 1.5G/2.5/2.5G/3.5/3.5EC/4.5), Common Fault Indication microswitch, 4NO+4NC Aux. contacts, Smart-racking shutter, Safety shutter assembly, Racking Handle, Door sealing frame, Pad-locking arrangement for ON/OFF button, Rating Error Preventer, Arc shield (with frame 1N, 2S & 3H version), operation counter for 4000 A & above ratings  
 A) For ratings upto 1600A, one side vertical terminal adaptors (Bottom).  
 B) For ratings 2000A & above, both side vertical Terminal adaptors (Top & Bottom).

**Fixed Version** : OMEGA ACBs with UW-MTX release will have inbuilt- Current Metering (MTX 1.5G/2.5/2.5G/3.5/3.5EC/4.5), Common Fault Indication microswitch, 4NO+4NC Aux. contacts, Door sealing frame & Pad-locking arrangement for ON/OFF button. operation counter for 4000 A a above ratings.

Electrically operated ACB includes ECD (240V AC), CR (240V AC) & SR (240V AC OR 24V DC).

\$ Please consult branch office for selection of 2500A in frame1





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