Susol
Super Solution

Molded Case Circuit Breaker

Instruction Manual
TS 1600

LS Industrial Systems
www.lsis.biz

Instruction manual of Susol MCCB

A. Safety Precaution

1. Safety precaution

■ Outline for safety operation

This manual does not cover all possible contingencies, variations and details that may arise during installation, operation or maintenance of this equipment. If the user has questions regarding a particular installation, contact the local LSIS sales office. For application information, consult your nearest LSIS sales office.
The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. LSIS's reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. If a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence

■ Qualified person

For the purpose of this manual and product labels, a qualified person with suitable knowledge of installation, construction, operation, or maintenance of the equipment and the hazards involved. In addition, this person has the following qualifications:
(a) is trained and authorized to energize, de-energize, clear, ground, and connect circuits and equipment in accordance with established safety practices.
(b) is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with safety practices.
(c) is trained in rendering first aid.
These instructions do not cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. In case particular problems arise which are not covered sufficiently for the purchaser's purposes further information should be desired or the matter should be referred to the local LSIS's sales office. The contents of this instruction manual shall not become part of or modify any prior or existing agreement, commitment or relationship.

■ Danger, Warning, Caution

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, or maintain it.. The following special messages may appear throughout this manual to warn of potential hazard and to call attention to additional information which clarifies or simplifies a procedure.
Safety precaution is classified by danger, warning, caution and the meaning is as follows.

⚠ Danger : Not following the instruction may result in serious injury and even death

⚠ Caution : Not following the instruction may result in minor or moderate injury or property damage

■ Dangerous Procedures

In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work only on de-energized equipment. Always de-energize a contactor, and remove it from the equipment before performing any tests, maintenance or repair.
2. Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

A. Safety Precaution

2. Danger /Caution

⚠ DANGER

1. Before you install the product, please make sure to turn the above circuit breaker off. There is a danger of electric shock during installation.
2. Please be careful not to contact terminal exposure unit. It can result in electric shock or short circuit fault
3. Please do not let any parts of your body touch two exposed hotlines at the same time. Even if there is an electric shock, the circuit breaker might not operate.

⚠ CAUTION

1. Before installing the product, please read precautions and install it accordingly.
2. There is a danger of fault operation or accident from incorrect installation. Please let a qualified person (electrician) install and repair the circuit breaker.
3. Please avoid installation in environments with rain, oil, dust, direct sunlight etc. There is a danger of electric shock, leakage, short circuit, fire and fault operation.
   ※ Normal condition of using circuit breaker.
   1) Usage temperature : -5~40℃ (But, average over 24hr should not exceed +35℃)
   2) Relative Humidity : 45~85% (Max. temperature 40°C ~ below 50%)
   3) Altitude : Below 2000m
   4) Avoid abnormal vibration and impact, excessive vapor, oil, smoke, dust, corrosive gas and flammable Gas.
4. Please connect to the power which is suitable for the product's rated voltage and current. If the rated voltage and current are not correct, it can cause damage or loss.
5. If there is shortage of tightening torque at the terminal, it can cause overheating or fire so please fix the terminal firmly referring to the stated tightening torque on each product's user manual.
7. If you use the products very close to each other, please install an insulation barrier between terminals. If you don't have an insulation barrier, please insulate the compression terminal or conductor's exposure unit with an insulating tape, or install cover. (sold separately) There is a danger of short circuit fault between each phase.
8. Please install insulation barrier between terminals. There is a danger of short circuit fault between each phase.
9. If the circuit breaker operates and break automatically, please remove the cause and then operate the handle.
10. Please be careful not to cause damage while transporting or installing.
11. Please follow your own country's guidelines for disposal of this product.
12. Please do not connect aluminum terminal and conductor directly to circuit breaker's terminal. It will cause corrosion and heating.
13. Please do not make unauthorized alternation.

B. Service condition

1. Normal/Special service condition

■ Normal service conditions

If under ordinary conditions the following normal working conditions are all satisfied, MCCB should be used under this condition unless otherwise specified..

1) Ambient temperature

A range of max. +40℃to min. -5℃ is recommended. However, the average temperature of 24 hours does not exceed +35℃.

2) Altitude : 2,000m or less.

3) Environmental conditions

The air must be clean, and the relative humidity does not exceed 85% at a max. of +40℃ and 90% at 20℃. Do not use and store in presence of corrosive or ammonia gas. (H2S ≤ 0.01ppm, SO2 ≤ 0.01ppm, NH3 ≤ a few ppm)

4) Installation conditions: When installing MCCB, refer to catalogue or the installation instructions in the instruction manual.

5) Storage temperature : A range of max. +60℃ to min. -20℃ is recommended.

6) Replacement : Approx. 15 years (depends on number of breaking of over current or service condition. Please see maintenance and inspection for further detail.

■ Special service conditions

In the case of special service condition, modified air circuit breakers are available. Please specify when ordering. Service life may be shorter, it depends on service conditions.

1) Special environmental conditions

If it is used at high temperature and/or high humidity, the insulation durability and other electrical or mechanical features may deteriorate. Therefore, the breaker should be specially treated. Moisture fungus treatment with increased corrosion-resistance is recommended. When using products under this condition, please contact LS service team or nearest sales representatives.

2) Special ambient temperature

If the ambient temperature exceeds +40℃, reduce the continuous conducting current for a use referring to Table. A.

3) Special altitude

If it is used at the 2,000m or higher the heat radiation rate is reduced and the operating voltage, continuous current capacity and breaking capacity are decreased. Moreover the durability of the insulation is also decreased owing to the atmospheric pressure.

Table A. The compensation of rated current according to ambient temperature

Type	Rated Current	Bus Applicable Standards	Ambient temperature (℃)				
			40	45	50	55	60
TS1000N/H/L	800A	5tX50X2ea	800A	800A	800A	800A	800A
	1000A	5tX60X2ea	1000A	1000A	1000A	1000A	1000A
TS1250N/H	1250A	5tX80X2ea	1250A	1250A	1250A	1250A	1250A
TS1600N/H	1600A	5tX100X2ea	1600A	1600A	1560A	1510A	1470A

B. Service condition

2. Altitude and Insulation voltage

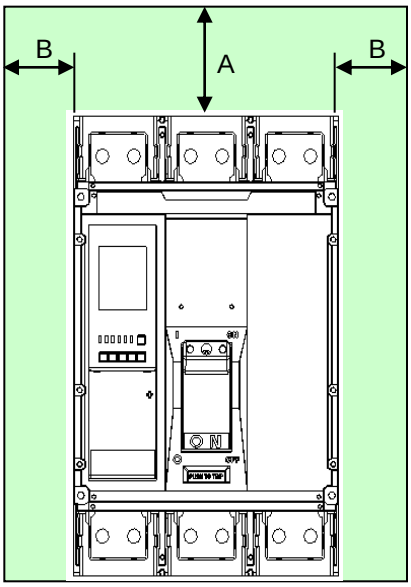
■ Altitude

MCCB is designed for operation at altitudes under 2000m. At altitudes higher than 2000m, change the ratings upon a service condition.

Item \ Altitude (m)	2000	3000	4000	5000
Withstand voltage [V]	3500	3150	2500	2100
Average insulating voltage [v]	1000	900	700	600
Max. using voltage [V]	690	590	520	460
Current compensation constant	1 x In	0.99 x In	0.96 x In	0.94 x In

■ Clearances

When drawing the electric power supply panel, please keep the distance of Insulation clearance between MCCB and panel as listed in table.

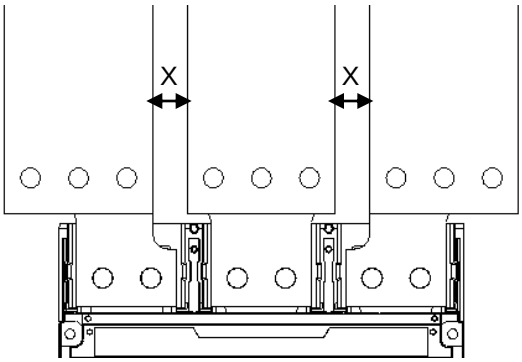


Unit :mm

Type		A	B
Front Connection type	N	150	50
	H	150	50
	L	150	50

■ Minimum insulation clearance

The dimension of all charging parts should be over the minimum insulation clearance

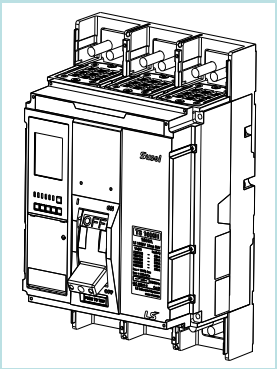


Insulating voltage(Ui)	Min. insulation clearance(X min)
600V	8 mm
1000V	14 mm

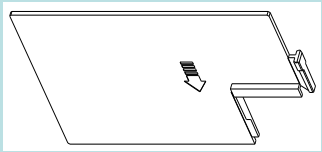
C. Structure and Operation

1. Internal structure and Components

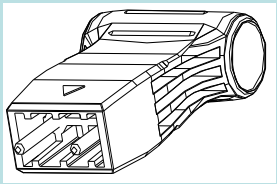
■ Product Configuration



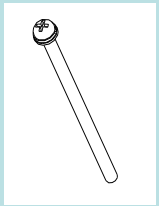
Circuit breaker : 1ea



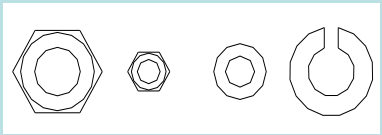
Barrier Interphase
3p : 2ea, 4p : 3ea



Handle Aux : 1ea



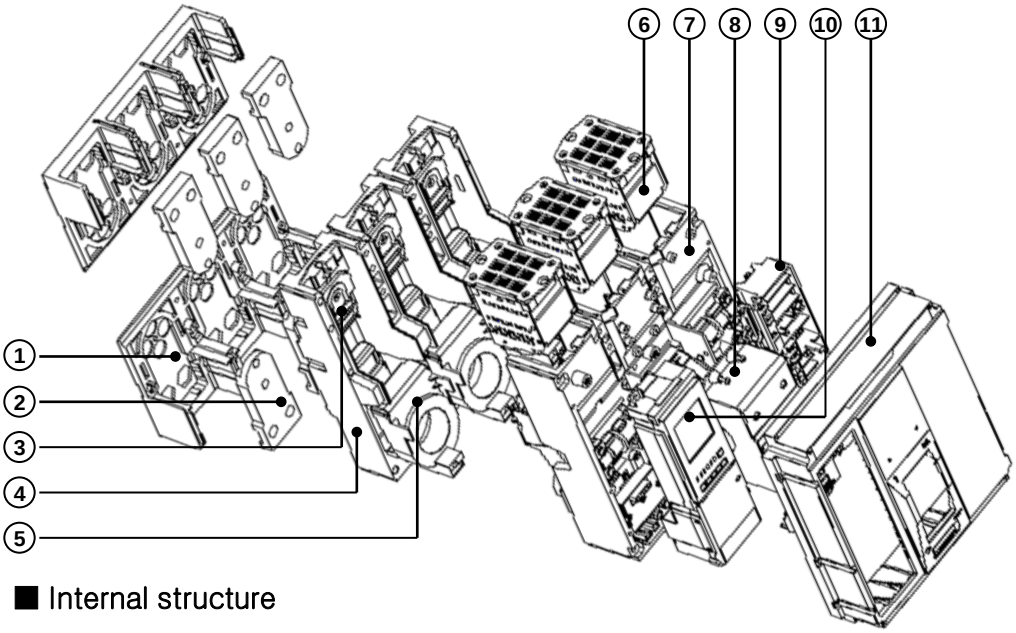
Screw (M5×110): 4ea



Nut(M5) : 4ea
Nut(M10),S/W,P/W
3p : 12, 4p : 16

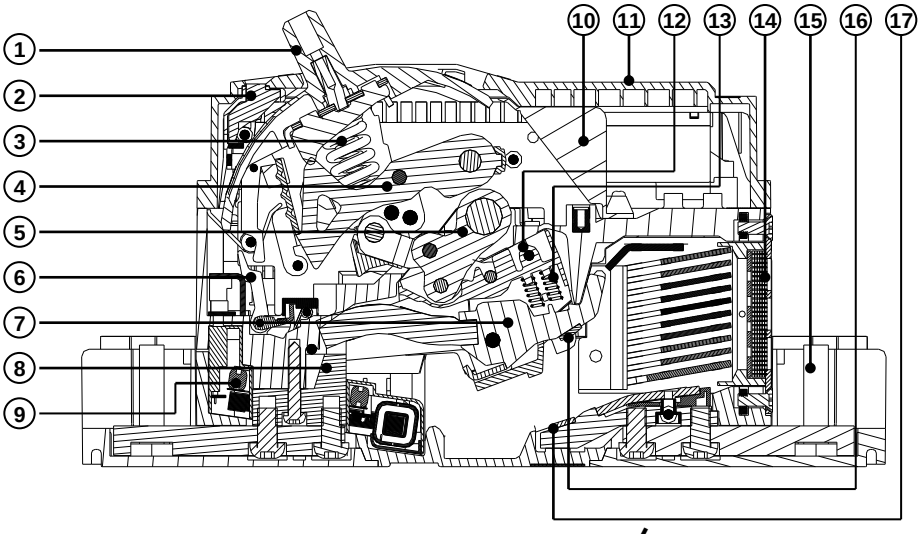
Plate protection : 1ea

■ Components



① Terminal Base
② Terminal
③ Fixed Contactor
④ Rear Base
⑤ Power CT
⑥ Arc Chute
⑦ Mechanism
⑧ Handle Cover
⑨ Mechanical Trip Device
⑩ Trip Relay
⑪ Main Cover

■ Internal structure

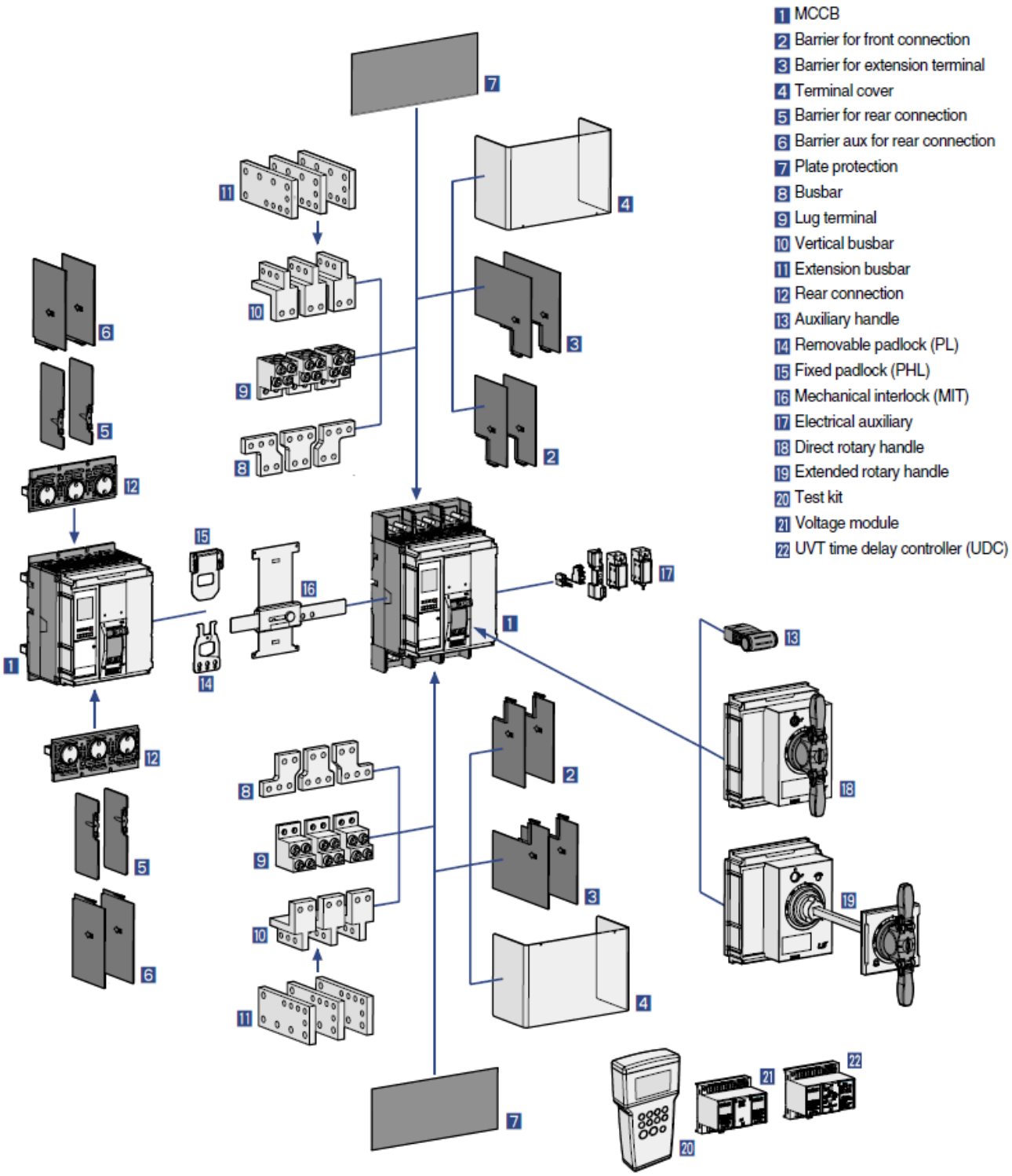


① Handle
② Test Button
③ Main Spring
④ Link Ass'y
⑤ Main Shaft Ass'y
⑥ Hard Trip Device
⑦ Moving Contactor
⑧ Load Terminal
⑨ Power CT
⑩ Handle Cover
⑪ Main Cover
⑫ Wall Holder Contactor
⑬ Contact Spring
⑭ Arc Chute
⑮ Terminal Bolt
⑯ Moving Tip
⑰ Fixed Tip

C. Structure and Operation

1. Internal structure and Components

■ System Overview



C. Structure and Operation

2. Basic function and Breaking operation

■ **MCCB prevents a fire, a property damage, the breakage of an electrical equipment on load side by protecting a circuit from the fault currents.**

1) Circuit Closing

The closing operation of mechanism applies the current to the load. When energized, some loads makes inrush current much greater than rated current (In) .To prevent these over current which causes the dangerous phenomena for contacts (Erosion by arcs), closing operation should be prompt. If a circuit breaker is in accordance with all standard cases, it should be able to endure 15~20 times of the rated current and be opened promptly for the faults occurred during closing operation or after it has closed.

2) Current Conducting

A circuit breaker must not be exceeding an acceptable temperature rise under normal current conducting and there must be safe current conducting within specified breaking time under over current. Furthermore, if a circuit breaker is of the discriminated type, it must has the structure which can withstand the high electrodynamics to accept the short-circuit current while a circuit breaker in downstream is operating to break it.

3) Circuit Opening, Current Breaking

ⓐ Current can be broken manually or remotely by voluntary operation on mechanism.

ⓑ A circuit breaker opens a circuit automatically under condition of current which may has any values at this time by an auxiliary trip unit (Under voltage, Ground fault, etc.)

ⓒ A circuit breaker opens a circuit automatically against the over current because it is operated by OCR (the trip unit) even if it is in the closed position.

4) Isolation

When a circuit breaker is open, a certain isolation level is required between charging and non-charging parts. The Isolation Level is decided by following tests.

ⓐ A maximum leakage current test under rated using voltage (Max. Ue)

ⓑ An impulse voltage

■ **There are following breaking principles regarding over current.**

1) Instantaneous trip

When short-circuit current flows in, MCCB trips instantly to minimize side effect due to the accident on load side. It is called instantaneous trip..

2) Time delay breaking

When abnormal current flows in such as inrush current of transformer or condenser, and starting current of motor, MCCB keeps the conducting condition for a regular time and break the current if it is continuously remained. In case of short-circuit, MCCB minimizes the damage from accident by keeping the circuit for the time previously set concerning the operating time of branch breakers under selective discrimination. However, it breaks the circuit after the delayed time in case abnormal current continuously flows in due to the breaking failure of branch breakers. It is called as Time delayed breaking.

3) Overload trip

If the current which exceeds the rated current flows in continuously, the cable is getting hotter and it causes the big fire. Therefore, MCCB breaks the current before the temperature of cable reaches the dangerous level. It is called overload trip.

4) Ground-fault trip

Ground fault defines as current flows into the ground from circuit or charging part of load due to breakdown. If ground fault current flows, it is inducted to other cables nearby owing to electronic induction, voltage level is risen and it finally cause severe effects or damage on other device. Furthermore, in case personnel hands are touched, it may result in electrical shock. Ground fault breaking is to prevent any possible accident occurred from ground fault.

D. Types and Ratings

1. Type of MCCB

TS 1600	N	NG0	1600A	3P	–	–

Basic form/ Ampere frame

TS	1000
	1250
	1600

TYPE

N	Normal
H	High
L	Current Limiting
NA	Switch-disconnector

Trip relay

N	Normal
A	Ammeter
P	Power meter
S	Supreme meter

Rated Current

800A
1000A
1250A
1600A

The number of poles

3P	3poles
4P	4poles

4-poles - Three-wire

L	N-R-S-T
R	R-S-T-N

–	STANDARD
REAR	Rear Connection

2. Model of Trip Relay

N	G	O

Trip relay type

000	Without trip relay
N	Normal
A	Ammeter
P	Power meter
S	Supreme meter

Communication & protection

G	Without comm. + L/S/I/G
G	Without comm.
Z	Without comm. + Earth leakage
E	Without comm. + Earth leakage
C	Comm.
K	Comm. + Earth leakage
X	Comm. + Earth leakage
A	Comm. + Pre-trip alarm

Control voltage & frequency

0	Self-Power, 60Hz
5	Self-Power, 50Hz
1	AC/DC 100V~250V, 60Hz
2	DC 24V~60V, 60Hz
6	AC/DC 100V~250V, 50Hz
7	DC 24V~60V, 50Hz

* L/S/I/G configuration as standard
  -with LED indicators
  -without output contacts
* Ground fault system by vector sum

* L/S/I/G configuration as standard
* Ground fault system by vector sum(G,C)
* Earth leakage system
  - Z,K: External CT - LS ZCT applied(fault current 0.5~30A, 1600AF)
  - E,X: External CT - Private ZCT applied(fault current >30A)
* Comm. And output contacts DO NOT work under self-power condition.
  (Only checking LED available)

* L/S/I/G configuration as standard
* Ground fault system by vector sum
* Earth leakage system
  - K: External CT - LS ZCT applied(fault current 0.5~30A, 1600AF)
  - X: External CT - Private ZCT applied(fault current >30A)
* Applicable to generator protection purpose
* Comm. And output contacts DO NOT work under self-power condition.
  (Only checking LED available)

* L/S/I/G configuration as standard
* Ground fault system by vector sum
* Earth leakage system
  - K: External CT - LS ZCT applied(fault current 0.5~30A, 1600AF)
  - X: External CT - Private ZCT applied(fault current >30A)
* Applicable to generator protection purpose
* Comm. And output contacts DO NOT work under self-power condition.
  (Only checking LED available)

Note) 1. L/S/I/G configuration as standard
2. Ground fault, earth leakage and pre-trip alarm functions are alternative.
3. The functions like Metering, Communication, ZSI, Remote reset and Digital output are NOT available only under Self-power condition.
4. Voltage module should be required for P and S types(supplied separately)

D. Types and Ratings

3. Rating Specification

Model				TS1000			TS1250		TS1600	
Frame (AF)				1000			1250		1600	
Pole				3, 4			3, 4		3, 4	
Type				N	H	L	N	H	N	H
Rated current(A)	In	-5~40℃		800, 1000			1250		1600	
		50℃		800, 1000			1250		1560	
		65℃		800, 1000			1240		1420	
Rated insulation voltage(V)	Ui			1000						
Impulse withstand voltage (kV)	Uimp			8						
Rated voltage	Ue	AC50/60Hz		690						
Icu (kA)	Icu	AC50/60Hz	220/240V	55	75	200	55	75	55	75
			380/415V	50	70	150	50	70	50	70
			440/460V	50	65	130	50	65	50	65
			480/500V	40	50	100	40	50	40	50
			660/690V	35	45	-	35	45	35	45
Service Breaking capacity (kA)	Ics	%Icu		100%	75%	100%	100%	75%	100%	75%
Short time current(kA)	Icw	AC50/60Hz	1s	25	25	12	25	25	25	25
			3s	-	-	-	-	-	-	-
Overriding instantaneous protection, kA peak				50		30	50			
Isolation				○						
Category				B	B	A	B	B	B	B
Endurance	Mechanical			10000		4000	10000		10000	
	Electrical	440V	In/2	6000	6000	4000	5000	5000	5000	5000
			In	5000	5000	3000	4000	4000	2000	2000
		690V	In/2	4000	4000	3000	3000	3000	2000	2000
			In	2000	2000	2000	2000	2000	1000	1000
Pollution degree				3			3		3	
Trip Relay				N	A	P	S			
Over current	Long time		Ir (In x…)	○	○	○	○			
	Short time		Isd (Ir x…)	○	○	○	○			
	Instantaneous		Ii (In x…)	○	○	○	○			
Ground Fault			Ig (In x…)	○	○	○	○			
Residual Earth Leakage			IΔn	-	△	△	△			
Zone Selective Interlocking			ZSI	-	○	○	○			
Nphase protection				○	○	○	○			
Current Measurement				-	○	○	○			
Voltage Measurement				-	-	○	○			
Indicating fault condition (LED)				○	○	○	○			
Fault condition output contact				-	△	○	○			
Communication				-	△	○	○			
Fault Recording				-	△	○	○			
Event Recording				-	-	○	○			
Dimension (mm)		3P		327 x 210 x 152.5						
H x W x D		4P		327 x 280 x 152.5						
Weight(kg)		3P		13						
		4P		16.8						
Standards				IEC60947-2						

E. Weight & Dimension

1. Weight / Dimension

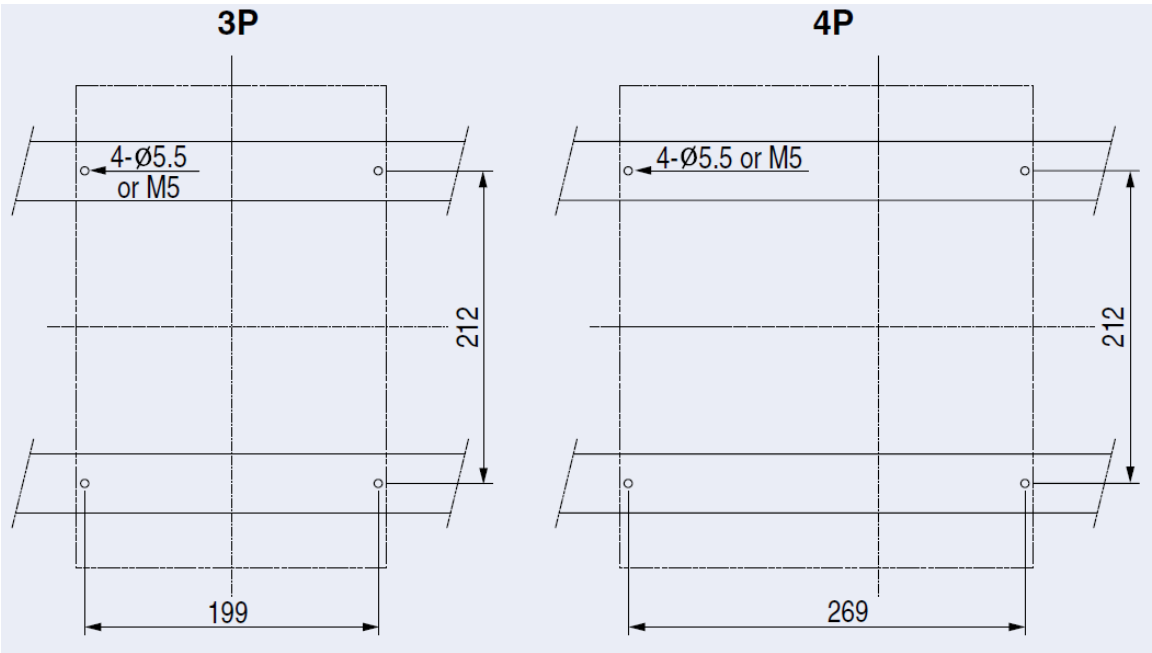
1. Weight

Unit : kg

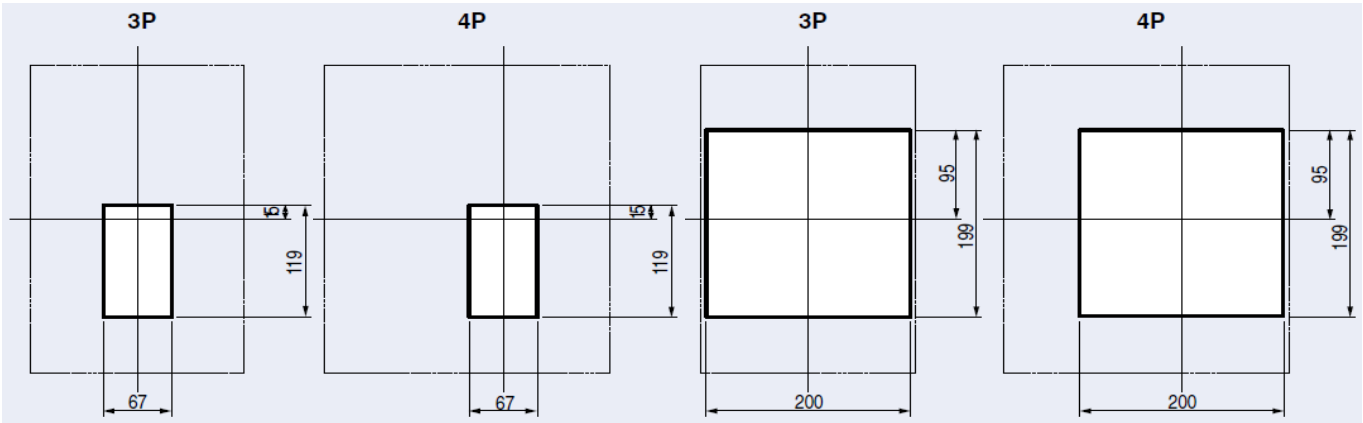
Type	The number of pole		Note
	3P	4P	
Front connection Type	13	16.8	
Rear Connection Type	12.6	16.4	

2. Overall Dimension

1) Panel installation.



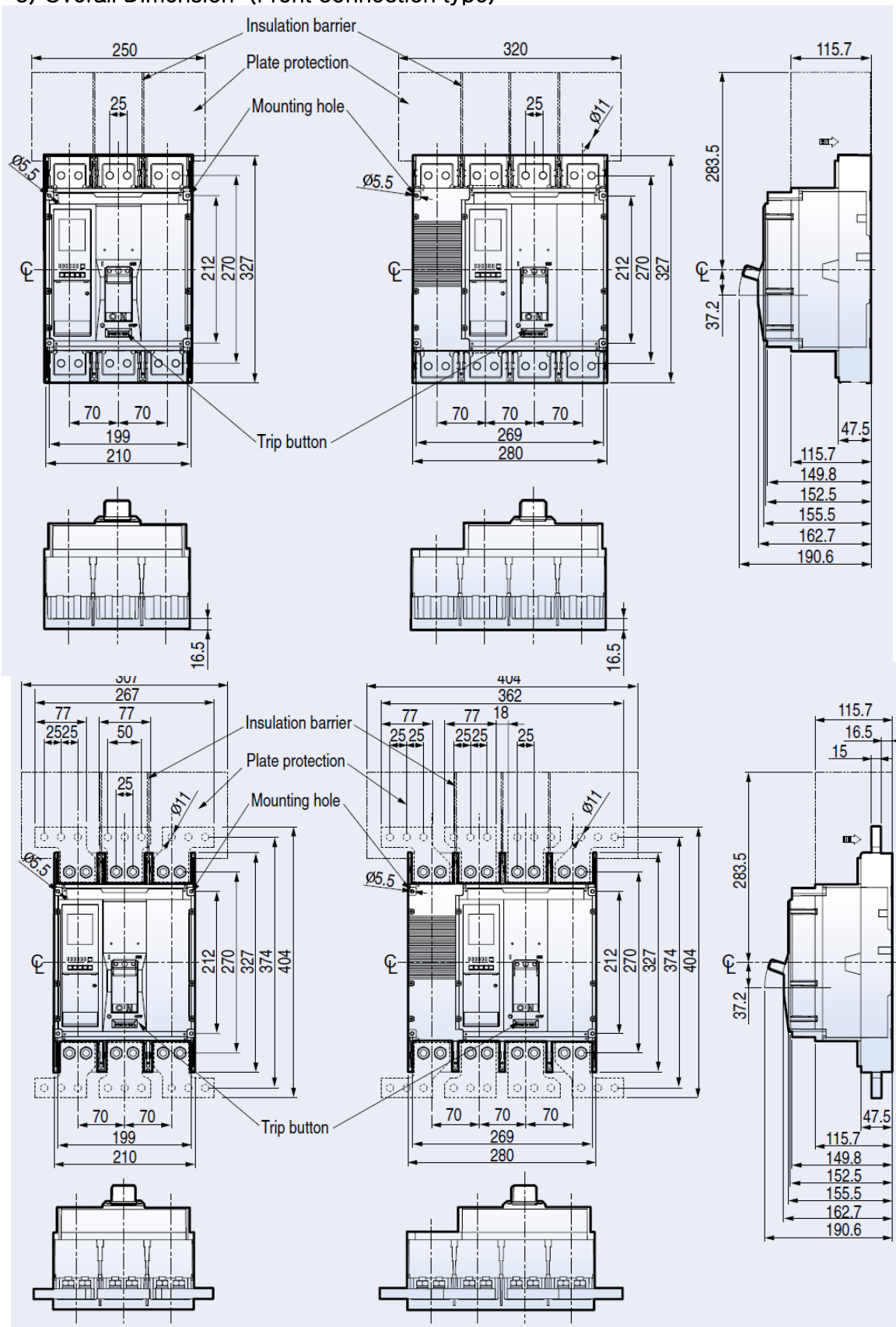
2) Panel cover cutting .



E. Weight & Dimension

1. Weight & Dimension

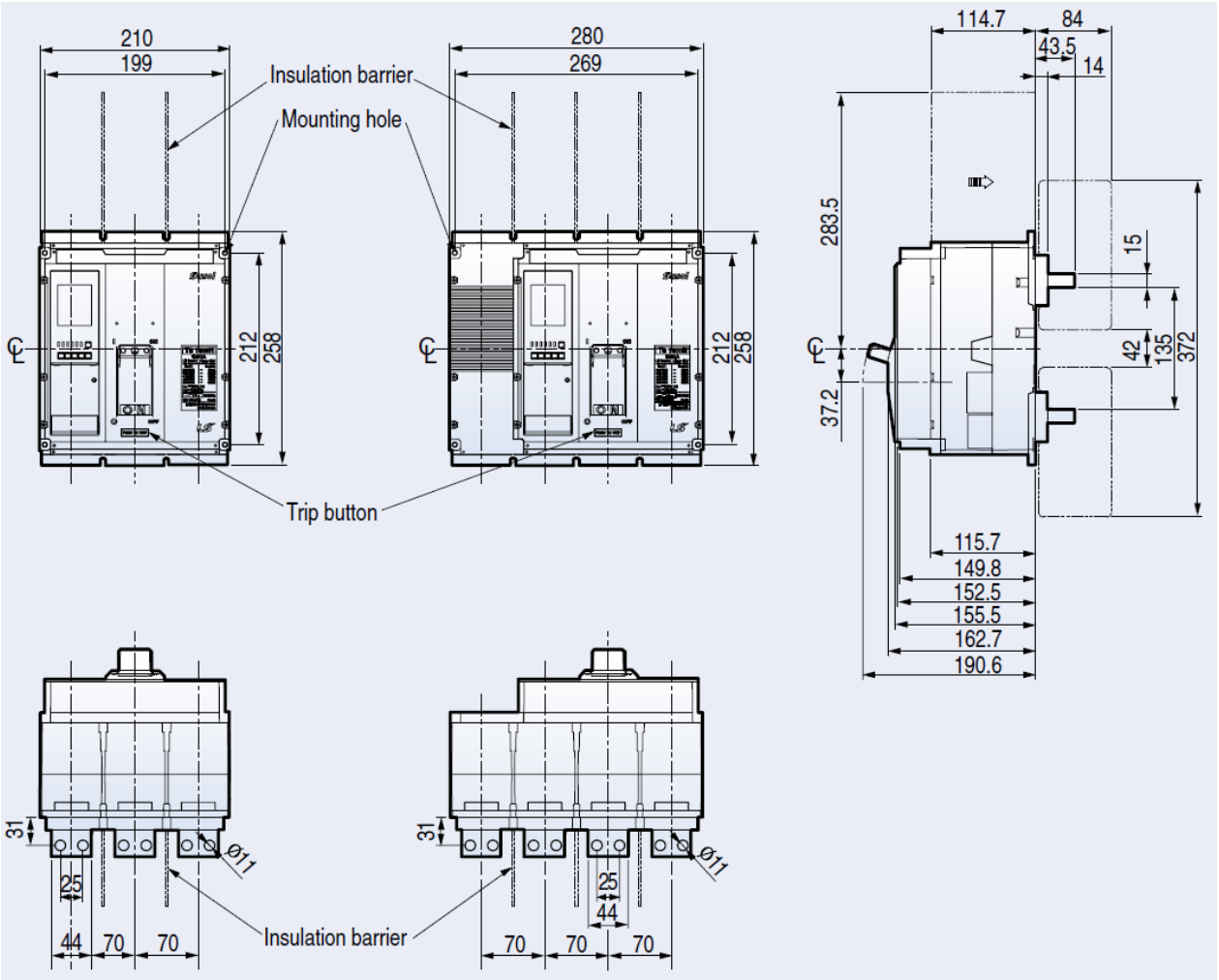
3) Overall Dimension (Front connection type)



E. Weight & Dimension

1. Weight & Dimension

4) Overall Dimension (Rear connection type)



F. Unpacking

1. Receiving

■ Receiving

A visual inspection – inside and out – should be performed immediately upon receipt of the MCCB and before removing it from the truck. Shipping papers should be checked to ensure all boxes or other accompanying pieces have been received. If any damage or shortages are evident, a claim should be filed at once with the carrier, and the nearest LSIS sales office. Claims for shortages or other errors must be made in writing to LSIS within 30 days after receipt of MCCB. Failure to do so constitutes unqualified acceptance and a waiver of all such claims by the purchaser.

2. Unpacking

■ Unpacking

1) **Before unpacking the breaker, check that all boxes and packing are in good condition.**

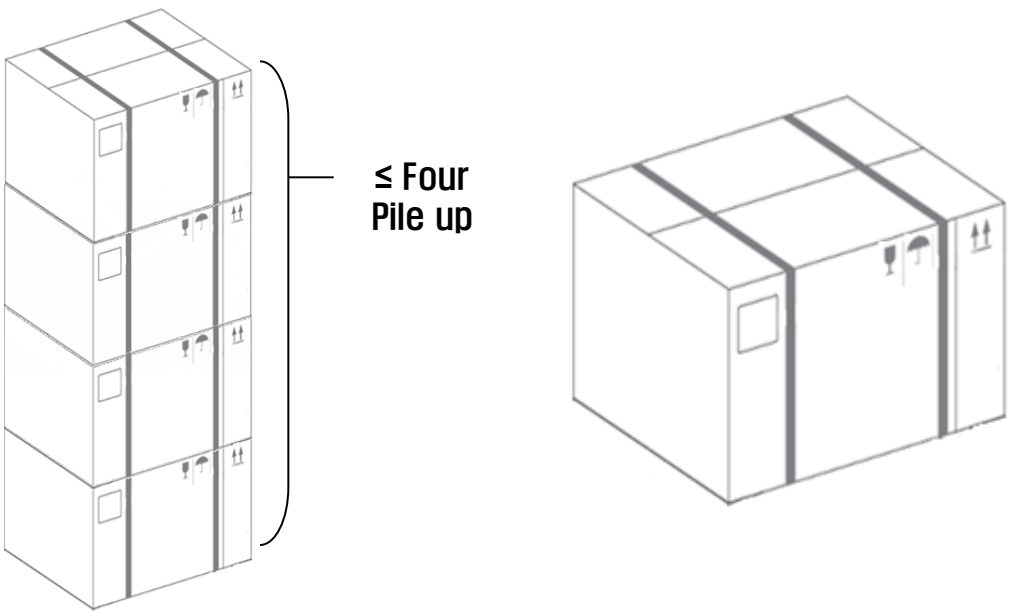
2) **While unpacking, check the breaker is in good condition.**

3) **Check that the information given on the rating /accessory nameplates corresponds to the purchase order.**

4) **Care about the unpacking to avoid damaging the products. Unpacking them attentively to avoid dropping the products from carrying components and pallets.**

5) **Install the products to the final installation place after unpacking as soon as possible. If you cannot install the products immediately, you had better not unpacking them. Keep the products indoor around 15℃ and under 50% of humidity. Standard packing condition for domestic portage is not suited to outdoor storage. If you cannot keep the maintenance above, you should inspect a degree of the damages before you install the products. Unsuitable keeping does not guarantee good qualities of the products and could occur additional danger of an accident.**

※ Pallet packing is supplied to customers requiring export and Pallet packing, not domestic.



F. Unpacking

3. Check and Caution

Please read the following check points and caution carefully as they imply the critical contents which should be confirmed before performing the unpacking, inspection, or installation, etc.

■ Check points upon receiving

1) **A visual inspection – inside and out – should be performed immediately upon receipt of the MCCB and before removing it from the truck. If any damage or shortages are evident, a claim should be filed at once with the carrier to the nearest LSIS sales office.**

2) **Unpacking them attentively to avoid dropping the products from carrying components and pallets.**

3) **Install the products to the final installation place after unpacking as soon as possible. If you cannot install the products immediately, you had better not unpacking them. Keep the products indoor around 15℃ and under 50% of humidity. Standard packing condition for domestic portage is not suited to outdoor storage. If you cannot keep the maintenance above, you should inspect a degree of the damages before you install the products. Unsuitable keeping does not guarantee good qualities of the products and could occur additional danger of an accident.**

■ Caution for installation inspection

1) **Confirm all power sources are completely de-energized first.**
2) **Disconnect all electrical switches which may operate during inspection.**
3) **Disconnect all plugs connected to operating part of product (Shunt coil, OCR, etc.)**
4) **Before you install the product, please make sure to turn the above circuit breaker off.**
   There is a danger of electric shock during installation.
5) **please make sure to handle is in off position .**
6) **Inspect product.**

G. Storage

1. Storage

■ Precaution of Storage

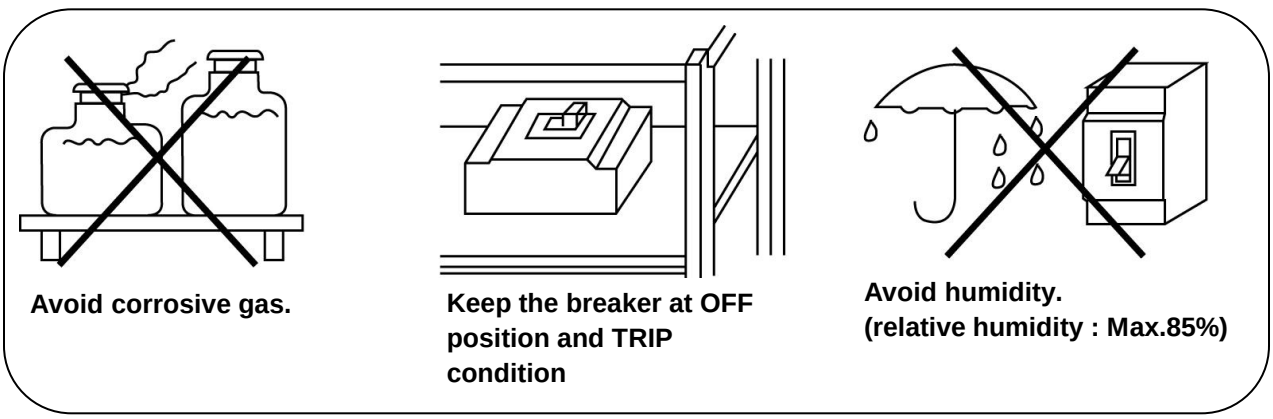
When storing a circuit breaker for a long term,

1) **Keep the breaker at OFF position and TRIP condition.**
2) **Avoid corrosive gas.**
3) **Avoid humidity. (relative humidity : Max. 85%)**

■ Storage method

1) **Store the breaker in a dust free and dry environment.**
2) **Keep the breaker in OFF position or in DISCHARGED condition.**
3) **Cover the breaker with a vinyl sheet or a similar cover. When putting the breaker into service after long term storage, it is unnecessary to lubricate the parts of the breakers.**
4) **Keep the breaker indoor as it was packaged around 15℃ and under 50% of humidity.**
5) **Standard packing condition for domestic portage is not suited to outdoor storage. If you cannot keep the maintenance above, you should inspect a degree of the damages before you install the products.**
6) **Unsuitable keeping does not guarantee good qualities of the products and could occur additional danger of an accident.**

■ Precaution of Storage



Avoid corrosive gas.

Keep the breaker at OFF position and TRIP condition

Avoid humidity. (relative humidity : Max.85%)

H. Installation and Handling

1. Precautions for installation.

1. Precautions for safe use.

Before use, please make sure to read the user manual and precautions for safety.
Please give the product user manual to the end user or a person in charge of repair.

⚠ Precautions for safety reasons.

Before handling, wiring work, operating, repair and inspecting, please read precautions for safety reasons and danger prevention to enable proper product use. Please make sure to follow these because they are very important details about safety.

⚠ Danger : If you violate this instruction, it could result in death or serious injury.

⚠ Warning : If you violate this instruction, it could result in light injury or material damage.

⚠ Danger

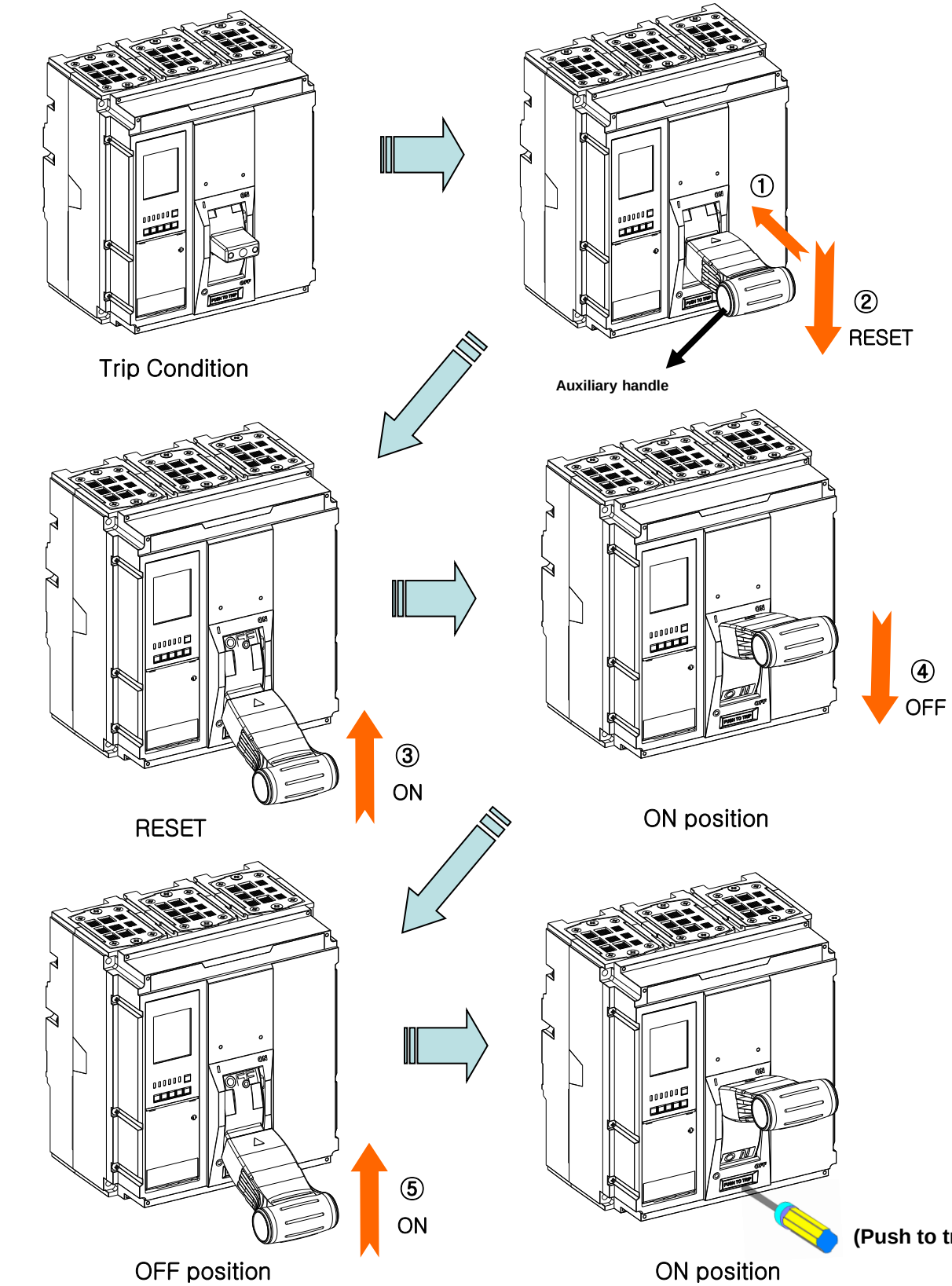
1. **Before you install the product, please make sure to turn the above circuit breaker off. There is a danger of electric shock during installation.**
2. **Please be careful not to contact terminal exposure unit. It can result in electric shock or short circuit fault**
3. **Please do not let any parts of your body touch two exposed hotlines at the same time. Even if there is an electric shock, the circuit breaker might not operate.**

⚠ Warning

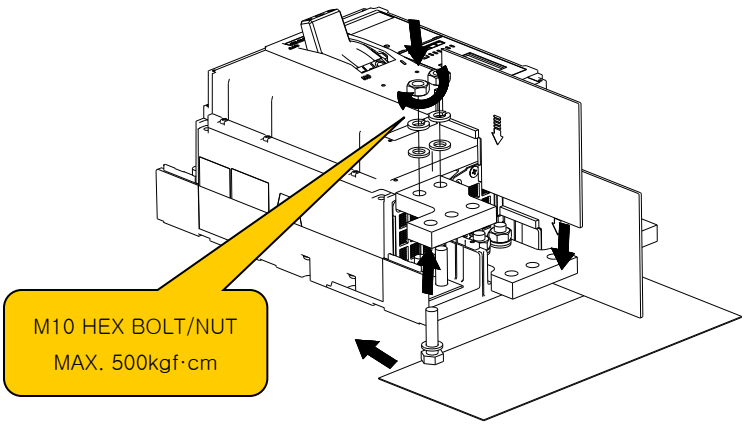
1. **Before installing the product, please read precautions and install it accordingly.**
2. **There is a danger of fault operation or accident from incorrect installation. Please let a qualified person (electrician) install and repair the circuit breaker.**
3. **Please avoid installation in environments with rain, oil, dust, direct sunlight etc. There is a danger of electric shock, leakage, short circuit, fire and fault operation.**
   - **1) Usage temperature : -5~40℃ (But, average over 24hr should not exceed +35℃)**
   - **2) Relative Humidity : 45~85% (Max. temperature 40°C ~ below 50%)**
   - **3) Altitude : Below 2000m**
   - **4) Avoid abnormal vibration and impact, excessive vapor, oil, smoke, dust, corrosive gas, and flammable gas.**
4. **Please connect to the power which is suitable for the product's rated voltage and current. If the rated voltage and current are not correct, it can cause damage or loss.**
5. **If there is shortage of tightening torque at the terminal, it can cause overheating or fire so please fix the terminal firmly referring to the stated tightening torque on each product's user manual.**
   *** For more details see the installation method for different types of product.**
6. **When you install the terminal, please install connection conductor and each phase in parallel. There is a danger of short circuit fault between each phase.**
7. **You can not test insulation resistance measurement and internal voltage between each phase. If you do those tests between each line of circuit breaker, please separate this product from circuit. There might be a fault.**
8. **Please be sure to ground the earth terminal of electrical machinery.**
9. **Please make sure to install an insulation barrier between each phase. If it's not installed, there is a danger of short circuit between phase.**
10. **If the circuit breaker operates and break automatically, please remove the cause and then operate the handle.**
11. **Please do not make unauthorized alternation.**
12. **Please follow your own country's guidelines for disposal of this product.**
13. **Please do not connect aluminum terminal and conductor directly to circuit breaker's terminal. It will cause corrosion and heating.**

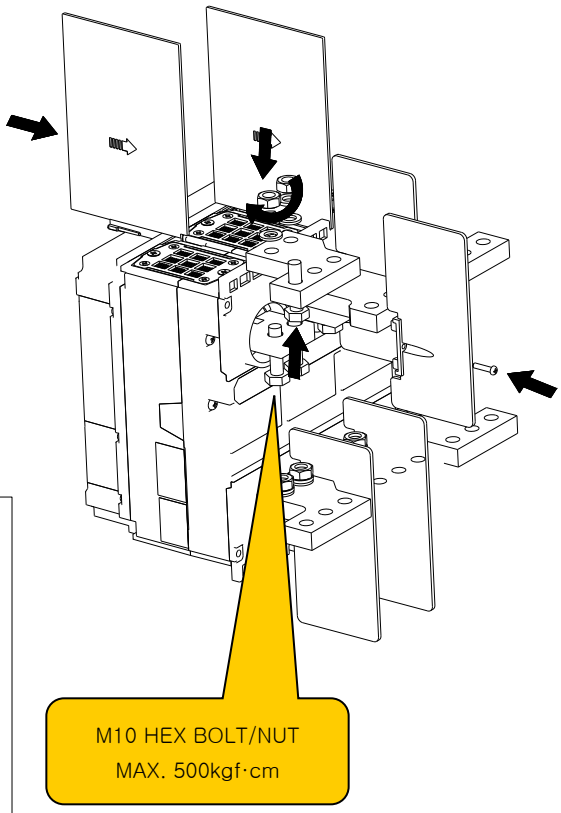
2. HANDLE operation

■ ON / OFF / TRIP Operation

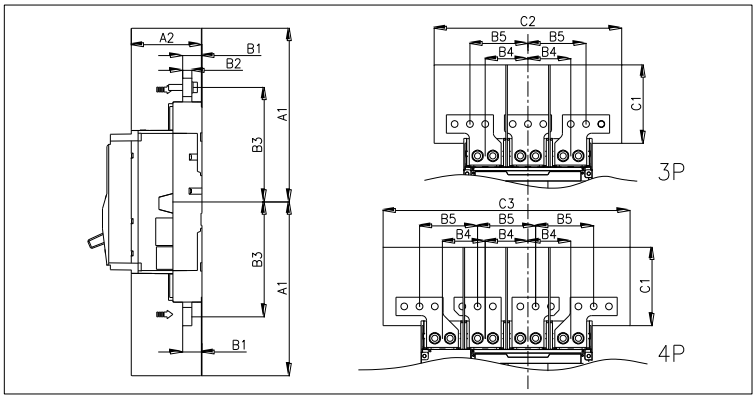


3. Installation of Front /Rear connection type

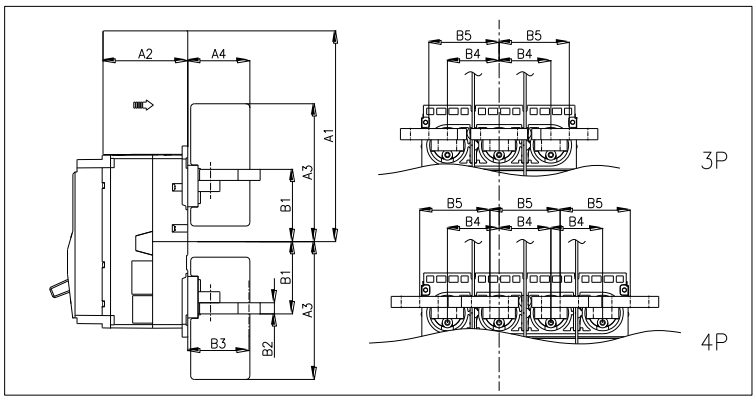




FRONT CONNECTION BUSBAR



REAR CONNECTION BUSBAR



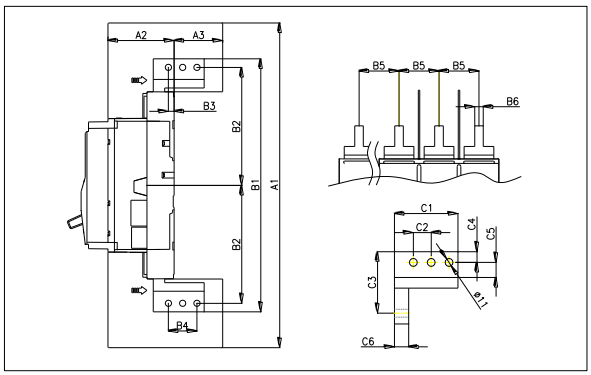
Dimensions

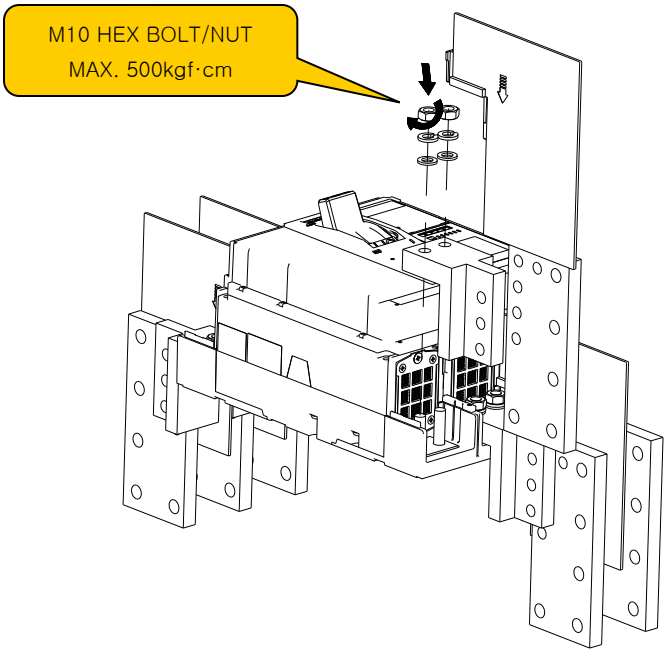
TYPE	A1	A2	A3	A4	B1	B2	B3	B4	B5	C1	C2	C3
FRONT CONNECTION (mm)	283.5	115.7			31.5	15	187	70	95	128	307	404
REAR CONNECTION (mm)	283.5	115.7	186	84	97.5	15	83	70	95			

H. Installation and Handling

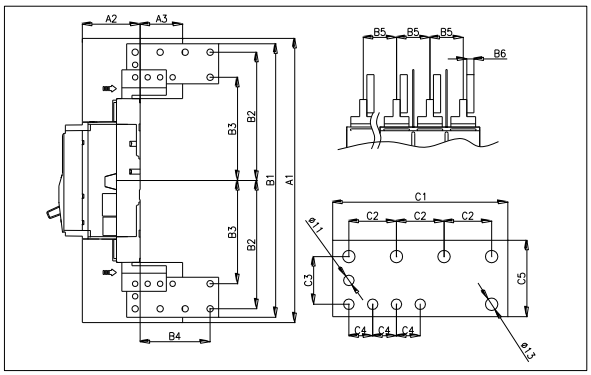
4. Installation of EXTENSION BUS BAR

FRONT CONNECTION BUSBAR VERTICAL





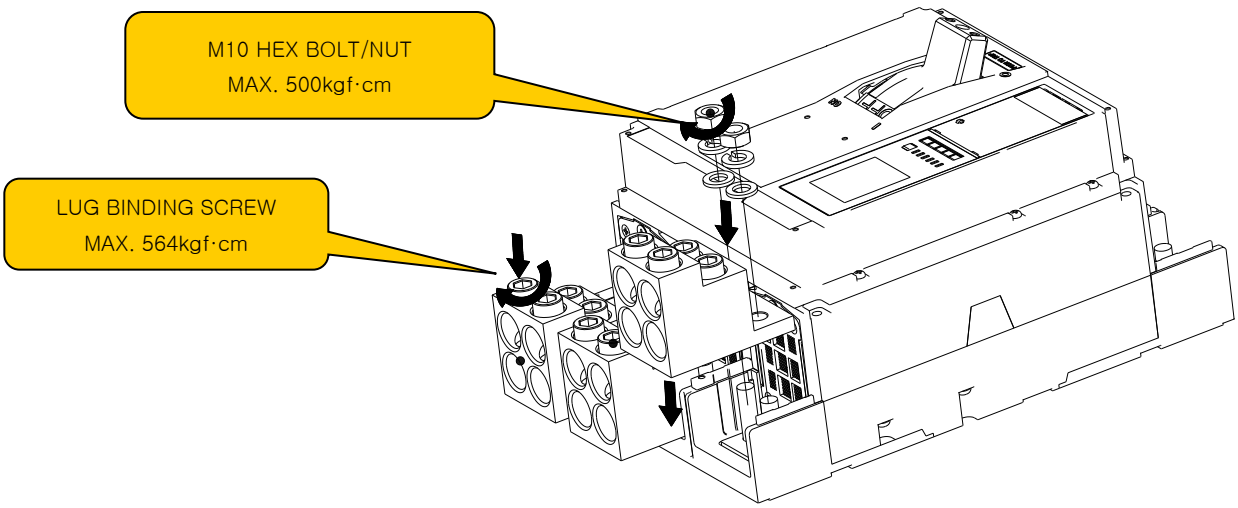
FRONT CONNECTION BUSBAR EXTENSION



Dimensions

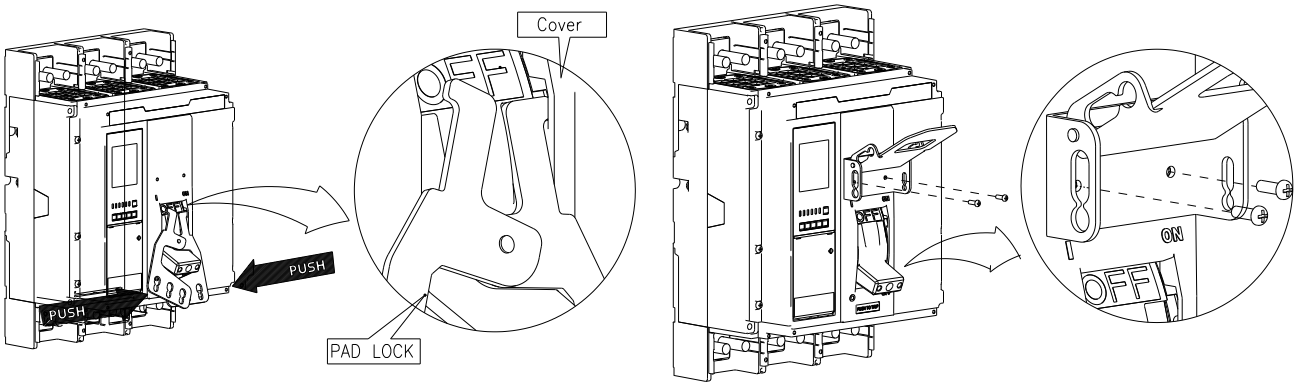
TYPE	A1	A2	A3	B1	B2	B3	B4	B5	B6	C1	C2	C3	C4	C5	C6
BUSBAR VERTICAL(mm)	567	115.7	85	442	206	10	50	70	15	89	25	86	15	21	20
BUSBAR EXTENSION (mm)	567	115.7	85	546	256	206	140	70	15	184	50	50	25	80	

5. Installation of LUG



6. Installation of accessories and handling

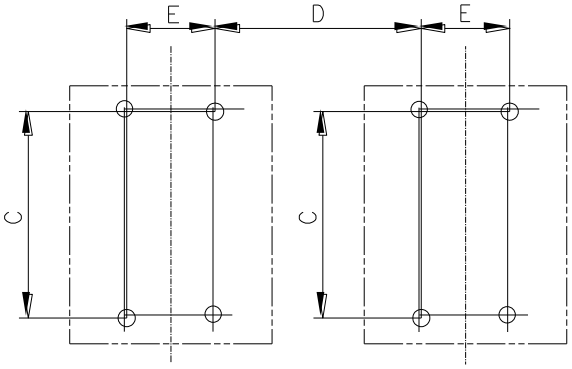
■ Locking Device

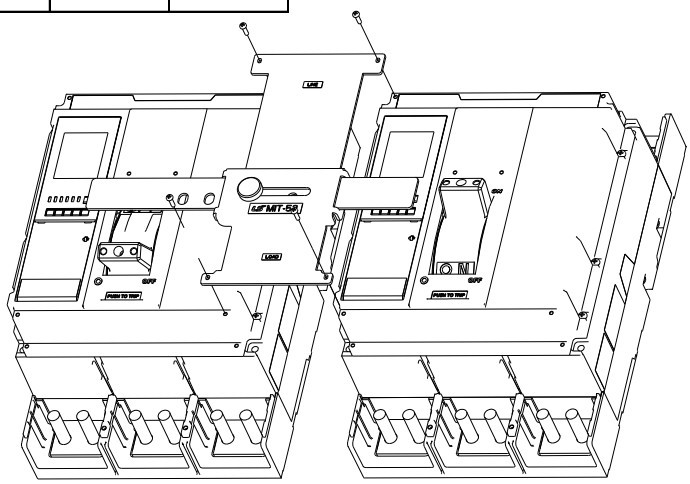


The dimension of installation holes

3P	C	D	E
TS1600	212	81	199

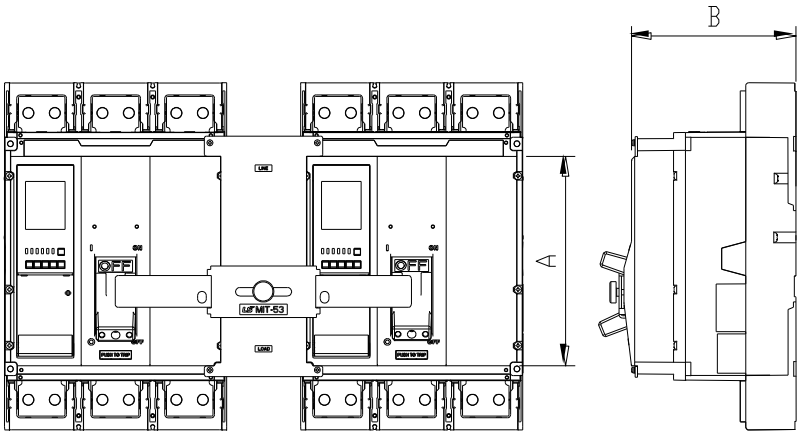
4P	D	E
TS1600	11	269





The cutting of Panel

3P	A	B
TS1600	197	156



6. Installation of accessories and handling

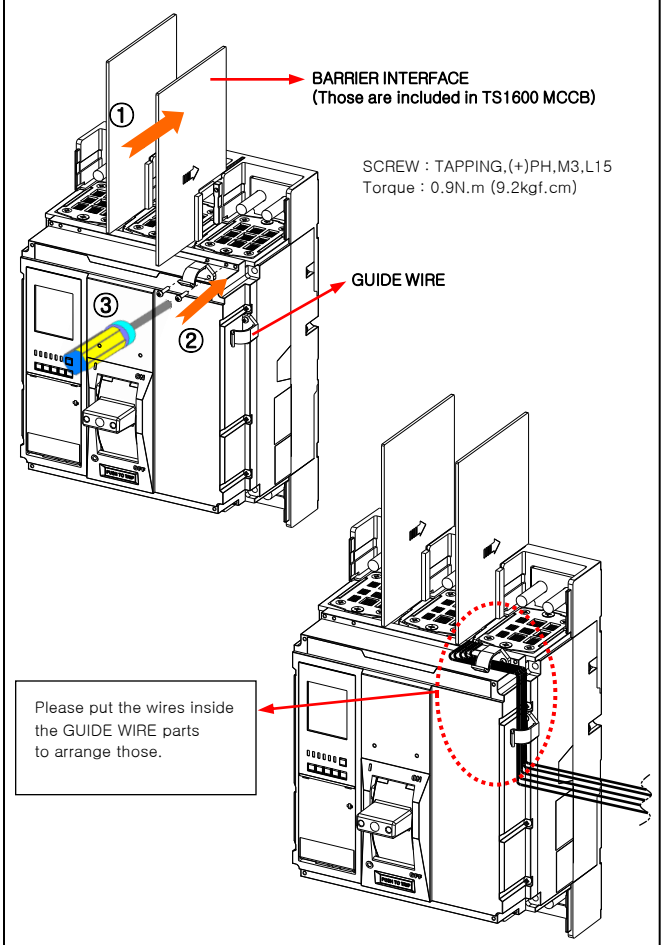
■ Arrangement of wires

- **Internal Accessories** : Auxiliary Switch (AX) / Alarm Switch (AL) / Shunt Trip (SHT) / Under voltage Trip (UVT) / Fault and SHT/UVT Trip Alarm Switch (FUAL)
- **Wiring part of Trip Relay** : WIRE ASS'Y OCR

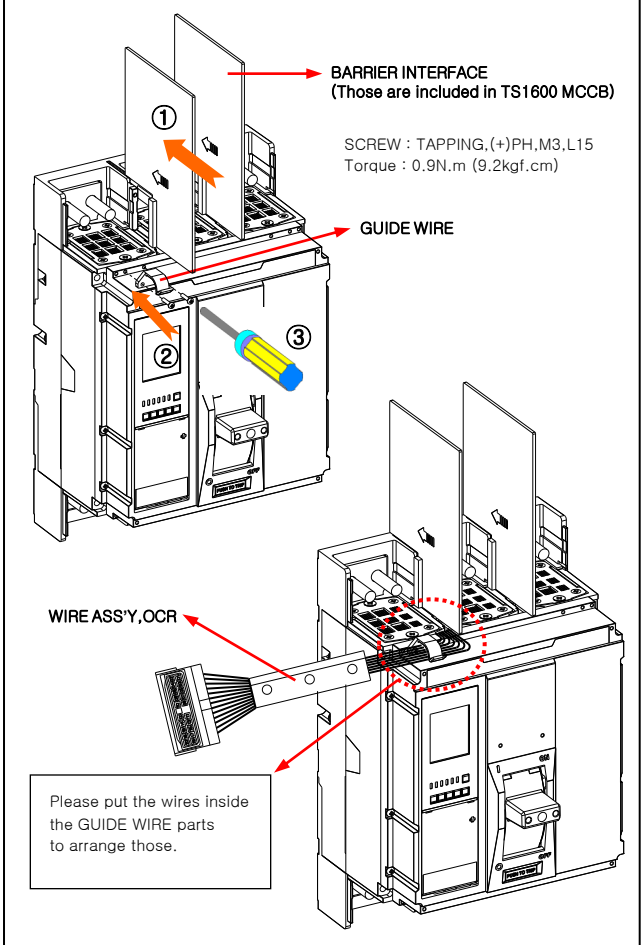
⚠ CAUTION

1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

Arrangement of wires for the inner accessory



Arrangement of wires for the WIRE ASS'Y OCR



6. Installation of accessories and handling

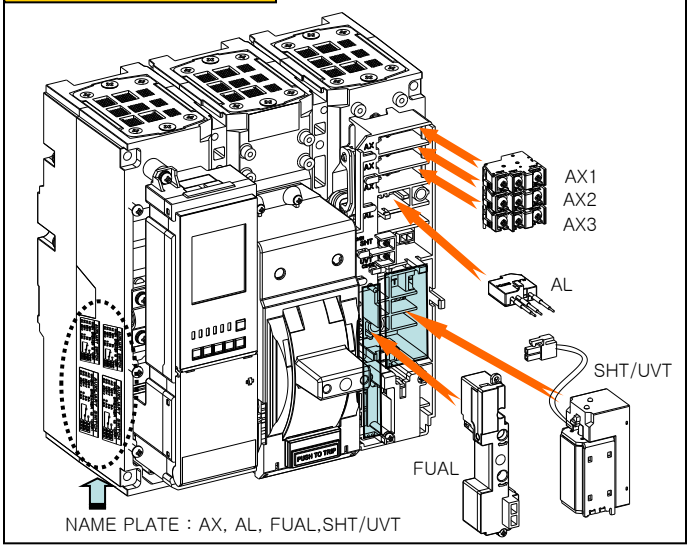
■ Internal Accessories.

Auxiliary Switch (AX) / Alarm Switch (AL) / Shunt Trip (SHT) / Under voltage Trip (UVT) / Fault and SHT/UVT Trip Alarm Switch (FUAL)

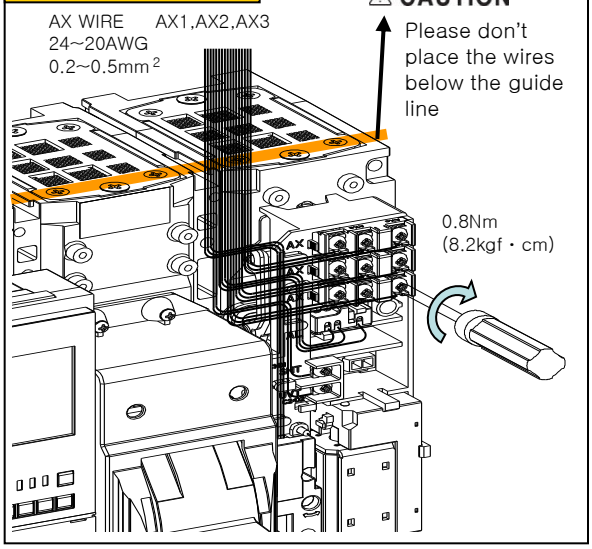
⚠ CAUTION

1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

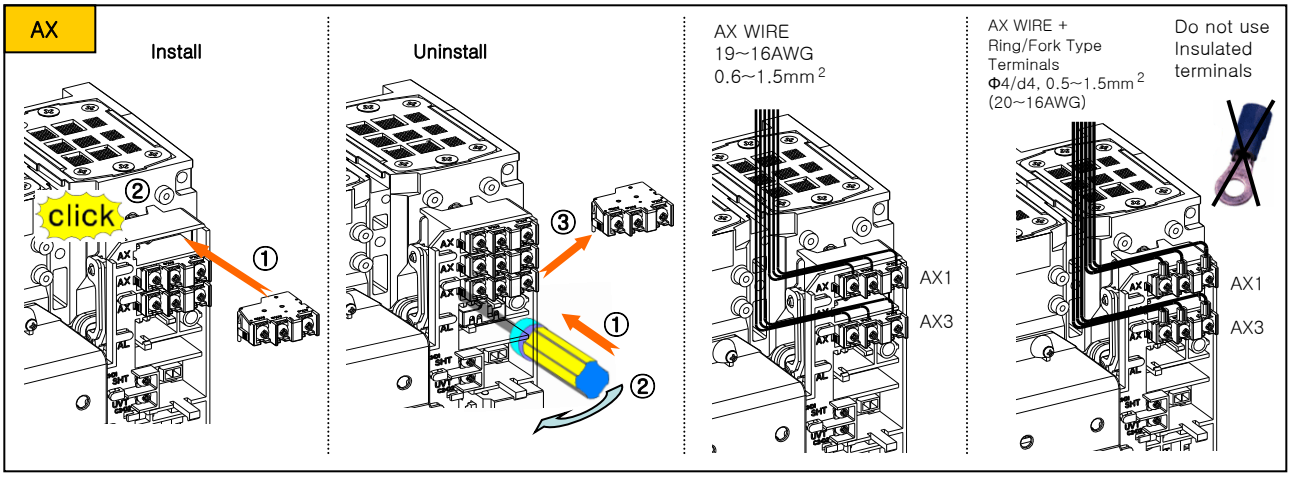
INNER ACCESSORY



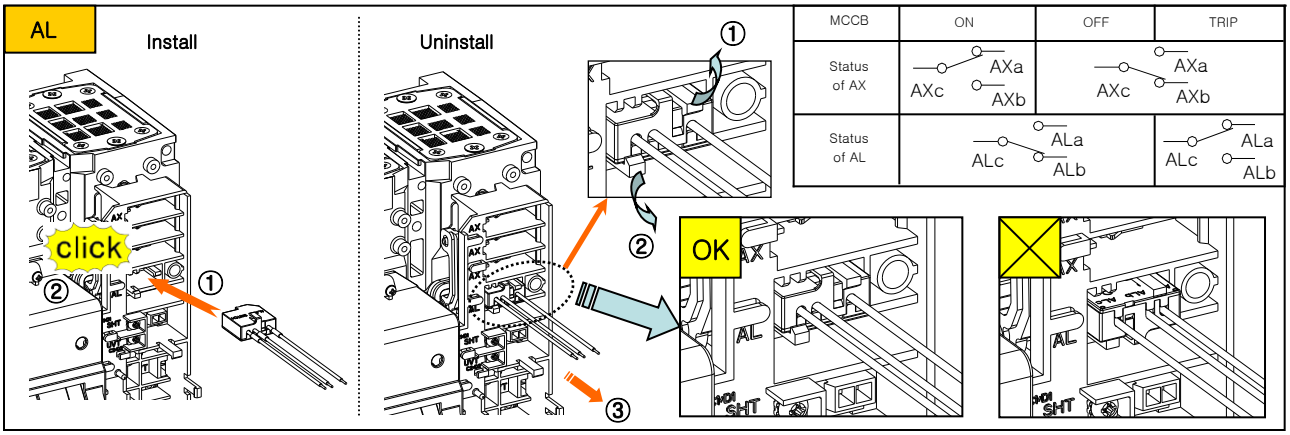
Withdrawal of wire



AX



AL



6. Installation of accessories and handling

■ Internal Accessories.

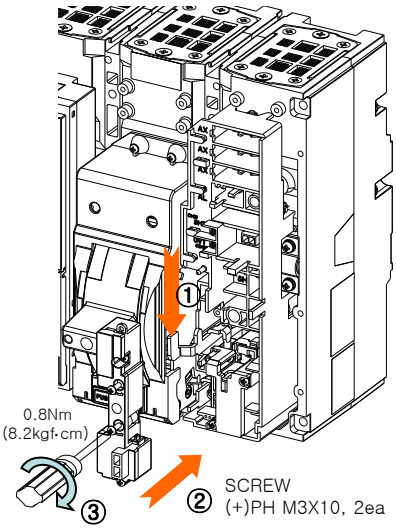
Auxiliary Switch (AX) / Alarm Switch (AL) / Shunt Trip (SHT) / Under voltage Trip (UVT) / Fault and SHT/UVT Trip Alarm Switch (FUAL)

⚠ CAUTION

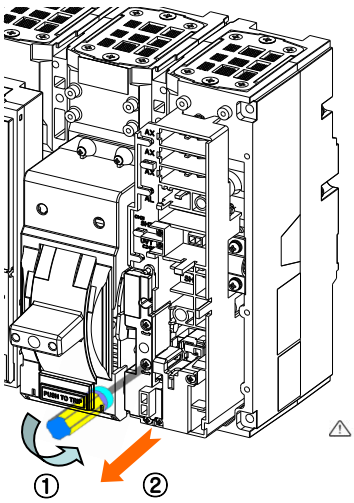
1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

FUAL

Install

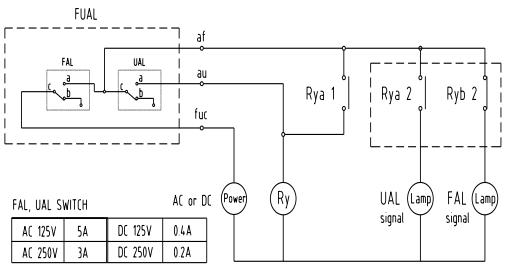


Uninstall



⚠ CAUTION : Please use "Lock up Circuit" following under figure "Example of lock up circuit for FUAL"

Figure. Example of Lock up Circuit for FUAL

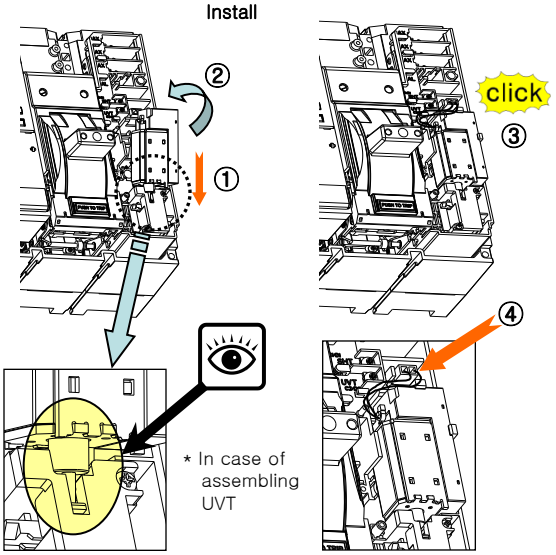


⚠ CAUTION : When MCCB is tripped by SHT or UVT, the FAL signal appears for 20ms that is time of being transferred from "b" contact to "a" contact of control relay.

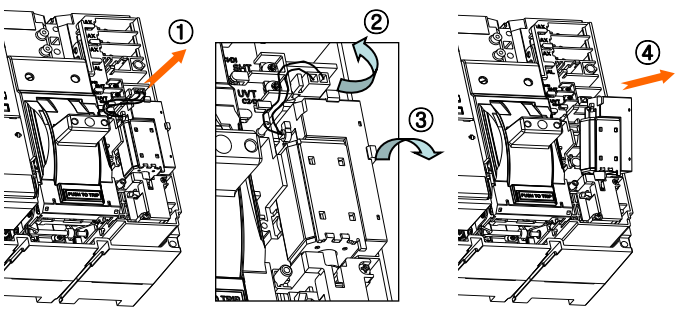
Shunt Trip (SHT) / Under Voltage Trip (UVT)

⚠ CAUTION : Don't operate MCCB unless Under Voltage Trip is energized.

Install



Uninstall



⚠ CAUTION

Please check that MCCB is trip state before installing UVT.

6. Installation of accessories and handling

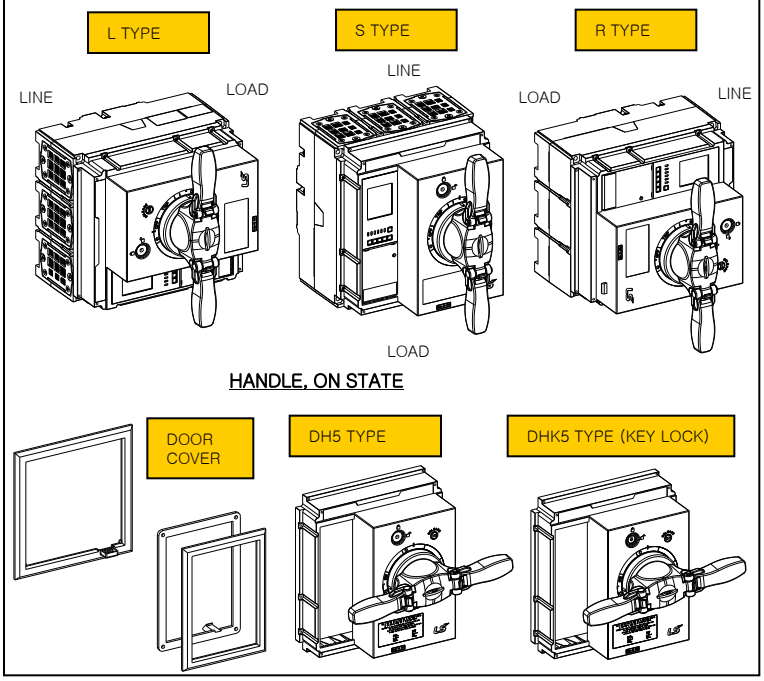
■ Rotary handle

- Direct rotary handle

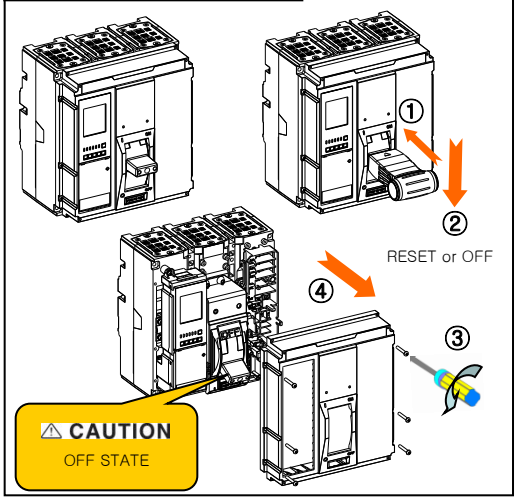
⚠ CAUTION

1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

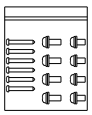
D-HANDLE TYPE



1. Disassembling cover

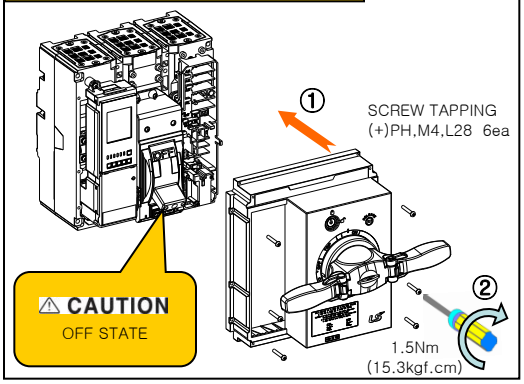


Spare part (사용 SCREW)

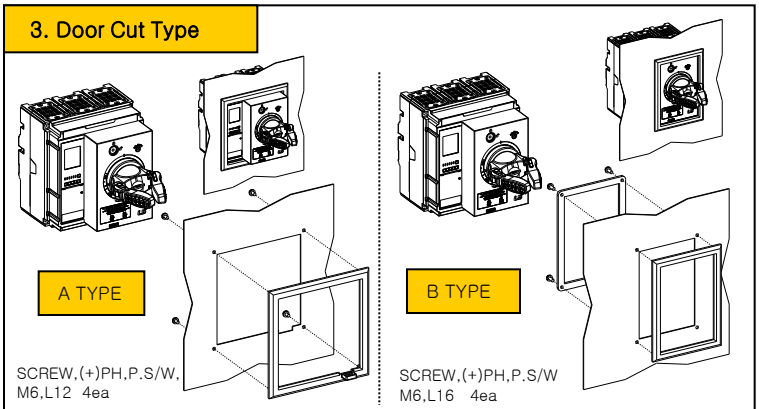


SCREW,(+)PH,P.S S/W,M4,L20	6ea
SCREW,(+)PH,P.S/W,M6,L16	4ea
SCREW,(+)PH,P.S/W,M6,L12	4ea

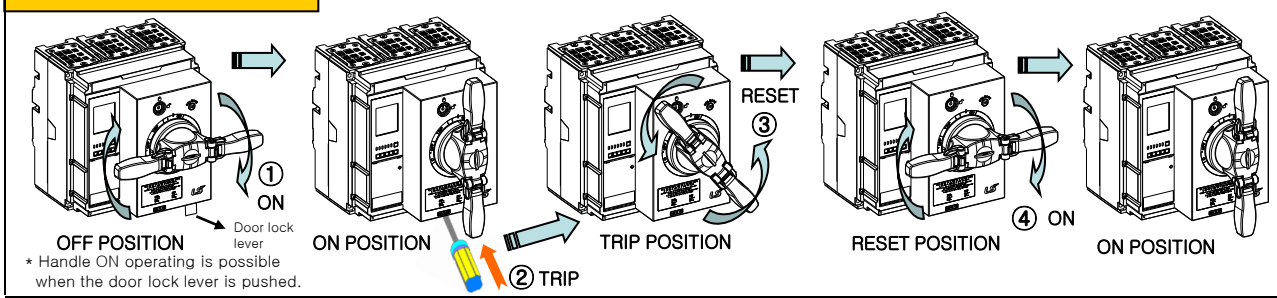
2. Assembling the D-handle



3. Door Cut Type



4. ON/OFF/TRIP Test



6. Installation of accessories and handling

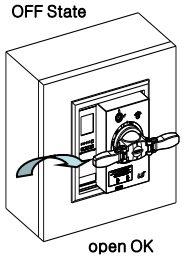
■ Rotary handle

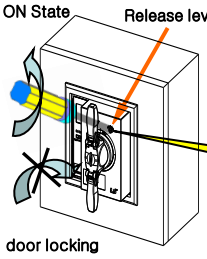
- Direct rotary handle

⚠ CAUTION

1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

5. Locking System



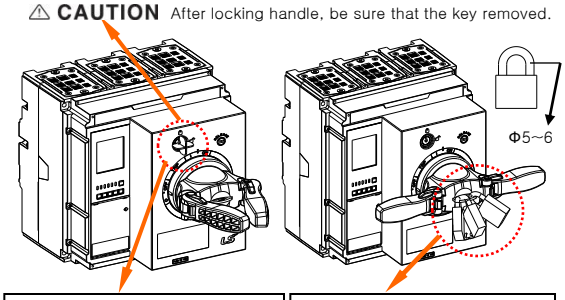


⚠ CAUTION

- If the door is opened with much pressure when the position of handle is ON or TRIP, the handle lock lever will be damaged.

Please open the door after rotating release lever

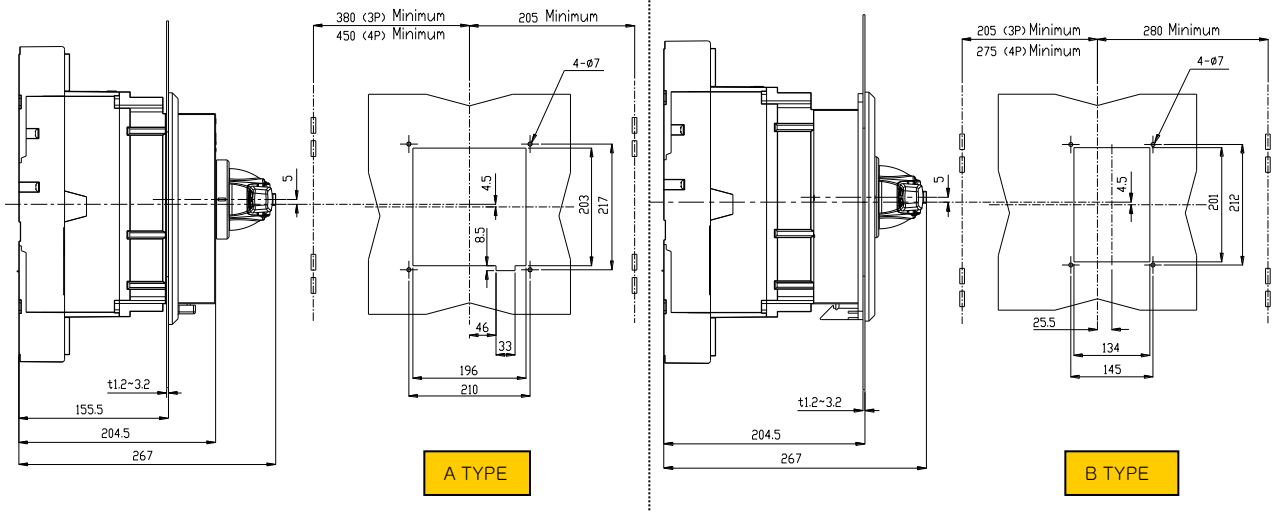
⚠ CAUTION After locking handle, be sure that the key removed.



Key lock: locking OFF position

Locking at ON or OFF position

6. Dimension of door cut



6. Installation of accessories and handling

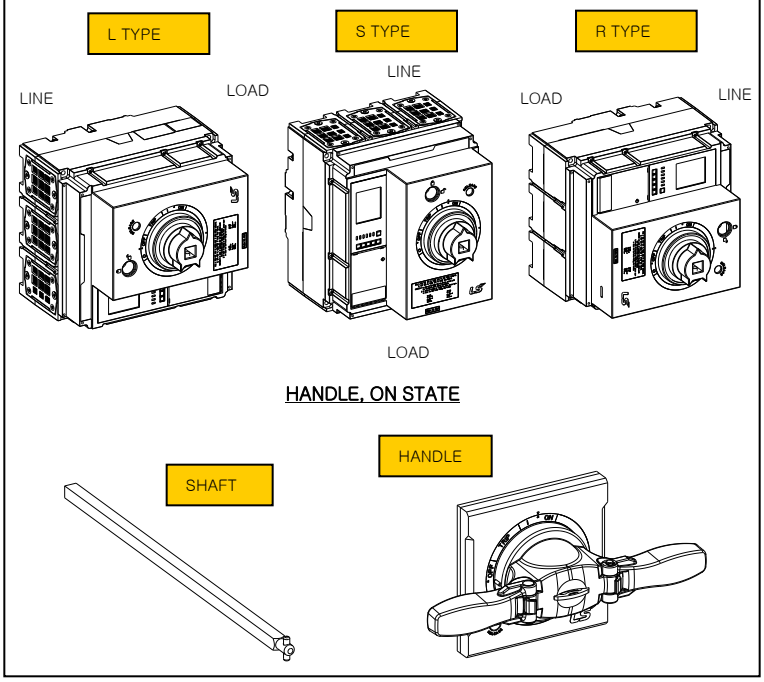
■ Rotary handle

- Extended rotary handle

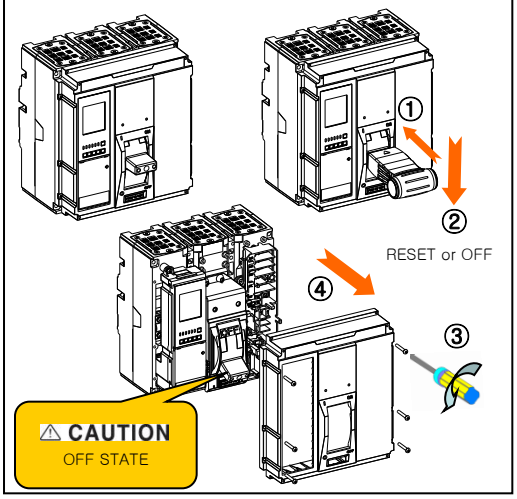
⚠ CAUTION

1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

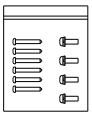
E-HANDLE TYPE



1. Disassembling cover

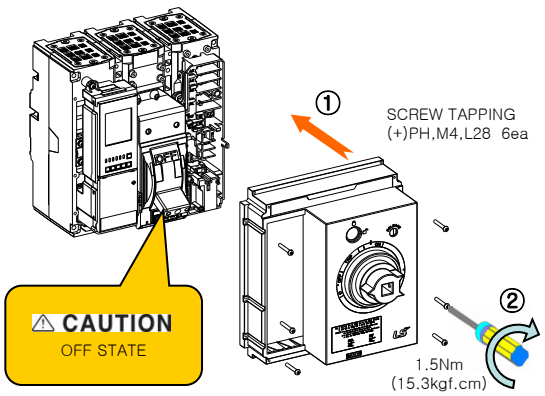


Spare part (사용 SCREW)

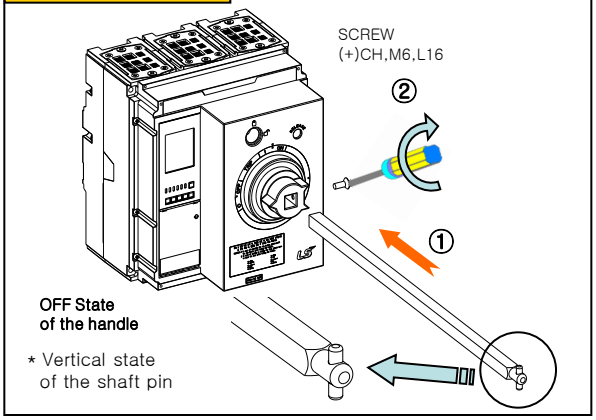


SCREW,(+)PH,P.S S/W,M4,L20	6ea
SCREW,(+)PH,P.S/W,M5,L18	4ea

2. Assembling the E-handle



3.Installing Shaft



6. Installation of accessories and handling

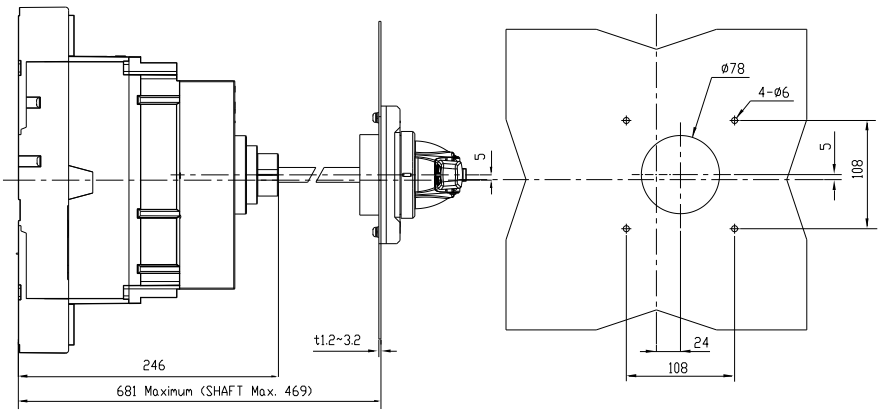
■ Rotary handle

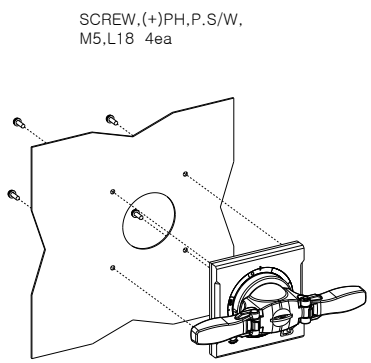
- Extended rotary handle

⚠ CAUTION

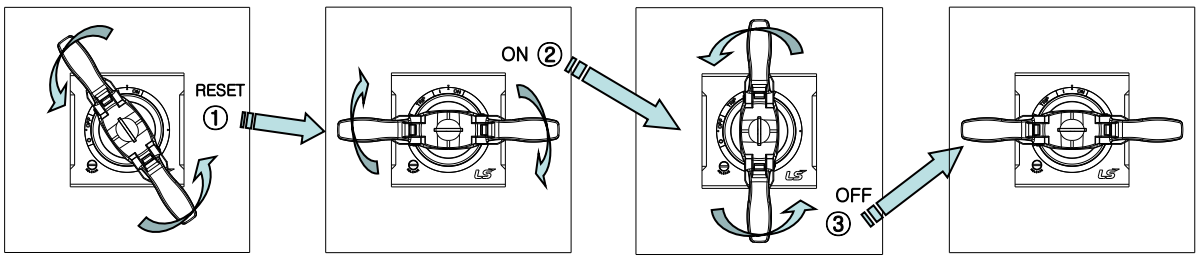
1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

4. Dimension of door cut and Installing Handle

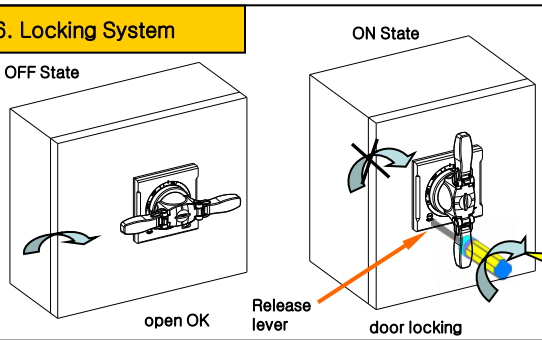




5. ON/OFF/TRIP Test



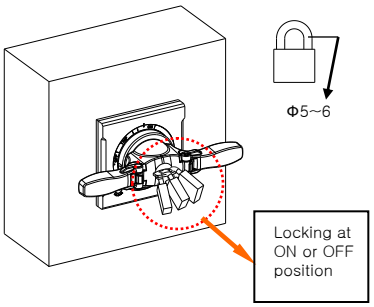
6. Locking System



⚠ CAUTION

- If the door is opened with much pressure when the position of handle. is ON or TRIP, the handle lock lever will be damaged.

Please open the door after rotating release lever



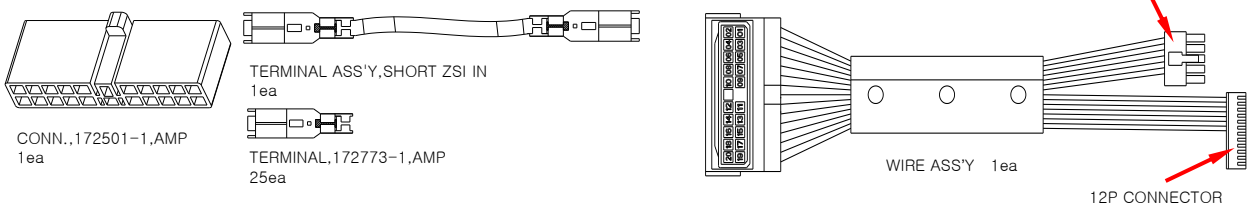
7. Installation of withdrawal wiring for Trip Relay

■ Withdrawal Wiring for Trip Relay

⚠ CAUTION

1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

Components of wire ass'y OCR and types

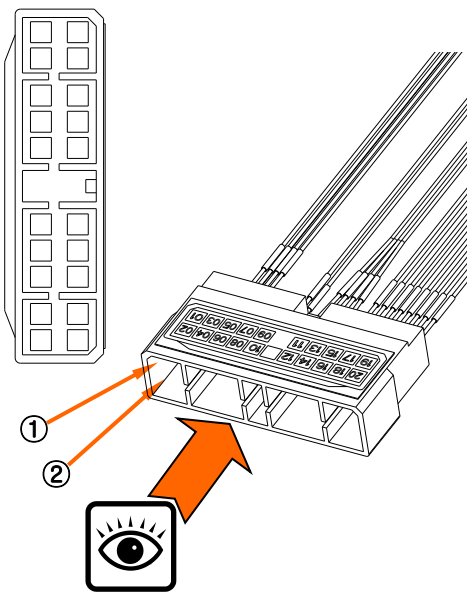


WIRE ASS'Y OCR TYPES

No.	Drawing No.	Part Name	Functions	OCR
1	76671176262	WIRE ASS'Y AG AC OCR	Communication, Digtal Output, ZSI, Remote Reset	A Type
2	76671176263	WIRE ASS'Y A ZK PS CKA OCR	Communication, Digtal Output, ZSI, Remote Reset, Earth Leakage(<30A), Voltage Module	P, S Type
3	76671176264	WIRE ASS'Y AE AX PX SX OCR	Communication, Digtal Output, ZSI, Remote Reset, Earth Leakage(>30A), Voltage Module	P, S Type

단자 번호 및 기호

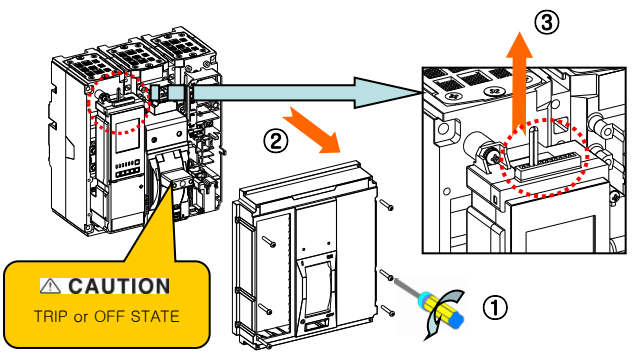
02	01
04	03
06	05
08	07
10	09
	✕
12	11
14	13
16	15
18	17
20	19



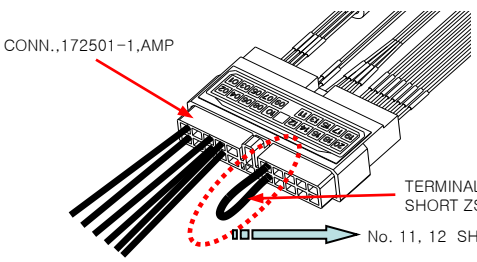
Terminal Number and Description

NUMBER	MARKING	DESCRIPTION
01	485+	Comm. +
02	485-	Comm. -
03	R1	POWER +
04	R2	POWER -
05	524	RELAY OUTPUT(Long Time)
06	534	RELAY OUTPUT(Short Time/Instantaneous)
07	544	RELAY OUTPUT(Ground Fault/PAL)
08	513	RELAY OUTPUT COMMON
09	Z3	ZSI OUT +
10	Z4	ZSI OUT -
11	Z1	ZSI IN +
12	Z2	ZSI IN -
13	R11	Remote Reset +
14	R22	Remote Reset -
15	E1 or B1	Earth Leakage +
16	E2 or B2	Earth Leakage -
17	V1	VR Input
18	V2	VS Input
19	V3	VT Input
20	VN	V Input COMMON

1. Disassembling cover and short connector



In case of not using ZSI function



⚠ **CAUTION** : If not using ZSI function of Trip Relay (OCR), please short ZSI INPUT of terminal No.11,12 (ZSI IN +, ZSI IN-) by using the "TERMINAL ASS'Y,SHORT ZSI IN"

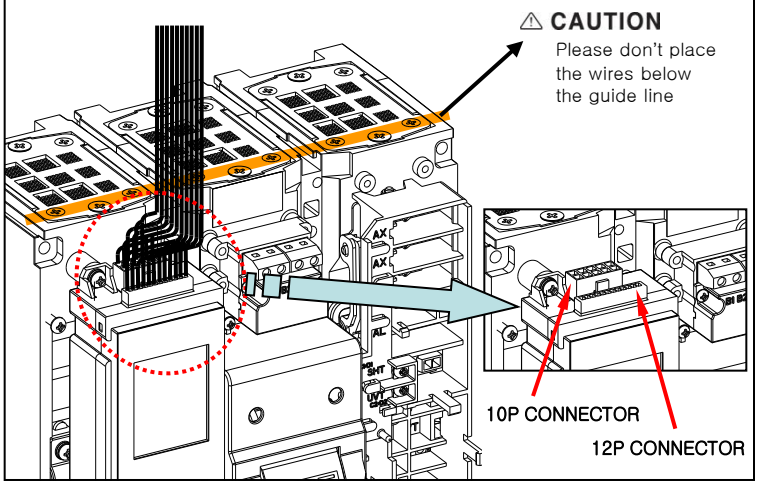
7. Installation of withdrawal wiring for Trip Relay

■ Withdrawal Wiring for Trip Relay

⚠ CAUTION

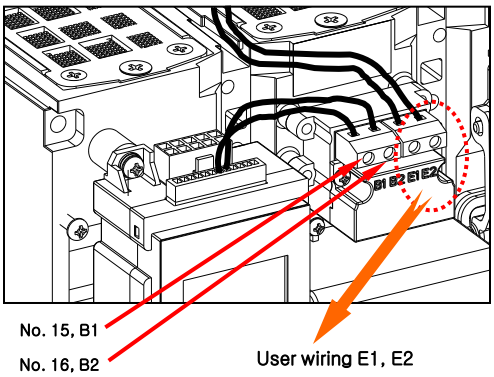
1. In case of disassembling and assembling the main cover, screw should be tightened in specific torque of1.5N.m (15.3kgf.cm)
2. In case of disassembling and assembling the main cover by over tightening torque, the parts of MCCB can be damaged.

2. Assembly of wire ass'y and withdrawal of wire



In case of the wiring of Earth Leakage ≥30A

Drawing No.	Part Name
76671176264	WIRE ASS'Y AE AX PX SX OCR



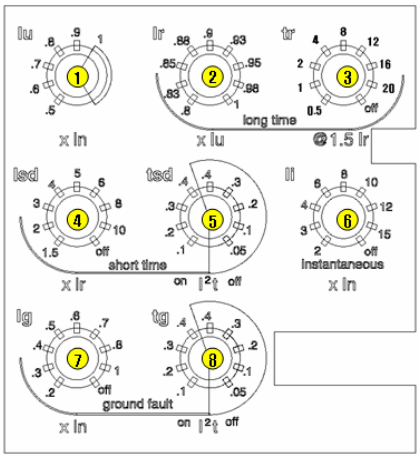
Trip Relay (OCR) type and applied wire ass'y

No	Type	WIRE ASS'Y, [ ] ,OCR,TS1600			No	Type	WIRE ASS'Y, [ ] ,OCR,TS1600		
		[AG AC] 76671176262	[A ZK PS CKA] 76671176263	[AE AX PX SX] 76671176264			[AG AC] 76671176262	[A ZK PS CKA] 76671176263	[AE AX PX SX] 76671176264
1	NG0				33	PC1		■	
2	NG5				34	PC2		■	
3	AG0				35	PC6		■	
4	AG1	■			36	PC7		■	
5	AG2	■			37	PK1		■	
6	AG5				38	PK2		■	
7	AG6	■			39	PK6		■	
8	AG7	■			40	PK7		■	
9	AZ0				41	PX1			■
10	AZ1		■		42	PX2			■
11	AZ2		■		43	PX6			■
12	AZ5				44	PX7			■
13	AZ6		■		45	PA1		■	
14	AZ7		■		46	PA2		■	
15	AE0				47	PA6		■	
16	AE1			■	48	PA7		■	
17	AE2			■	49	SC1		■	
18	AE5				50	SC2		■	
19	AE6			■	51	SC6		■	
20	AE7			■	52	SC7		■	
21	AC1	■			53	SK1		■	
22	AC2	■			54	SK2		■	
23	AC6	■			55	SK6		■	
24	AC7	■			56	SK7		■	
25	AK1		■		57	SX1			■
26	AK2		■		58	SX2			■
27	AK6		■		59	SX6			■
28	AK7		■		60	SX7			■
29	AX1			■	61	SA1		■	
30	AX2			■	62	SA2		■	
31	AX6			■	63	SA6		■	
32	AX7			■	64	SA7		■	
					65	NV1	■		
					66	NV6	■		

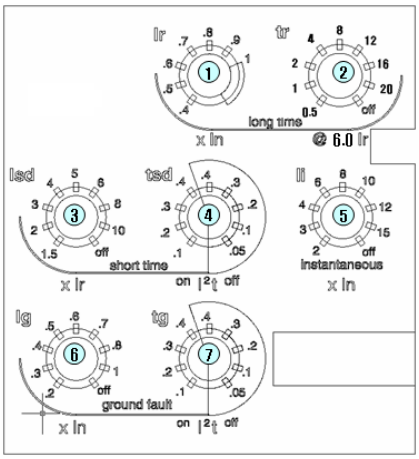
I. TRIP RELAY Externals and Configuration

1. Knob Setting

■ N, A type Knob Configuration



■ S type Knob Configuration



■ N, A type Knob information

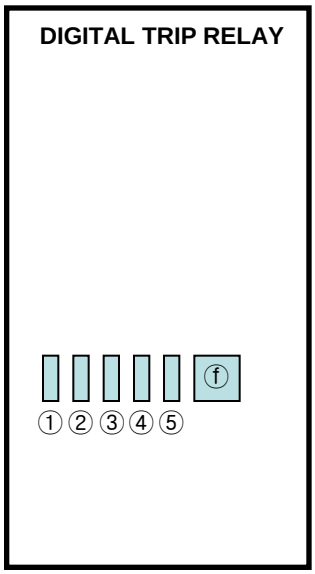
No	Type of knob	Mode	setting step
①	Continues current setting	Iu	(0.5-0.6-0.7-0.8-0.9-1.0) × In
②	Long-time current setting	Ir	(0.8-0.83-0.85-0.88-0.89-0.9-0.93-0.95-0.98-1.0) × Iu
③	Long-time tripping delay	tr	(0.5-1-2-4-8-12-16-20-off), sec @ 6 Ir
④	Short-time current Setting	Is	(1.5-2-3-4-5-6-8-10-off)× Ir
⑤	Short-time tripping delay	tsd	I²t off : (0.05-0.1-0.2-0.3-0.4), sec I²t on : (0.1-0.2-0.3-0.4), sec
⑥	Instantaneous pick-up	Ii	(2-3-4-6-8-10-12-15-off)× In
⑦	Ground-fault pick-up	Ig	(0.2-0.3-0.4-0.5-0.6-0.7-0.8-1-off)× In
⑧	Ground-fault tripping delay	tg	I²t off시: (0.05-0.1-0.2-0.3-0.4) I²t on시: (0.1-0.2-0.3-0.4)

■ P, S type Knob information

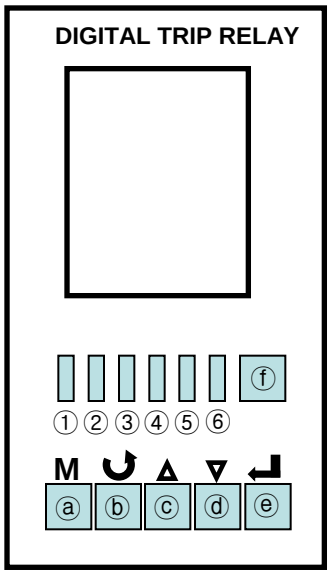
No	Type of knob	Mode	setting step
①	Long-time current setting	Ir	(0.4-0.5-0.6-0.7-0.8-0.9-1.0) × In
②	Long-time tripping delay	tr	(0.5-1-2-4-8-12-16-20-off), sec @ 6 Ir
③	Short-time current setting	Is	(1.5-2-3-4-5-6-8-10-off)× Ir
④	Short-time tripping delay	tsd	I²t off : (0.05-0.1-0.2-0.3-0.4), sec I²t on : (0.1-0.2-0.3-0.4), sec
⑤	Instantaneous pick-up	Ii	(2-3-4-6-8-10-12-15-off)× In
⑥	Ground-fault pick-up	Ig	(0.2-0.3-0.4-0.5-0.6-0.7-0.8-1-off)× In
⑦	Ground-fault tripping delay	tg	I²t off시: (0.05-0.1-0.2-0.3-0.4) I²t on시: (0.1-0.2-0.3-0.4)

2. Key and LED Configuration

■ N tpye Key / LED



■ A, P, S type Key / LED



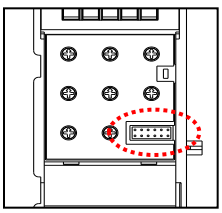
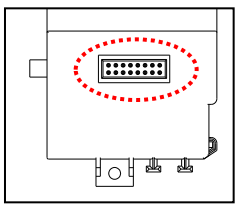
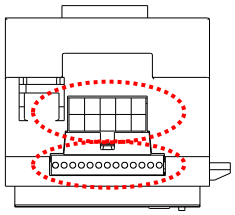
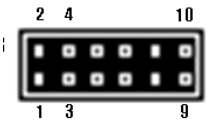
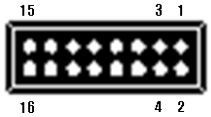
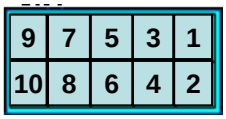
■ LED Information

No	LED type	Operational mode
①	Alarm	LED Indicating an overload (Turn on above 90%, Blink above 105%)
②	Batt/SP	Self-Protection LED and Battery test LED
③	Ir	LED Indicating long-time delay
④	Isd/Ii	LED indicating short-time or instantaneous tripping
⑤	Ig/I△n	LED indicating ground-fault
⑥	COMM	LED indicating Communication

■ Key Configuration

No	Type of button		Function
ⓐ	M	Menu	Measurement display → Menu Display, Menu display→ Measurement Display
ⓑ	↻	TAP	Maintain the active display
ⓒ	△	Up cursor	Move the cursor up on screen or increment a setting value
ⓓ	▽	Down cursor	Move the cursor down on screen or decrement a setting value
ⓔ	↵	Enter	Enter into secondary menu or setting input
ⓕ		Reset/ESC	Reset errors or ESC from menu

3. Terminal Configuration

Division	CN1	CN2	CN3	CN4
Figure	FRONT 	REAR 	TOP 	
				
1	TTL TX (OCR side)	CT-Ir	ZSI OUT (+)	RS485 (+)
2	Current signal-Ir	Power CT (-), GND	ZSI OUT (-)	DO Relay #1
3	TTL RX (OCR side)	CT-Is	ZSI IN (+)	RS485 (-)
4	Current signal-Is	Power CT (+), 24V	ZSI IN (-)	DO Relay #2
5	Power (+), 24V	CT-It	Remote reset (+)	Spare
6	Current signal-It	Delay Contact (-), GND	Remote reset (-)	DO Relay #3
7	Power (-),GND	CT-In	RCD (+)	Spare
8	Current signal-In	Delay Contact (+)	RCD (-)	DO Relay COM
9	Power (-),GND	CT-Ir, Override	Vr	Power (+)
10	Current signal COM	MTD (+),24V	Vs	Power (-)
11		CT-Is, Override	Vt	
12		MTD (-)	V COM	
13		CT-It, Override		
14		CT-COM		
15		In Override		
16		Spare		

J. TRIP RELAY Setting

1. Protection

■ N Type

Long time										
Current setting (A)	Iu = In × ...		0.5	0.6	0.7	0.8	0.9	1.0		
	Ir = Iu × ...		0.8	0.83	0.85	0.88	0.9	0.93	0.95	0.98	1.0
Time delay (s)	tr@(1.5 × Ir)		12.5	25	50	100	200	300	400	500	Off
Accuracy: ±15% or below	tr@(6.0 × Ir)		0.5	1	2	4	8	12	16	20	Off
100ms	tr@(7.2 × Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	Off
Short time										
Current setting (A) Accuracy: ±10%	Isd = Ir × ...		1.5	2	3	4	5	6	8	10	Off
Time delay (s) @ 10 × Ir	tsd	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous										
Current setting (A)	Ii = In × ...		2	3	4	6	8	10	12	15	Off
Tripping time			50 (±10ms)								
Ground fault										
Pick-up (A) Accuracy: ±10%(Ig > 0.4In) ±20%(Ig ≤ 0.4In)	Ig = In × ...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	Off
Time delay (s) @ 1 × In	tg	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				

■ NV Type (For ship only)

Long time [Long time delay protection]										
Current setting (A)	Ir = In × ...		0.8	0.9	1.0	1.05	1.1	1.15	1.2	1.25	Off
Time delay (s)	tr@(1.2× Ir)		10	15	20	25	30	40	50	60	100
Accuracy: ±15% or below	tr@(3× Ir)		0.99	1.49	1.99	2.48	2.98	3.97	4.97	5.96	9.93
100ms	tr@(6× Ir)		0.24	0.36	0.48	0.59	0.71	0.95	1.19	1.43	2.38
Short time [Short time delay protection]										
Current setting (A) Accuracy: ±10%	Isd = In × ...		2	2.5	2.7	3	3.5	4	4.5	5	Off
Time delay (s) @ 10× Ir	tsd	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous [Instantaneous protection]										
Current setting (A)	Ii = In × ...		2	4	6	8	10	12	14	16	Off
Tripping time			below 50ms								

PTA(Pre Trip Alarm)										
Current setting (A)	Ip = In × ···		0.7	0.8	0.85	0.9	0.95	1.0	.05	1.1	Off
Time delay (s) Accuracy: ±15%	tp@(1.2× Ip)		5	10	15	20	25	30	35	40	45

■ The fine-adjustable setting of the rated current[In]

- In = Ict × [0.4~1.0]
- Setting range: 40~100% of Ict (unit: 0.5%)

J. TRIP RELAY Setting

1. Protection

■ A Type

Long time											
Current setting (A)	Iu = In×...		0.5	0.6	0.7	0.8	0.9	1.0			
	Ir = Iu×...		0.8	0.83	0.85	0.88	0.9	0.93	0.95	0.98	1.0
Time delay (s)	tr@(1.5×Ir)		12.5	25	50	100	200	300	400	500	Off
Accuracy: ±15% or below	tr@(6.0×Ir)		0.5	1	2	4	8	12	16	20	Off
100ms	tr@(7.2×Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	Off
Short time											
Current setting (A) Accuracy: ±10%	Isd = Ir×...		1.5	2	3	4	5	6	8	10	Off
Time delay (s) @ 10×Ir	tsd	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous											
Current setting (A)	Ii = In×...		2	3	4	6	8	10	12	15	Off
Tripping time			50 (±10ms)								
Ground fault											
Pick-up (A) Accuracy: ±10%(Ig>0.4In) ±20%(Ig≤0.4In)	Ig = In×...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	Off
Time delay (s) @ 1×In	tg	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				

Earth leakage (Option)											
Current setting (A)	Ig		0.5	1	2	3	5	10	20	30	Off
Time delay (ms) Accuracy: ±15%	tg	Alarm Time(ms)	140	230	350	800	950				
		Trip Time(ms)	140	230	350	800					

Note) Earth leakage function is available with ZCT or external CT

J. TRIP RELAY Setting

1. Protection

■ P, S Type

Long time										
Current setting (A)	Ir = In × ...		0.4	0.5	0.6	0.7	0.8	0.9	1.0	
Time delay (s)	tr@(1.5 × Ir)		12.5	25	50	100	200	300	400	500	Off
Accuracy: ±15% or below	tr@(6.0 × Ir)		0.5	1	2	4	8	12	16	20	Off
100ms	tr@(7.2 × Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	Off
Short time										
Current setting (A) Accuracy: ±10%	Isd = Ir × ...		1.5	2	3	4	5	6	8	10	Off
Time delay (s) @ 10 × Ir	tsd	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous										
Current setting (A)	Ii = In × ...		2	3	4	6	8	10	12	15	Off
Tripping time			50 (±10ms)								
Ground fault										
Pick-up (A) Accuracy: ±10%(Ig > 0.4In) ±20%(Ig ≤ 0.4In)	Ig = In × ...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	Off
Time delay (s) @ 1 × In	tg	I²t Off	0.05	0.1	0.2	0.3	0.4				
		I²t On		0.1	0.2	0.3	0.4				
	(I²t Off)	Min. Trip Time(ms)	20	80	160	260	360				
		Max. Trip Time(ms)	80	140	240	340	440				

Earth leakage (Option)										
Current setting (A)	Ig		0.5	1	2	3	5	10	20	30	Off
Time delay (ms) Accuracy: ±15%	tg	Alarm Time(ms)	140	230	350	800	950				
		Trip Time(ms)	140	230	350	800					

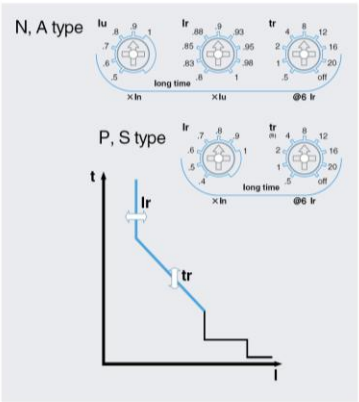
Note) Earth leakage function is available with ZCT or external CT

PTA(Pre Trip Alarm)										
Current setting (A)	Ip = Ir x ···		0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	1
Time delay (s) Accuracy: ±15%	tp@(1.2 × Ip)		1	5	10	15	20	25	30	35	Off

Other protection		Pick-up			Time delay(s)		
		Setting range	Step	Accuracy	Setting range	Step	Accuracy
Under voltage		80V ~ 0V_Pick-up	1V	±5%	1.2~40sec	0.1sec	±0.1sec
Over voltage		UV_Pick-up ~ 980V	1V	±5%			
Voltage unbalance		6% ~ 99%	1%	±2.5% or (*±10%)			
Reverse power		10~500 kW	1kW	±10%	0.2~40sec		
Over power		500~5000 kW	1kW	±10%			
Current unbalance		6% ~ 99%	1%	±2.5% or (*±10%)	1.2~40sec		
Over frequency	60Hz	UF_Pick-up ~ 65	1Hz	±0.1Hz			
	50Hz	UF_Pick-up ~ 55	1Hz	±0.1Hz			
Under frequency	60Hz	55Hz ~ OF_Pick-up	1Hz	±0.1Hz			
	50Hz	45Hz ~ OF_Pick-up	1Hz	±0.1Hz			

2. Operation Characteristic

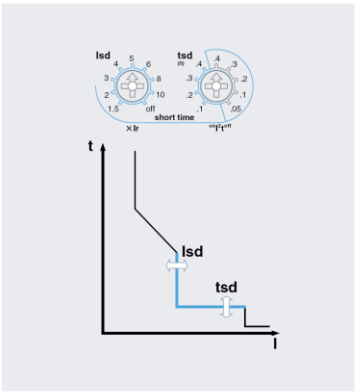
■ Long-time delay (L)



The function for overload protection which has time delayed characteristic in inverse ratio to fault current.

1. Standard current setting knob: Ir
   1) Setting range in P type and S type: (0.4-0.5-0.6-0.7-0.8-0.9-1.0)×In
   2) Setting range in N type and A type: (0.4 ~1.0)×In
      - Iu: (0.5-0.6-0.7-0.8-0.9-1.0)×In
      - Ir: (0.8-0.83-0.85-0.88-0.9-0.93-0.95-0.98-1.0)×Iu
2. Time delay setting knob: tr
   - Standard operating time is based on the time of 6×Ir
   - Setting range: 0.5-1-2-4-8-12-16-20-Off sec (9 modes)
3. Relay pick-up current
   - When current over (1.15)×Ir flows in, relay is picked up.
4. Relay operates basing on the largest load current among R/S/T/N phase.

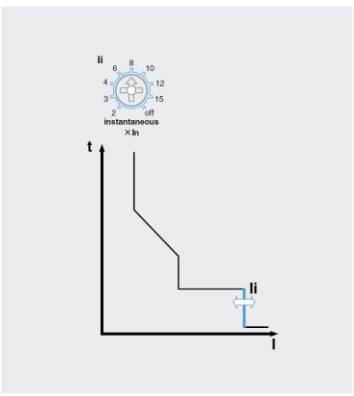
■ Short-time delay (S)



The function for fault current (over current) protection which has definite time characteristic and time delayed in inverse ratio to fault current.

1. Standard current setting knob: Isd
   - Setting range: (1.5-2-3-4-5-6-8-10-Off)×Ir
2. Time delay setting knob: tsd
   - Standard operating time is based on the time of 10×Ir.
   - Inverse time (I^2t On): 0.1-0.2-0.3-0.4 sec
   - Definite time (I^2t Off): 0.05-0.1-0.2-0.3-0.4 sec
3. Relay operates basing on the largest load current among R/S/T/N phase.
4. Relay can operate at instantaneous current through ZSI.

■ Instantaneous (I)

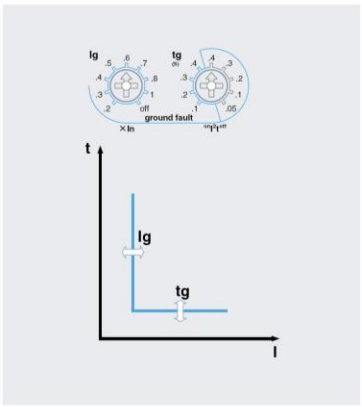


The function for breaking fault current above the setting value within the shortest time to protect the circuit from short-circuit.

1. Standard current setting knob: Ii
   - Setting range: (2-3-4-6-8-10-12-15-Off)×In
2. Relay operates basing on the largest load current among R/S/T/N phase.
3. Total breaking time is 50 (±10ms)

2. Operation Characteristic

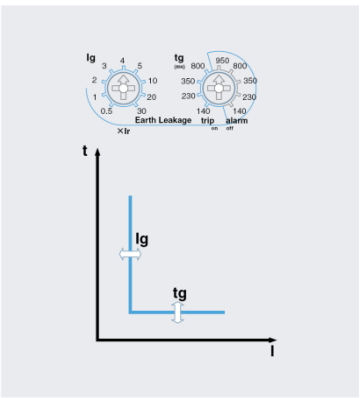
■ Ground Fault (G)



The function for breaking ground fault current above setting value after time-delay to protect the circuit from ground fault.

1. Standard setting current knob: Ig
   - Setting range: (0.2-0.3-0.4-0.5-0.6-0.7-0.8-1.0-Off) × In
2. Time delay setting knob: tg
   - Inverse time (I^2t On): 0.1-0.2-0.3-0.4 sec
   - Definite time (I^2t Off): 0.05-0.1-0.2-0.3-0.4 sec
3. Ground fault current =R+S+T+N(Vector Sum)
4. Relay can operate at instantaneous current through ZSI.
5. The protection for ground fault is a basic function of Trip relay (Internal CT type)

■ Earth Leakage (G) – Option

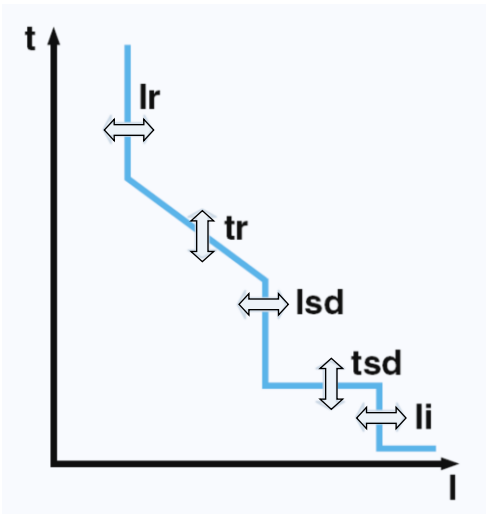


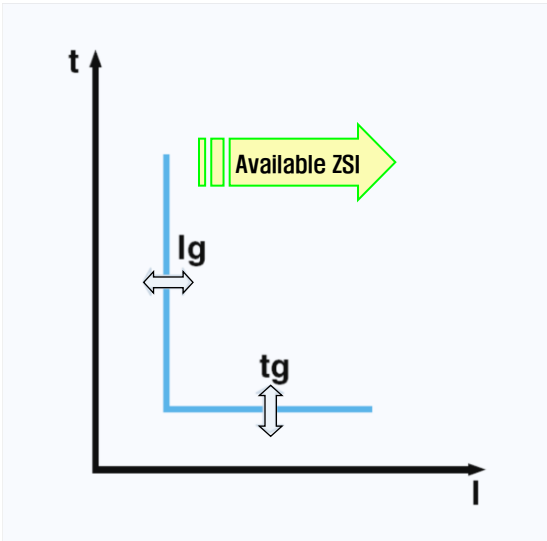
The function for breaking earth leakage current above setting value after time delay to protect the circuit from earth leakage. (A, P, S type)

1.Standard setting current Knob : Ig
 (1) ZCT provided Susul ACB (OCR Z,K Type)
  – Setting range : 0.5–1–2–3–4–5–10–20–30–Off(A)
 (2) Private ZCT (OCR E,X Type)
  – Setting range : 0.5–1–2–3–4–5–Off(A)
2. Time delay setting knob : tg
  – Alarm time : 140–230–350–800ms
  – Trip time : 60–140–230–350–800ms

3. It is only available with private ZCT or general purpose external CT.

* Notice in setting range
 In case of using our ZCT all setting points from 0.5 to 30A, the secondary current of ZCT are available.
 However if private ZCT is selected the setting range is limited to 0.5~5A.



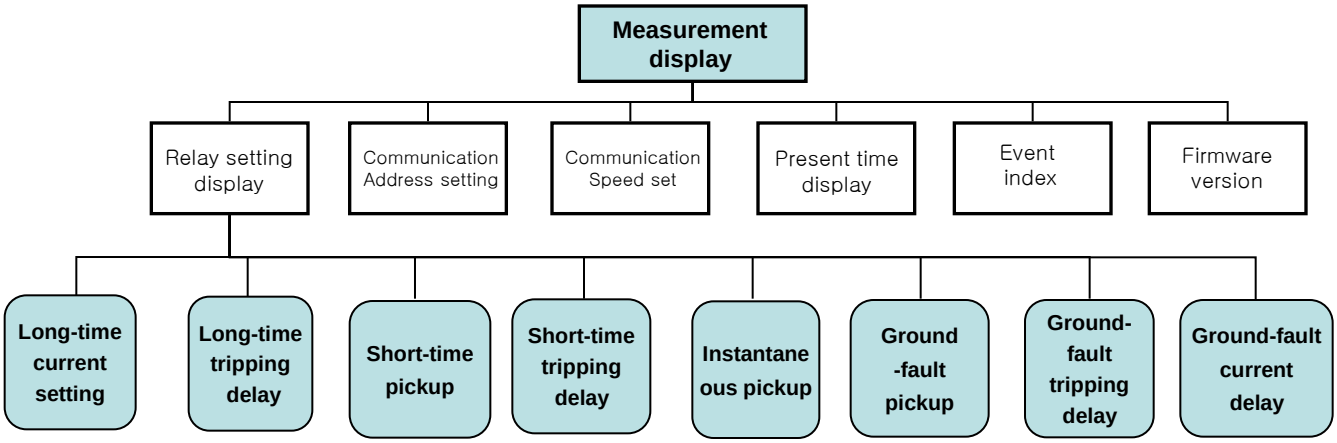


K. Operation of A type TRIP RELAY

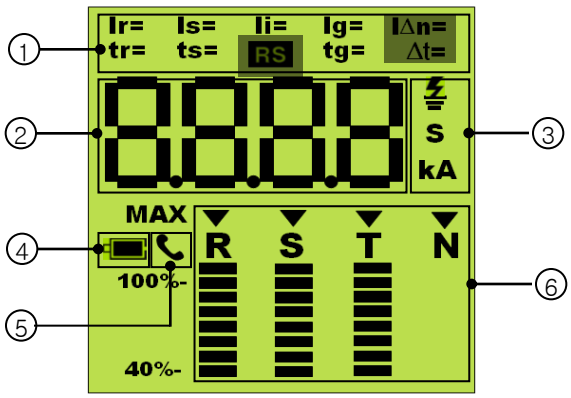
1. Menu Tree

Caution

- Each movement within Menu Tree can be done by using Menu and ESC button.
- Use UP(△)/Down(▽) button to move around each setting information under Relay Setting Display.
- If not pressing any button for 30seconds after moving to other screens, the screen moves back to Measurement Display and any relevant data will not be saved.



2. LCD Segment

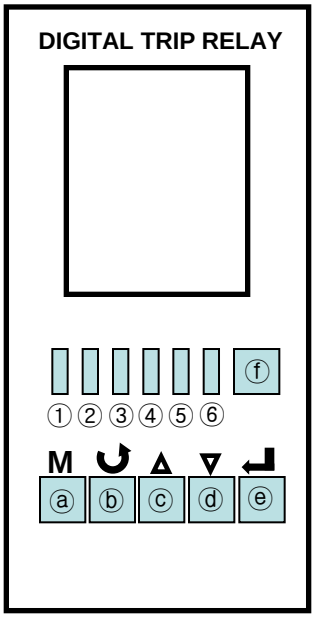


NO	Contents
①	Segment that displays the types of relay current and time - Display of Setting values or Event
②	Segment that displays numbers or characters - Current, Time, and Simple character
③	Segment that displays the unit of current and time.
④	Low Battery Segment -LED flickers at 2~3 second interval if the voltage of 3.6V Lithium battery built in OCR is discharged below 2.5V.
⑤	Communication Segment - Upon answering to communication, it is displayed on the screen of Address and Speed Setting.
⑥	Segment which displays the measured current and the load rate of each phase - Inverted triangle indicates the current of phase which is being displayed on Measurement Display. - Load rate of R/S/T phase in proportion to Ir

When OCR is plugged in for the first time, all segments will be shown for approximately a second, and then return to Measurement Display.

K. Operation of A type TRIP RELAY

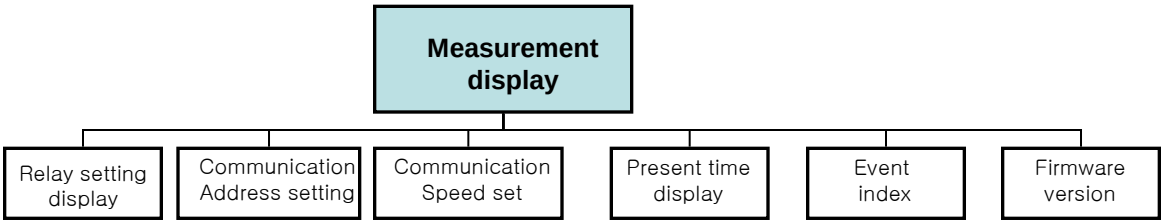
3. Button Configuration



Caution

- OCR A type is composed of 6 buttons, and its LCD Back Light comes on for 30s if it sensing any button pressed during its operation.
- After 30 seconds under Idle condition, it moves back to Measurement Display page.
- If pressing ESC/RESET button in case of no power supply withOCR, BATT LED will come on to indicate the residual quantity of battery.
- If pressing ESC/RESET button in case of existing power supply with OCR, the status of LED only can be checked, not checking residual quantity of battery
- Only BATT LED turns on while pressing ESC/RESET button and other LEDs will turn on for 1~2 seconds after releasing ESC/RESET button.
- If ACB breaking the fault current normally, the information of cause for accident will be informed to users by turning on Indication LED.
- At this time Indication LED is operated by a separate battery built in OCR. Therefore, turn it off by pressing ESC/RESET button when discovering the cause of fault. .

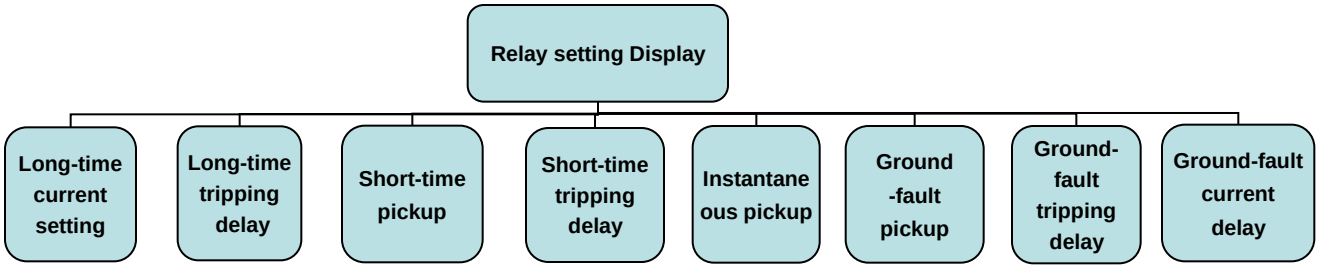
4. Measurement Display

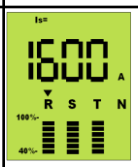


Display	Button	Contents
		1. The current of R, S, T, N phase are displayed in rotation at 3 second interval 2. At this very moment, the inverted triangle is moving sideways from left to right to show which phase is being displayed on LCD currently, and the below bar graphs represent each phase's load rate in scale (40%~110%).
	↻	If pressing TAP button to display only one phase value exclusively on the screen without displaying each phase's current in rotation,. the triangle sign(Δ) will appear at the top-right side of LCD screen. ※ This screen-freeze can be apply at other screens as well.
	↻ △ ▽	The phase which will be displayed exclusively can be selected by pressing Up / Down cursor.

K. Operation of A type TRIP RELAY

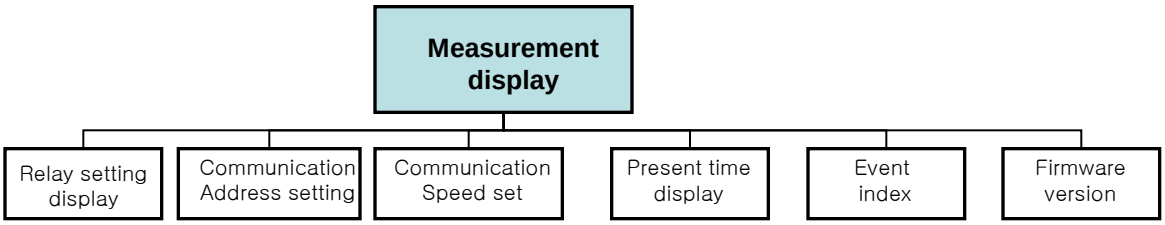
5. Display of Relay setting

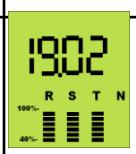
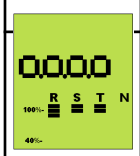


Display			Button	Contents
Long-time	current		M ▲ ▼	If pressing a Menu button once from its normal Measurement Display will switch to the screen that displays relay setting values. An initial screen of Measurement Setting Display is arranged for long-time delay current setting, and other setting values can be seen by pressing Up/Down cursor.
	delay time		M ▲ x 1	If pressing ‘Up cursor’ once from the Relay setting Display, the setting value of long-time tripping delay will be displayed.
short-time	current		M ▲ x 2	If pressing ‘Up cursor’ two times on the Relay setting display, the setting value of short-time tripping delay will be displayed
	delay time		M ▲ x 3	If pressing ‘Up cursor’ three times on the Relay setting Display, the setting time of short- time tripping delay will be displayed At this time, one larger value than the initial one will be displayed because LSB of time setting value is set in case of I2t is On. For example, if it is of I2t 0.400sec on setting, 0.401 will be displayed
Instantaneous	current		M ▲ x 4	If pressing ‘Up cursor’ four times on the Relay setting Display, Instantaneous pick up setting value will be displayed.
ground fault	pick up		M ▲ x 5	If pressing ‘Up cursor’ five times on the Relay setting Display, the setting value of Ground-fault pickup will be displayed.
	tripping delay		M ▲ x 6	If pressing ‘Up cursor’ six times on the Relay setting Display, the setting value of Ground- fault tripping delay will be displayed. At this time, one larger value than the initial one will be displayed because LSB of time setting value is set in case of I2t is On. For example, if it is of I2t 0.400sec on setting, 0.401 will be displayed
	current delay		M ▲ x 7	If pressing ‘Up cursor’ seven times on the Relay setting Display, the setting current of ground fault will be displayed. At this time, the 10~100% of In will be displayed and other values out of this range will be indicated as “_ _ _ _”

K. Operation of A type TRIP RELAY

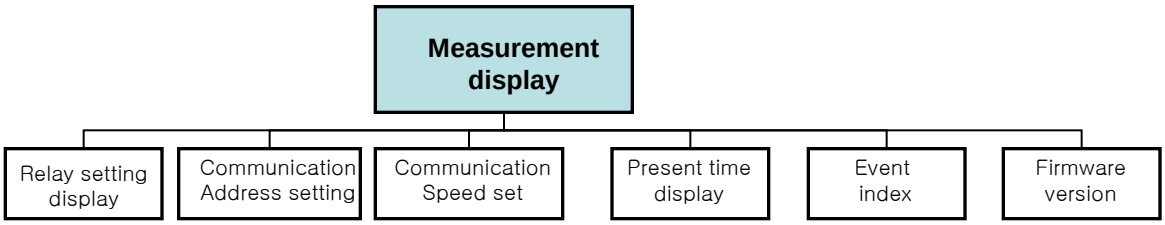
6. Display of measurement

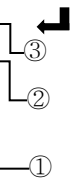
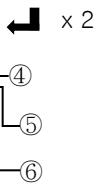
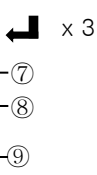


Display			Button	Contents
Communication	address		**M** x 2 ▲▼	If pressing MENU' button 3 times from the measurement Display, move to Communication Address Setting screen. Communication Address can be set from 1 to 247.
			↵	Press Enter button to save the setting, otherwise press ESC/RESET button to move back to Measurement Display. If successfully saved, "SAVE" is displayed on screen and move to Measurement Display and if pressing ESC/RESET button, move to Measurement Display without saving.
	Speed		**M** x 3 ▲▼	If pressing 'MENU' button 3 times from measurement Display screen, move to Communication Speed Setting screen. Communication speed can be set through Baud rate 38400 / 19200 / 9600. If pressing 'Up / Down' cursor, the value of Baud rate rolling over will be displayed
			↵	Press Enter button to save the setting, otherwise press ESC/RESET button to move back to Measurement Display. If successfully saved, "SAVE" is presented on screen and move to Measurement Display and if pressing ESC/RESET button, move to Measurement Display without saving.
Present	time		**M** x 4	If pressing 'MENU' button 4 times from Measurement Display, move to Present Time Display.. The present time is displayed with 'hour' and 'minute' by 24H type and Dot between hour and minute turns on and off every second. Unless present time is set, present time will be set '1 hour 1minute' as initial time is set as '1hour 1minite 1 second January 1st, 2000'.
Event			**M** x 5	If pressing 'MENU' button 5 times from Measuring Display, move to Event Index. On the Event Index, The information of fault events is shown on screen up to 10 faults and each information displays fault current, a type of fault, fault phases, occurring time which includes second, minute, hour, date, month, and year.
				1. "Ii=" : Fault : long time/short time/instantaneous/ground fault 2. "1600A" : fault current 3."▼" : Fault phase : R, S, T, N ACB OCR N / A type can save 10 events and Event Index indicates events order. When displaying the latest event, only one Segment will be showed on the Event Index and if pressing 'Up' cursor, Segment will be increased and the former saved event will be displayed.
				If there is no data in Event Index, 'Empty' will be displayed.

K. Operation of A type TRIP RELAY

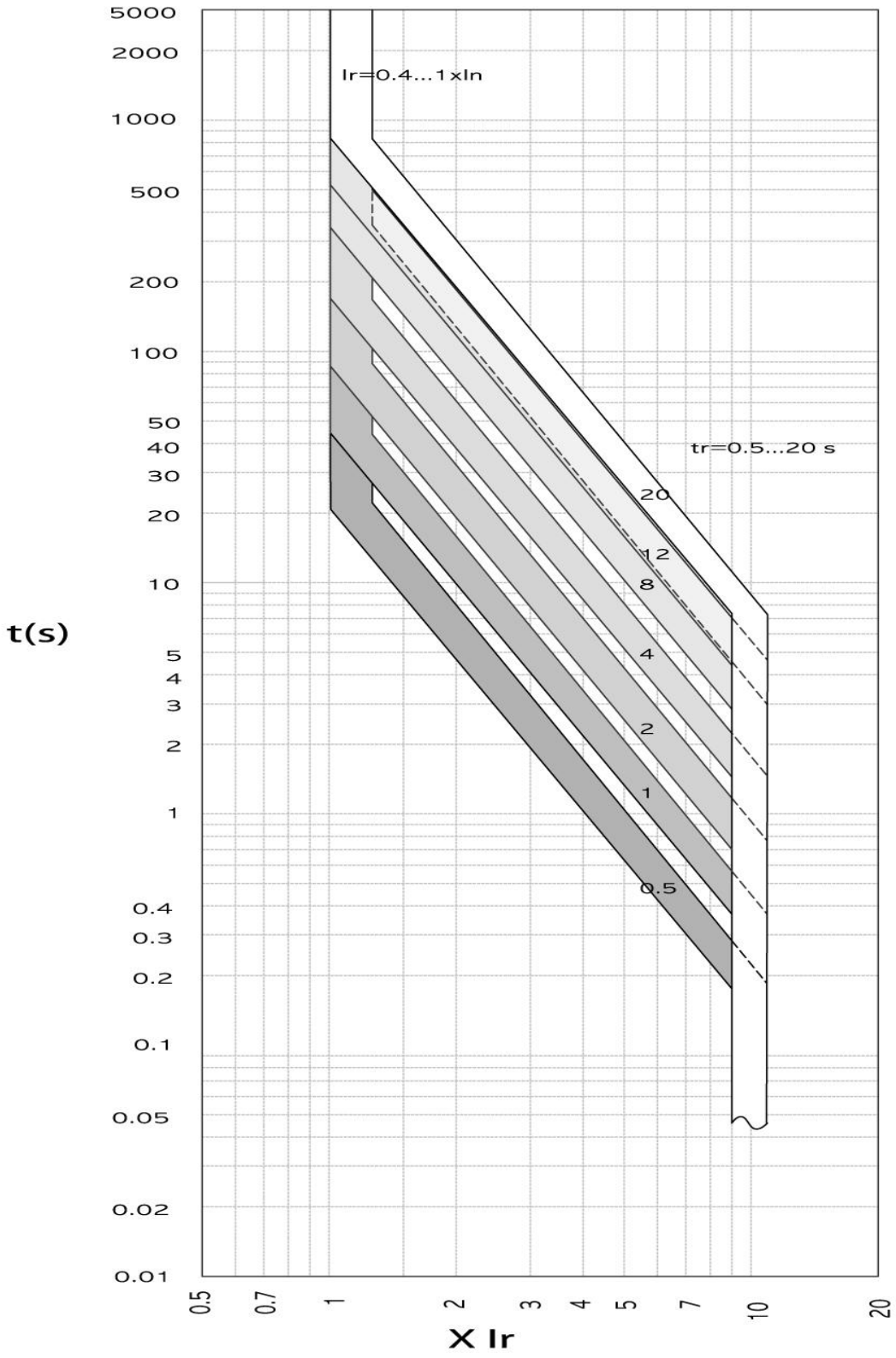
6. Display of measurement



Display		Button	Contents
Event			1. If pressing' Enter' from Event Index, the time information of relevant events is displayed. ① : Displaying the 7th Event (Event Index) ② ▼▼ : Displaying Event Year/Month ③ If pressing 'Enter' once, the information of Year/month will be displayed. Left screen indicates "January, 2007
			1. If pressing 'Enter' 2 times, the information of Date/Time will be displayed. ④ : The current screen indicates '1 o'clock, 8th" . ⑤ : Displaying Event Date/Time ⑥ : Event Index : Displaying the 7th Event
			1. If pressing 'Enter' 3 times, the information of minute/second will be displayed. . ⑦ : The current screen is to indicate "12 minutes 51seconds". ⑧ : Displaying Event Minute/Second ⑨ : Event Index : Displaying the 7th Event
Firmware version		**M** x 6	1. If pressing 'MENU' button 6 times from Measurement Display, move to irmware Version

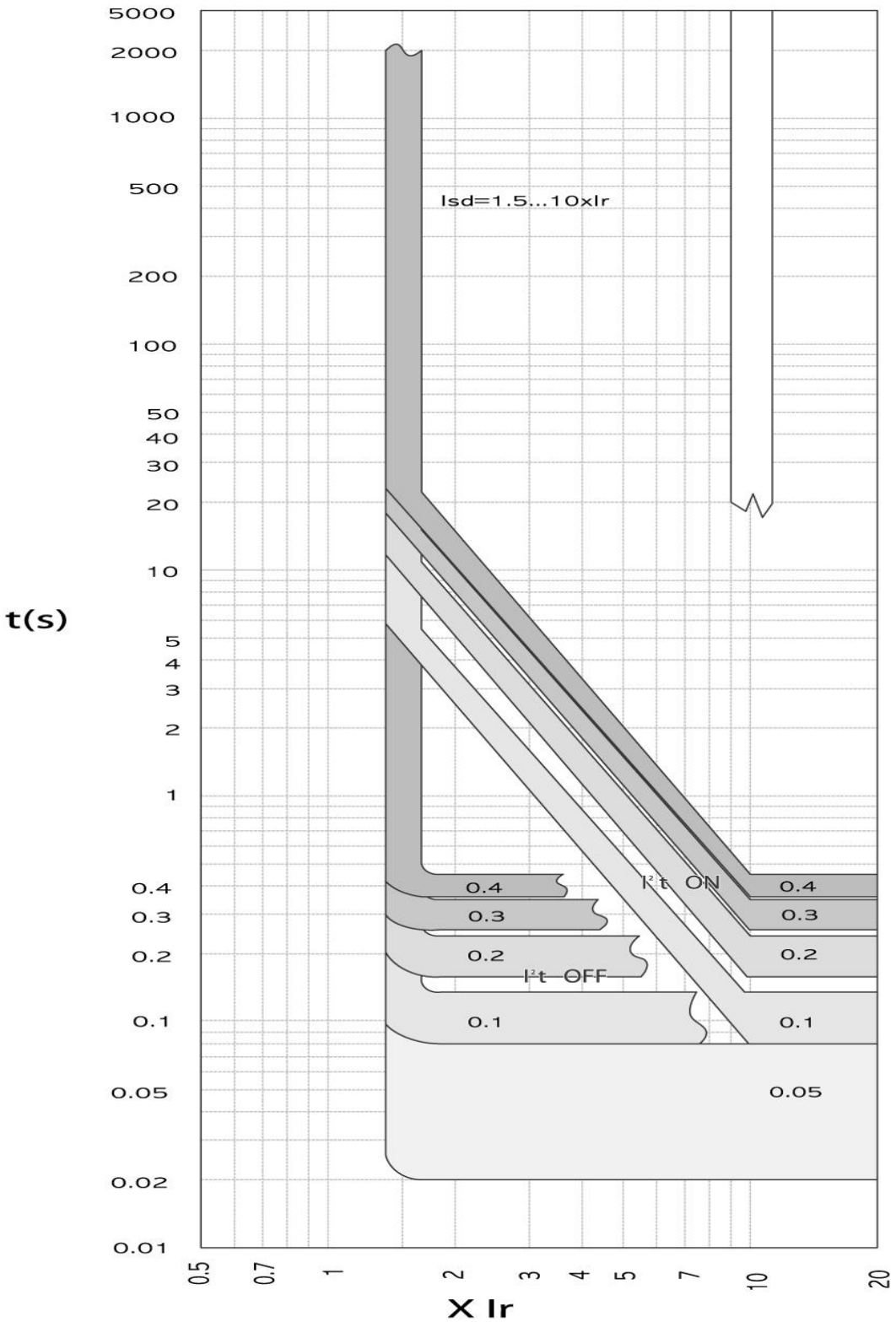
L. Characteristic Curves of TRIP RELAY

1. Long-time Delay



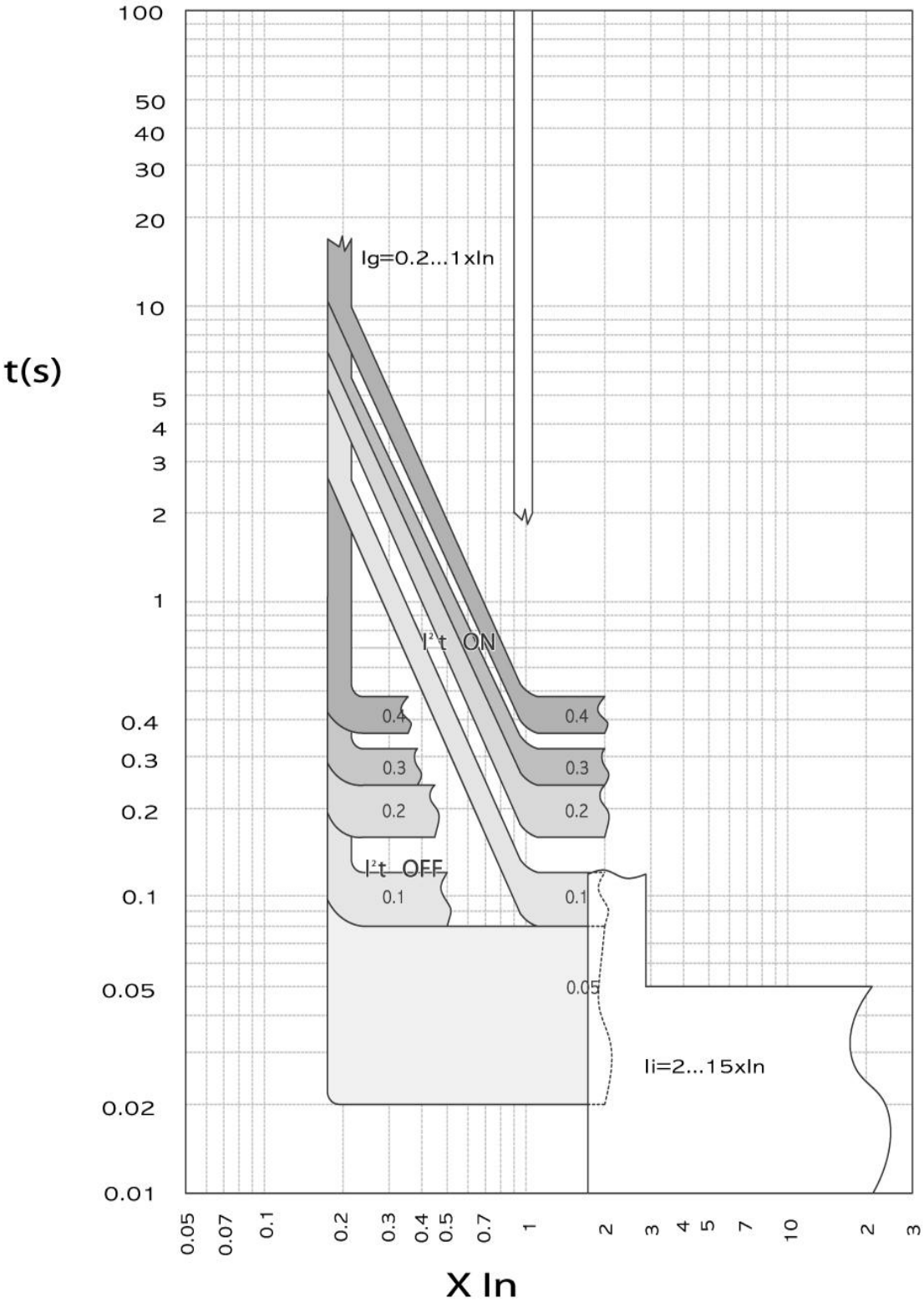
L. Characteristic curves of TRIP RELAY

2. Short – time Delay



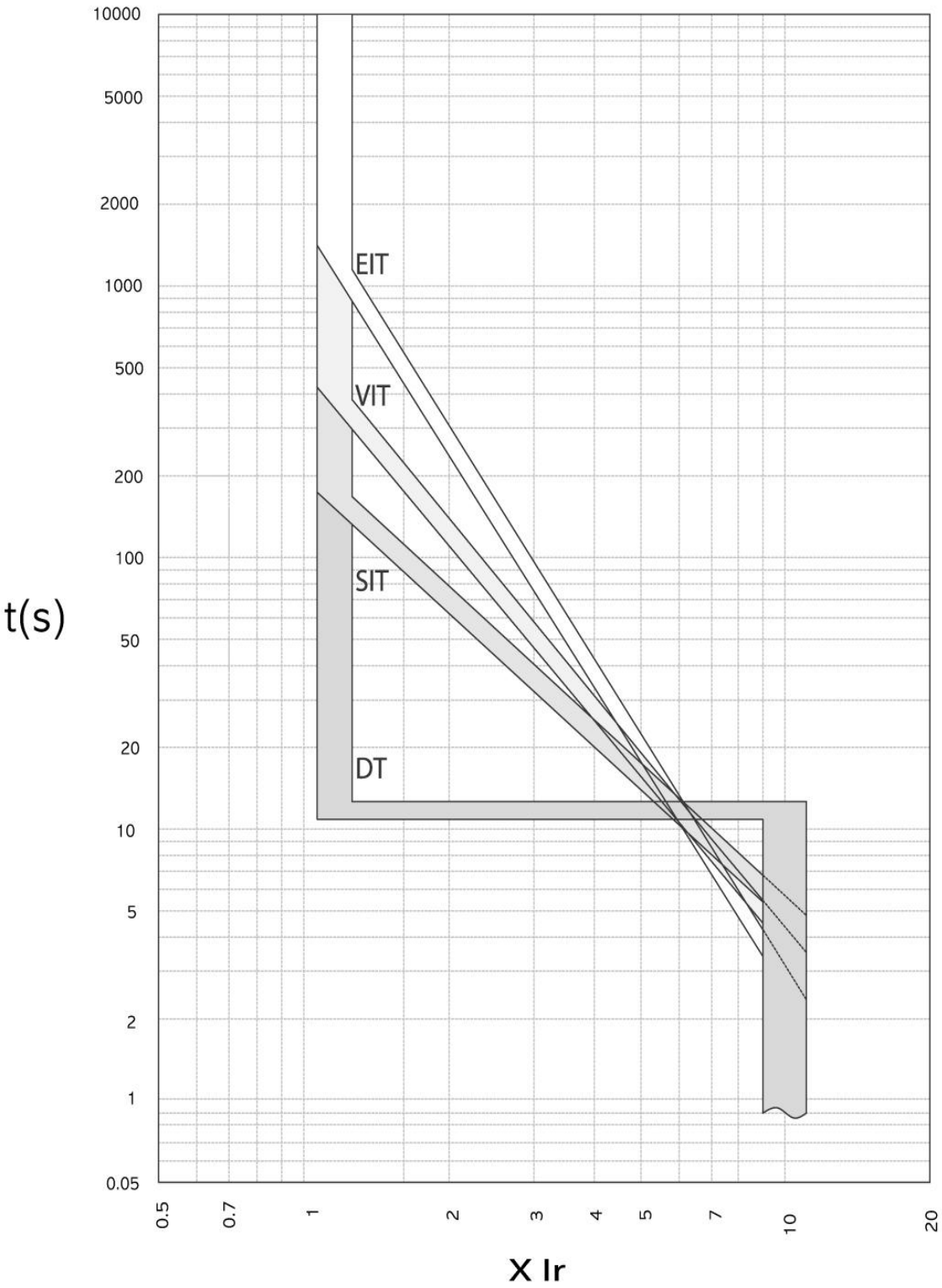
L. Characteristic curves of TRIP RELAY

3. Instantaneous / Ground Fault



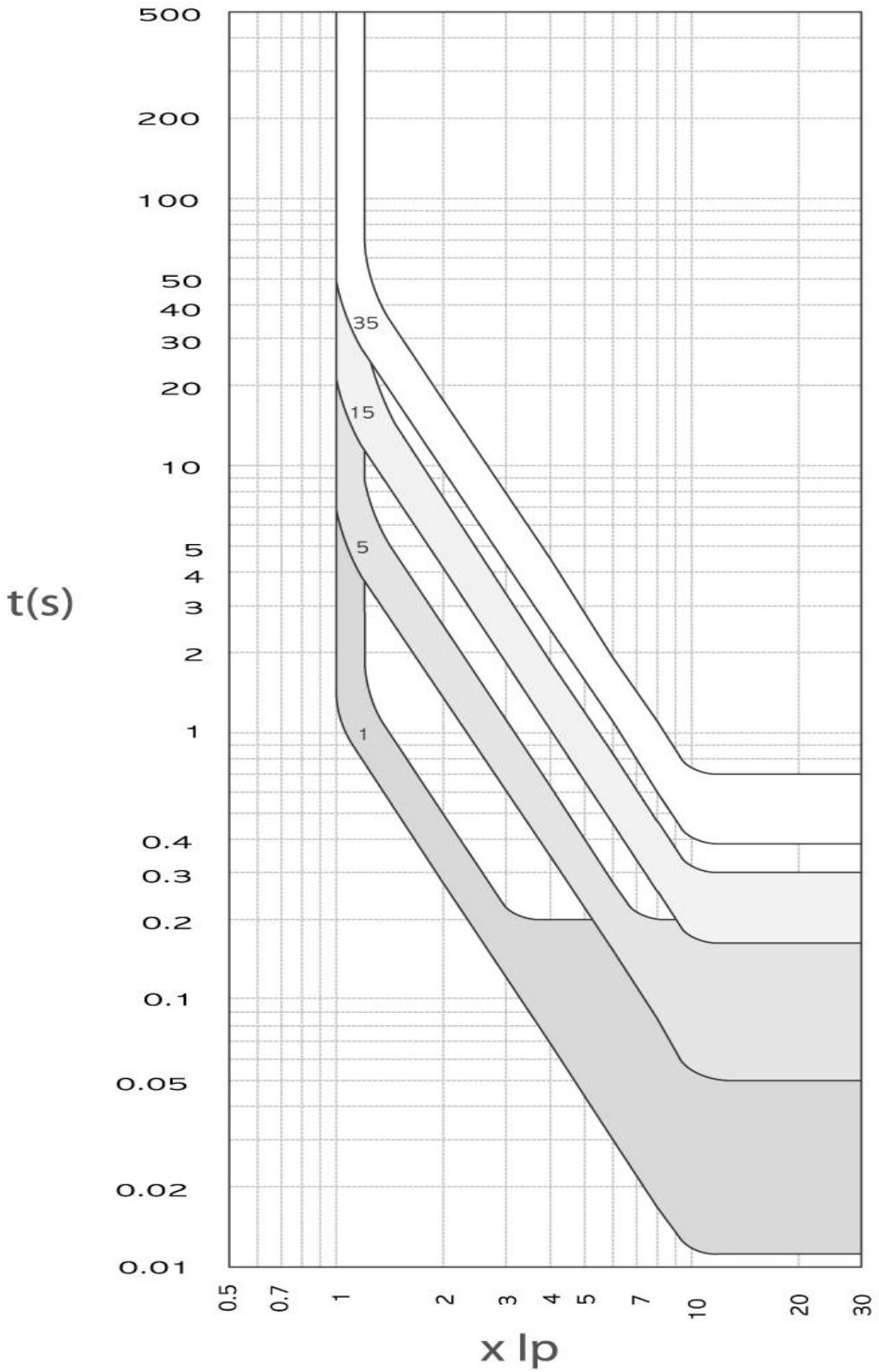
L. Characteristic curves of TRIP RELAY

4. IDMTL



L. Characteristic curves of TRIP RELAY

5. Pre Trip Alarm



M. Inspection and Troubleshooting

1. Inspection and maintenance cycle

The qualified engineer should perform the maintenance and inspection for safety reason and make sure that main circuit breaker is disconnected from the power supply before placing it service.

■ Initial check

After installing MCCB, make sure the inspection items listed below before supplying the power.

Type	Inspection item	Criteria
Common	1. Shall be no remains after cutting screws, wires around terminal	Shall be no remains
	2. Shall be no cracks and breakage on Cover, Case	Shall be no cracks and breakage
	3. Shall be no dew condensation on Cover and Case	Shall be no dew condensation
	4. Measure the insulating resistance with 500V insulating resistor	More than 5㏁
	5. Conducting part shall be fully tightened	Specified tightening torque

■ Precaution

(1) Withstand voltage test

The standard of withstand voltage test is as follows.

Main circuit		Aux circuit or control circuit	
Rated insulating voltage [UI]	Testing voltage (A.C effective value)	Rated insulating voltage of operating circuit	Testing voltage (A.C effective value)
300<UI≤690	2,500	UI≤60	1,000
690<UI≤800	3,000	60<UI≤600	2UIs+1,000

Note) 1. Shall be no withstand voltage test between terminals of circuit breakers for motor protection.

2. Shall be 1000V of withstand voltage between contacts embedded in Earth Leakage Relay.

3. This test voltage is based on standards of K60947-4-1 9.3.3.4.3.

■ Routine Check

Inspect circuit breaker a month earlier than it is taken into service and a month later to prevent the accident in advance and to keep circuit breaker in good condition. After that carry out the inspection according to inspection schedule and then record the result in the routine check table.

1. Clean and dry condition	Once in 2~3years
2. In presence of dust, corrosive gas, vapor, salinity	Once in a year
3. Severer condition than listed above 1,2	Once in a half year

M. Inspection and Troubleshooting

1. Inspection and replacement cycle

[Inspection method]

Checklist	Checklist	Solution
1. Dust	■ Inspect for dust on the surface of circuit breaker, especially on the top side of the switch and for dust stuck by oil etc.	■ Clear dust away with cleaner and dry, then wipe with a clean cloth. ■ Use neutral detergent (do not use corrosive detergent)
2. Loose terminal screw	■ Check if terminal screws or wire tightening screws etc, are unscrewed or loose. ■ Use standard tools.	■ Depending on the material and the size of screws, please tighten them with designated tightening torque
3. Opening and closing	■ If the circuit breaker is closed at all times, move the switch off and on many times to prevent a friction increase by grease hardening. ■ Stabilize contact resistance with a small moving operation of the contact.	■ If switch is not flexible, then request replacement or repair.
4. Insulation detail	■ Measure insulation resistance between each phase and ground with a 500V insulation resistance meter. ■ Measure the outer side of conductor.	■ If it's under 5㏁, you need to exchange it with a new product as a rule and investigate why resistance went down.

■ Inspection after breaking

If circuit breaker is broken by fault current, depending on the size of fault current, you can either reuse it or replace it.

Size of breaking current	Damage level of circuit breaker	Solution
Operating range of instantaneous trip (The current less than 10times of rated current)	No defects other than exhaust hole	Reusable *Available to break the 6times of rated current around 50times (less than 100A)
The circuit current which has a small value relatively ⇕ The short circuit current near to rated breaking capacity	The carbonization are shown around exhaust hole ⇕ The carbonization around Handle and exhaust hole Welded metals inside circuit breakers after tripping	Reusable ⇕ Replace with new product

1) Measure the insulation resistance of circuit breakers after removing it when it is unable to estimate the value of faulty current.
2) Carry out dielectric test only in case insulation resistance is less than 5㏁. If dielectric strength comply with the specified value it can be used temporarily but it is recommended to replace circuit breakers with a new one.
3) In case insulation resistance and dielectric strength is sufficient, circuit breakers can be reusable but check there has been no temperature-rise for a regular term.

■ replacement cycle (Life span)

For repair and inspection, you need to inspect according to installation environment, the life of a circuit breaker can not be decided by the number of years used. Usually an expert needs to inspect it but it is recommended to repair it as per the table below

Type	Environment	Location	Cycle (years)
Standard Usage Condition	Clean and dry place	Dustproof and air-filtered switchboard	Approx.10~15
	Place with dust but no corrosive gas	Private switchboard without dustproof or air filter	Approx. 7~10
Extreme Condition	Sulfuric acid, hydrogen sulfide, salinity, high humidity, etc. contains gas but less dust.	Local power plant, sewage treatment plant , steel mill, pulp mill.	Approx. 3~7
	Place with corrosive gas and much dust	Chemical factory, quarry, mine.	Approx. 1~3

2. Abnormal condition and solution

■ Solution for Circuit Breaker's abnormal condition

Type	Abnormal Condition	Cause	Solution
Temperature Increase	Terminal unit Overheating	■ Loose terminal unit tightening screw ■ Faulty booth bar assemble	■ Tightening with designated torque ■ Booth bar reassemble
	Product (except terminal unit) overheating	■ Faulty contact to internal contactor ■ Current density increase by wire terminal	■ New product replacement
Abnormal operation	Impossibility of closing (ON)	■ Foreign substance in switch ■ Reclosing without reset on trip position	■ Remove foreign substance ■ Closing after reset
	Impossibility of reoperating Impossibility of Breaking/ OFF Impossibility	■ Worn out by breaking endurance	■ New product exchange
		■ Reset device operation fault	■ Request after service
		■ The coil of under voltage trip device is not excited.	■ Applying power
		■ Switch spring burn out and exhaustion.	■ Replacement and mending
		■ Bimetal corrosion and transformation	■ Request after service
		■ Reaching the life of switch limit	■ New product exchange
		■ Overheating of over current detecting element	■ Operating after cooling
		■ Contact meeting and fusion by excessive breaking current	■ New product exchange
Fault Current Flow	Fault Current Flow	■ Inflow of insulation material between contact.	■ Remove foreign substance
		■ Conductive unit melting	■ New product exchange
		■ Contact burn out (wear)	
MCCB's Frequent breaking	Break On normal load	■ Wrong selection of product rating (causing overheating) ■ No window inside panel (Causing overheating) ■ MCCB internal heating ■ Loose terminal connection unit.	■ New product exchange (rating reselect) ■ New product exchange ■ Tightening terminal screw (check)
	Fault operating During motor starting	■ Heating by starting current	■ New product exchange
		■ Overload current more than rated current flows. (when using motor with overload or over voltage)	■ Rating adjustment
	Instantaneous Operation While Starting	■ Excessive starting current	■ Instantaneous breaking current setting or rating adjustment
		■ Excessive current Y△ starting switching	
		■ Excessive current by reversible operation	
		■ Instantaneous restarting rush current	
		■Operation by starting current like charging current of condenser, incandescent electric lamp flow, charging, etc.	
		■ Motor's Layer Short	■ Motor mending
		■ Abnormal current flow at the same time with closing	■ Circuit inspection
		■ Operating circuit fault connection	
Inactivity	Operating current of rated current	■ Large rated current	■ Select low rated current
		■ Current limit break of top fuse or incompatibility with top circuit breaker	■ Protection cooperation review or rating adjustment
Short circuit of Power side	Inactive operation over rated operating current	■ Dust piling up	■ New product exchange
		■ Switch side drop away of conductive material	■ New product exchange

2. Abnormal condition and solution

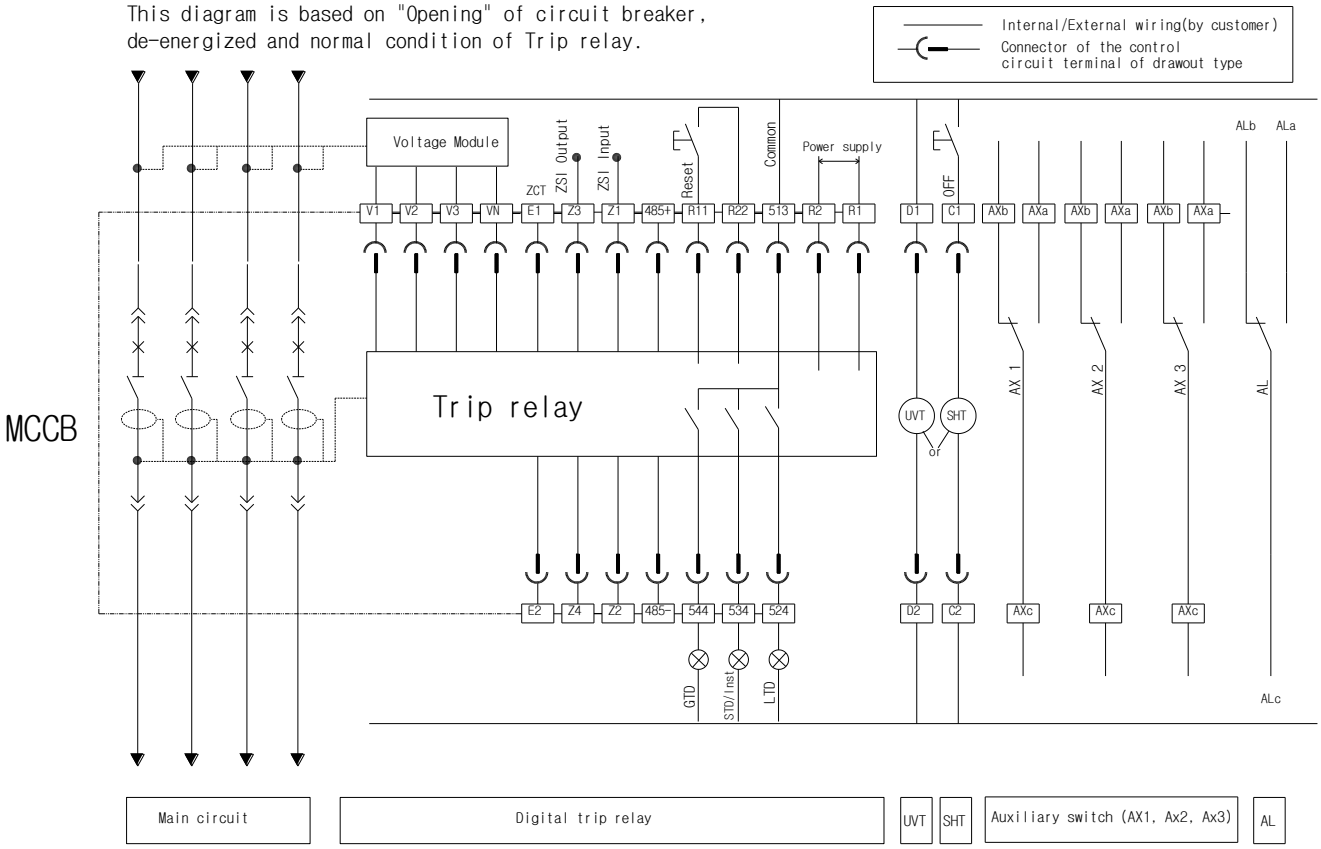
■ Solution for accessories abnormal operation

Type		Abnormal condition	Cause	Solution
Internal Accessories	SHT	Trip inactive	■ Operating voltage drop ■ Incorrect commercial voltage selection	■ Power improvement
			■ Coil burn out	■ Request after service
	UVT	Closing impossible	■ Applied frequency or voltage fault	■ Power improvement
	AL AX	Fault operation	■ Loose attachment screw	■ Readjustment
	FUAL	Fault operation	■ FUAL SWICTH fault	■ Request after service
			■ Lock up circuit wiring fault	■ Lock up circuit inspection

N. Wiring diagram of Control Circuit

1. Wiring diagram of Control Circuit

This diagram is based on "Opening" of circuit breaker, de-energized and normal condition of Trip relay.



Terminal code description

C1 C2	Voltage trip Device (SHT)
D1 D2	Under Voltage Trip (UVT)
R1 R2	Control power of Trip realy
513 ~ 544	Rely output for trip reason
R11 R22	Remote reset of relay output
485+ 485-	RS - 485 communication

Z1 Z2	ZSI input
Z3 Z4	ZSI output
E1 E2	ZCT INPUT
VN ~ V3	Voltage Module

Symbol and DESCRIPTIONS

AX , AL	Auxiliary switch , Alarm switch
LTD	Long time delay trip indicator
STD/Inst	Short time delay/instantaneous
GTD	Ground fault trip indicator
(SHT)	Voltage trip Device (SHT)
(UVT)	Under Voltage Trip (UVT)

Note)
1) The diagram is shown with "Opening" position of circuit breaker, de-energised and normal condition of Trip relay.
2) Please consult us for the use of ZSI (Zone selective Interlocking).
3) Refer to the catalogue for the connection of Trip relay and ZCT input terminals (E1,E2).
4) UVT and SHT can not work together at the same time.

Super Solution

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