Susol / Metasol

Air Circuit Breakers

Susol & Metasol

Super Solution

Meta Solution

Air Circuit Breakers

Technical Catalog

Air Circuit Breakers Technical Catalog

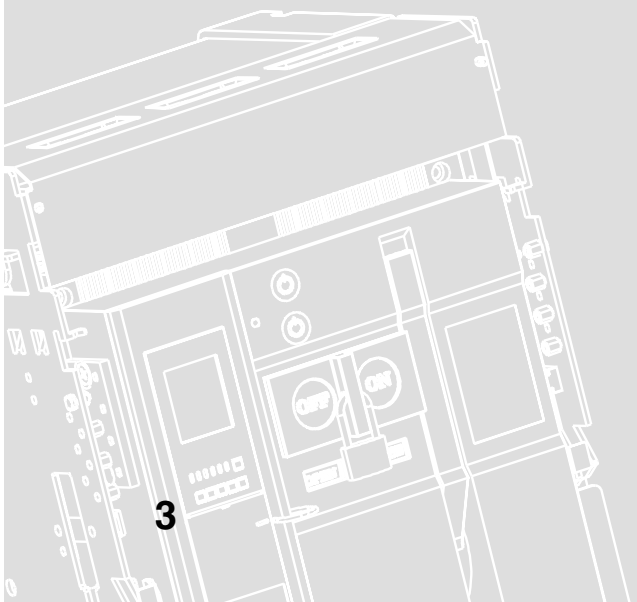
LS IS Co., Ltd.

Metasol
Meta solution

Susol
Super solution

Contents

A. Overview



1. Product Introduction

Background Information on Development of Susol / Metasol Series

It is developed to meet high breaking capacity required for elevated electricity demand, to satisfy compact distribution panel size demanded in markets, to achieve 100% N phase current conducting capacity on single phase load(3ϕ4w line), and to increase users' convenience by providing various accessories and connecting methods. Moreover, providing total solutions for customers by developing a relay, to achieve absolute protective coordination, and to correspond with IT system.

Susol / Metasol Series Characteristics

- Various Accessories Possession.
- Appropriate products for confronting IEC and ANSI (include nuclear energy plant purpose) standard
- Acquire multi-rating (690Vac, 500Vac) standard for all models
- Impulse Withstand Voltage (Uimp) : 12kV
- Ics = 100%Icu
- N phase current conducting capacity : 100%
- Suitable for installment with IT system
- Possess various customer oriented digital trips (N,A,P,S Type)

Susol Series

Susol Series ACB has high breaking capacity and multi-function product at the world class level which is used with P and S type of digital trip relay. It is basically equipped with arc box to assure arc space zero performance. Therefore it is appropriate for important machineries.

• AH Type

• Ics = 100%Icu at 500Vac

2000 AF	4000 AF	6300 AF
85kA	100kA	150kA

Metasol Series

Metasol Series ACB has AS type product for the highest breaking capacity for its domestic market, and AN type product for concentrating on fundamental functions at affordable price.

• AS Type

• Ics = 100%Icu at 500Vac

2000 AF	4000 AF	6300 AF
70kA	85kA	120kA

• AN Type

• Ics = 100%Icu at 500Vac

1600 AF	3200 AF
65kA	70kA

1. Product Introduction

Standard and Approvals

It has obtained approvals in accordance with following international standard and can be applicable to service condition defined from international standard.

- **IEC 60947-1**
  Low-voltage switchgear and controlgear - Part 1: General rules
- **IEC 60947-2**
  Low-voltage switchgear and controlgear - Part 2: Circuit-breakers

Susol / Metasol ACB have obtained following certificates and They are available upon a request

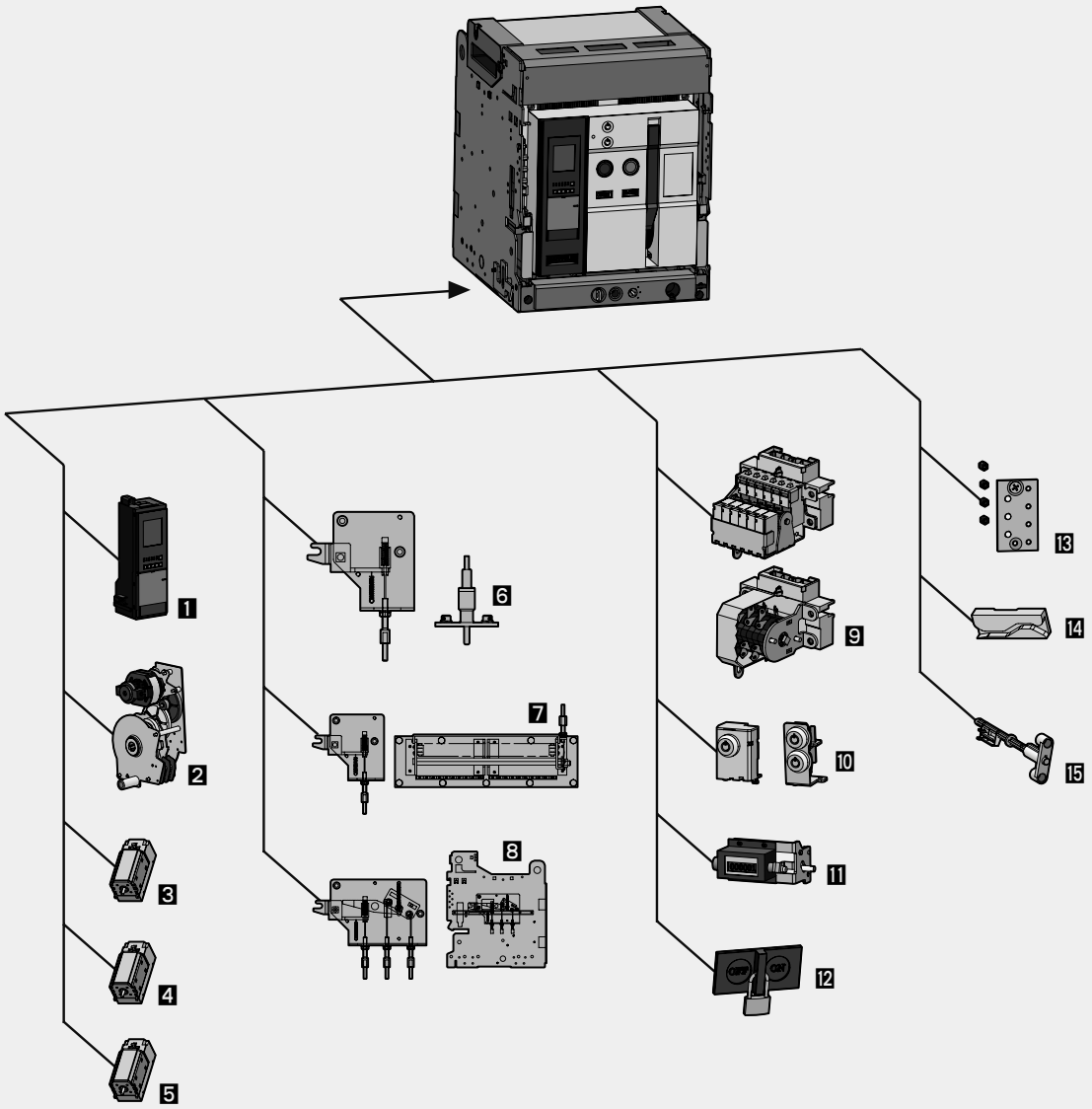
- Certificate of conformance test (KEMA - IEC 60947)
- Test report (KEMA / KERI)

CE Conformance Marking

The CE Marking indicates that a product complies with the requirements of the applicable European Directives. These Directives for products set out essential requirements which must be met before products may be marketed or traded within the European Economic Area. Thus, a displayed CE Marking indicates that a product complies with the applicable Directives.

2. Accessories

Main Body Structure - Auxiliary Devices

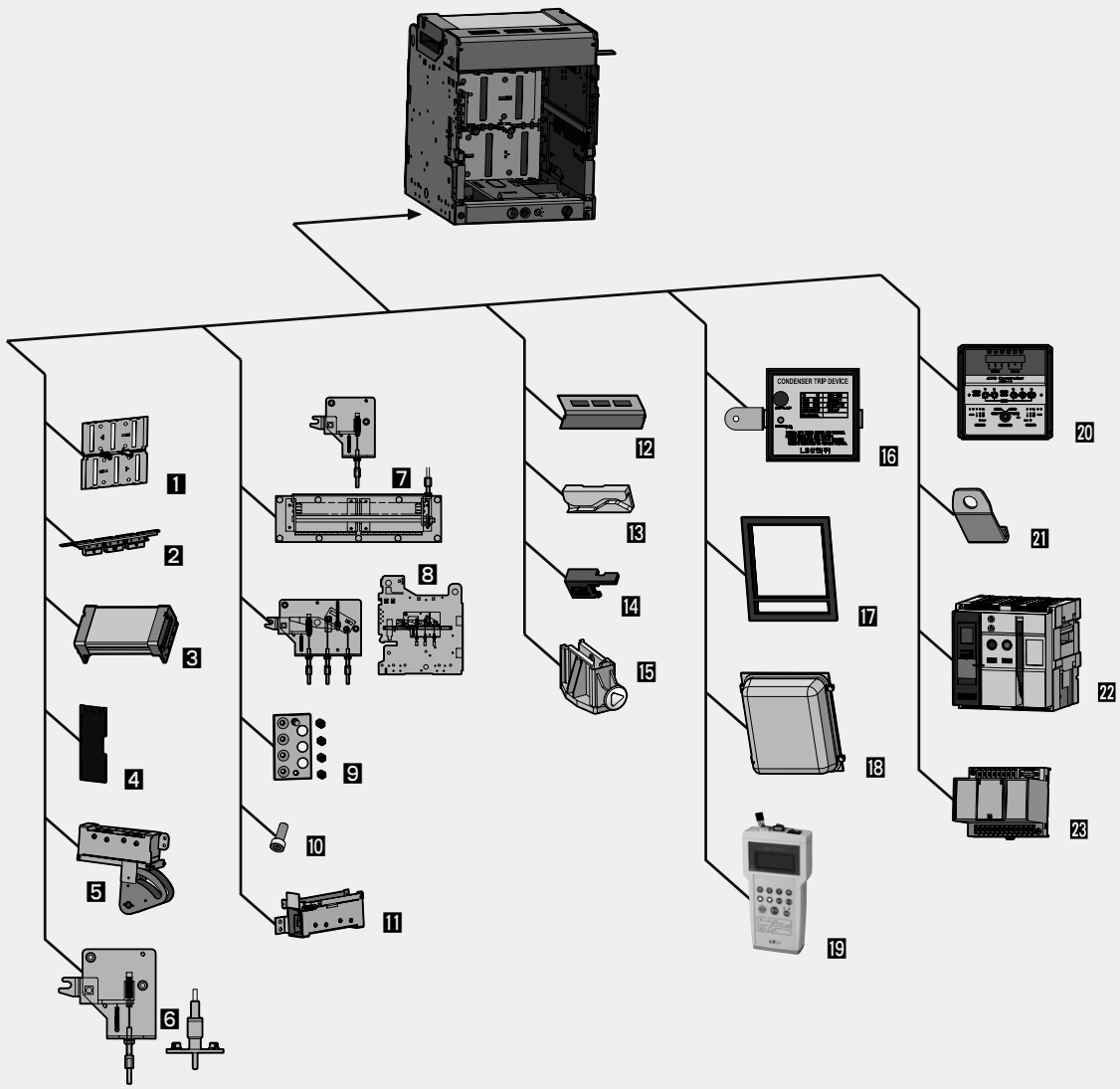


1 Trip Relay(OCR)
2 Motor(M)
3 Closing Coil(CC)
4 Shunt Coil(SHT)
5 Under Voltage Trip device(UVT)
6 Door Interlock(DI)
7 Mechanical Operated Cell switch(MOC)
8 Mechanical Interlock(MI)
9 Auxiliary Switch(AX)
10 Key Lock(K1), Key Interlock Double(K3)
11 Counter(C)
12 On/Off Button Lock(B)
13 Miss insertion prevent device(MIP)
14 Automatically discharge mechanism (ADM)
15 Manual Reset Button(MRB)

A

2. Accessories

Cradle Accessories / External Installation and Others



Cradle Accessories

1 Safety Shutter(ST)
2 Jack connection(J)
3 Zero Arc Space(ZAS)
4 Insulation Barrier(IB)
5 Cell Switch(CEL)
6 Door Interlock(DI)
7 Mechanical Operated Cell switch(MOC)
8 Mechanical Interlock(MI)
9 Miss Insertion Prevent device(MIP)
10 Cradle Mounting Block(CMB)
11 Shorting “b”contact(SBC)
12 Safty Controll Cover(SC)
13 Automatically discharge mechanism (ADM)
14 Racking Interlock(RI)
15 Safety Shutter Lock (STL)

External Installation and Other

16 Condenser Trip device(CTD)
17 Door Frame(DF)
18 Dust Cover(DC)
19 OCR Tester(OT)
20 Automatic Transfer Switch Controller(ATS)
21 Lifting Hook(LM)
22 Dummy ACB(DUM)
23 UVT Time Delay Controller (UDC)

3. Introduction of Digital Trip Relay

OCR with Multi-functions is to Satisfy Using Conditions for Diverse Customers' Demand.

N Type

Susol Metasol

- ZSI / Override/MCR
- L / S / I / G / Thermal

- Self Power
- Timer mounted
- Fault info. Kept by Battery (LED)
- 12bit ADC

[SType]

A Type

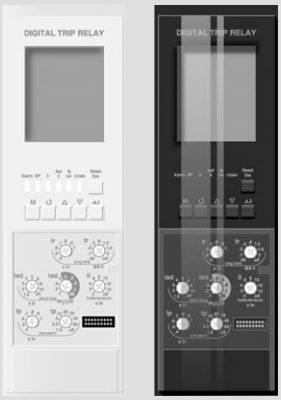
Susol Metasol

- L / S / I / G / Thermal
- ZSI / Override / MCR
- Communication (RS485)

- SMPS : 110 ~ 220V
- DC24 / 48V
- Self Power
- Timer mounted
- Fault info. Kept by Battery (10 faults + LED) (Fault / Current / Time / Date)

P/S Type

Susol Metasol



- L / S / I / G / Thermal / Earth leakage
- UV/OV/OF/UF/rP/Vun/Iun
- Measurement : V/A/W/Wh/F/PI
- Harmonics(63rd)/ Waveform (S Type)
- Communication (RS485)/ Fault waveform
- ZSI / Override/MCR
- SMPS : 110 ~ 220V
- DC24 / 48V
- Self Power
- Timer mounted
- Fault info. Kept by Battery (256 faults + LED) (Fault Info. + Fault waveform)

OCR Characteristics by Each Type

N type	**N Type (Normal)**	Operate as a current relay with its self-power
A type	**A Type (Ammeter)**	Current Meter + Current Relay + DO Control (3scores) + Communication
P type	**P Type (Power Meter)**	Current / Voltage / Frequency / Energy Meter Type + Current Relay + Voltage + Frequency Relay + Communication
S type	**S Type (Supreme)**	Every function of P type + Harmonics Analysis (63 harmonics) + Record Fault Frequency

4. Ratings

Susol Series

AH-10D3-10J

M1	D1	D1	AX	NGO	U1	B / C

Motor power suppy

MA	Motor Not Provided
M1	AC / DC 100V~130V
M2	AC / DC 200V~250V
M3	DC 125V
M4	DC 24V~30V
M5	DC 48V~60V
M6	AC 380V~480V
M7	AC 440V~480V
M8	AC 48V

Closing power suppy

D0	C.C Not Provided
D1	AC / DC 100~130V
D2	AC / DC 200~250V
D3	DC 125V
D4	DC 24~30V
D5	DC 48~60V
D6	AC 380V~480V
D7	AC 48V

Trip power suppy

D0	SHT Not Provided
D1	AC / DC 100~130V
D2	AC / DC 200~250V
D3	DC 125V
D4	DC 24~30V
D5	DC 48~60V
D6	AC 380V~480V
D7	AC 48V

Aux.contact & Charging types

AX	Low capacity OFF charge 3a3b
AC	Low capacity ON charge 3a3b
BX	Low capacity OFF charge 5a5b
BC	Low capacity ON charge 5a5b
HX	High capacity OFF charge 5a5b
HC	High capacity ON charge 5a5b
CC	Low capacity ON charge 6a6b
JC	High capacity ON charge 6a6b

OCR

UVT

U0	UVT Not Provided
U1	AC / DC 100~130V
U2	AC / DC 200~250V
U3	DC 125V
U4	DC 24~30V
U5	DC 48~60V
U6	AC 380V~480V
U7	AC 48V

∗UVT Delay usable from AC / DC 48V

OPTION

AH	10	D	3	10	J

Susol

AMPERE FRAME

-	-
06	630AF
08	800AF
10	1000AF
13	1250AF
16	1600AF
20	2000AF

Frame sizes & Phase array

D : 630~2,000AF
3/4P
Standard type
RST(N)

W : 630~2,000AF
4P
Reverse phase type
NRST

No. of pole

3 : 3 poles(D)
4 : 4 poles(D,W)

Rated current(CT SFEC)

00	OCR & CT Not Provided
02	200A
04	400A
06	630A
08	800A
10	1000A
13	1250A
16	1600A
20	2000A

Installation

	Draw-out type
J	Manual Connection
A	Autometic Connection
	Fixed type
H	Horizontal Connection
V	Vertical Connection
M	Top horizontal / Bottom vertical type
N	Top vertical / Bottom horizontal type
P	Front connection
L	Separate order / Installation on user's side

-	-
06	630AF
08	800AF
10	1000AF
13	1250AF
16	1600AF
20	2000AF
25	2500AF
32	3200AF
40	4000AF

E : 630~4,000AF
3/4P
Standard type
RST(N)

X : 630~4,000AF
4P
Reverse phase type
NRST

3 : 3 poles(E)
4 : 4 poles(E,X)

00	OCR & CT Not Provided
06	630
08	800
10	1000
13	1250
16	1600
20	2000
25	2500A
32	3200A
40	4000A

-	-
40	4000AF
50	5000AF
63	6300AF

G : 4000/5000/6300AF
3/4P Standard type RST(N)

Z : 4000/5000/6300AF 4P
Reverse phase type NRST

3 : 3 poles(G)
4 : 4 poles(G,Z)

00	OCR & CT Not Provided
40	4000A
50	5000A
63	6300A

Metasol Series

AN-10D3-10J

M1 — Motor power suppy

MA	Motor Not Provided
M1	AC / DC 100V~130V
M2	AC / DC 200V~250V
M3	DC 125V
M4	DC 24V~30V
M5	DC 48V~60V
M6	AC 380V~480V
M7	AC 440V~480V
M8	AC 48V

D1 — Closing power suppy

D0	C.C Not Provided
D1	AC / DC 100~130V
D2	AC / DC 200~250V
D3	DC 125V
D4	DC 24~30V
D5	DC 48~60V
D6	AC 380V~480V
D7	AC 48V

D1 — Trip power suppy

D0	SHT Not Provided
D1	AC / DC 100~130V
D2	AC / DC 200~250V
D3	DC 125V
D4	DC 24~30V
D5	DC 48~60V
D6	AC 380V~480V
D7	AC 48V

AX — Aux.contact & Charging types

AX	Low capacity OFF charge 3a3b
AC	Low capacity ON charge 3a3b
BX	Low capacity OFF charge 5a5b
BC	Low capacity ON charge 5a5b
HX	High capacity OFF charge 5a5b
HC	High capacity ON charge 5a5b
CC	Low capacity ON charge 6a6b
JC	High capacity ON charge 6a6b

NGO — OCR

U1 — UVT

U0	UVT Not Provided
U1	AC / DC 100V~130V
U2	AC / DC 200V~250V
U3	DC 125V
U4	DC 24V~30V
U5	DC 48V~60V
U6	AC 380V~480V
U7	AC 48V

∗UVT Delay usable from AC / DC 48V

B / C — OPTION

AN — Metasol

10 — AMPERE FRAME

-	-
08	630AF
08	800AF
10	1,000AF
13	1,250AF
16	1,600AF
-	-
20	2,000AF
25	2,500AF
32	3,200AF

D — Frame sizes & Phase array

D : 630~2,000AF
3/4P
Standard type
RST(N)

W : 630~2,000AF
4P
Reverse phase type
NRST

E : 630~4,000AF
3/4P
Standard type
RST(N)

X : 630~4,000AF
4P
Reverse phase type
NRST

3 — No. of pole

3 : 3 poles(D)
4 : 4 poles(D,W)

3 : 3 poles(E)
4 : 4 poles(E,X)

10 — Rated current(CT SFEC)

00	OCR & CT Not Provided
02	200A
04	400A
06	630A
08	800A
10	1000A
13	1250A
16	1600A
00	OCR & CT Not Provided
06	630
08	800
10	1,000
13	1,250
16	1,600
20	2,000
25	2,500A
32	3,200A

J — Installation

	Draw-out type
J	Manual Connection
A	Autometic Connection
	Fixed type
H	Horizontal Connection
V	Vertical Connection
M	Top horizontal / Bottom vertical type
N	Top vertical / Bottom horizontal type
P	Front connection
L	Separate order / Installation on user's side

4. Ratings

Metasol Series

AS-10D3-10J

M1	D1	D1	AX	NGO	U1	B / C

Motor power suppy

MA	Motor Not Provided
M1	AC / DC 100V~130V
M2	AC / DC 200V~250V
M3	DC 125V
M4	DC 24V~30V
M5	DC 48V~60V
M6	AC 380V~480V
M7	AC 440V~480V
M8	AC 48V

Closing power suppy

D0	C.C Not Provided
D1	AC / DC 100V~130V
D2	AC / DC 200V~250V
D3	DC 125V
D4	DC 24V~30V
D5	DC 48V~60V
D6	AC 380V~480V
D7	AC 48V

Trip power suppy

D0	SHT Not Provided
D1	AC / DC 100V~130V
D2	AC / DC 200V~250V
D3	DC 125V
D4	DC 24V~30V
D5	DC 48V~60V
D6	AC 380V~480V
D7	AC 48V

Aux.contact & Charging types

AX	Low capacity OFF charge 3a3b
AC	Low capacity ON charge 3a3b
BX	Low capacity OFF charge 5a5b
BC	Low capacity ON charge 5a5b
HX	High capacity OFF charge 5a5b
HC	High capacity ON charge 5a5b
CC	Low capacity ON charge 6a6b
JC	High capacity ON charge 6a6b

OCR

UVT

U0	UVT Not Provided
U1	AC / DC 100V~130V
U2	AC / DC 200V~250V
U3	DC 125V
U4	DC 24V~30V
U5	DC 48V~60V
U6	AC 380V~480V
U7	AC 48V

*UVT Delay usable from AC / DC 48V

OPTION

AS	10	D	3	10	J

Metasol

AMPERE FRAME

-	-
06	630AF
08	800AF
10	1000AF
13	1250AF
16	1600AF
20	2000AF

Frame sizes & Phase array

D : 630~2,000AF 3/4P Standard type RST(N)

W : 630~2,000AF 4P Reverse phase type NRST

No. of pole

3 : 3 poles(D)
4 : 4 poles(D,W)

Rated current(CT SFEC)

00	OCR & CT Not Provided
02	200A
04	400A
06	630A
08	800A
10	1000A
13	1250A
16	1600A
20	2000A

Installation

	Draw - out type
J	Manual Connection
A	Autometic Connection
	Fixed type
H	Horizontal Connection
V	Vertical Connection
M	Top horizontal / Bottom vertical type
N	Top vertical / Bottom horizontal type
P	Front connection
L	Separate order / Installation on user's side

-	-
20	2000AF
25	2500AF
32	3200AF
40	4000AF

E : 630~4,000AF 3/4P Standard type RST(N)

X : 630~4,000AF 4P Reverse phase type NRST

3 : 3 poles(E)
4 : 4 poles(E, X)

00	OCR & CT Not Provided
06	630
08	800
10	1000
13	1250
16	1600
20	2000
25	2500A
32	3200A
40	4000A

-	-
40	4000AF
50	5000AF

F : 5000AF 3/4P Standard type RST(N)

Y : 5000AF 4P Reverse phase type NRST

3 : 3 poles(F)
4 : 4 poles(F, Y)

00	OCR & CT Not Provided
40	4000A
50	5000A

40	4000AF
50	5000AF
63	6300AF

G : 4000/5000/6300AF 3/4P Standard type RST(N)

Z : 4000/5000/6300AF 4P Reverse phase type NRST

3 : 3 poles(G)
4 : 4 poles(G, Z)

00	OCR & CT Not Provided
40	4000A
50	5000A
63	6300A

OCR

N

OCR TYPE	
0	OCR Not Provided
N	NORMAL

G

Communication & Ground fault detection	
O	-
G	No communication

∗Ground fault detection (internal CT Vector Sum)
∗No. L, S, I, G output terminal (Available to check OC

O

Control power supply & Frequency	
0	-
0	No control power supply, 60Hz
5	No control power supply, 50Hz

A

OCR TYPE	
A	Ammeter

G

Communication & Ground fault detection	
G	No communication
Z	No communication + Ground fault detection
E	No communication + External CT Ground fault
C	Communication
K	No communication + Ground fault detection
X	No communication + External CT Ground fault

O

Control power supply & Frequency	
0	No control power supply, 60Hz
1	AC/DC 110V~220V, 60Hz
2	DC 24V~48V, 60Hz
5	No control power supply, 50Hz
6	AC/DC 110V~220V, 50Hz
7	DC 24V~48V, 50Hz

∗Ground fault detection (internal CT Vector Sum)
∗Unable to communicate without control power supply (Available to check OCR LED)
∗No. L, S, I, G output contact without control power supply (Available to check OCR LED)
∗N0 AG0, AG5, AZ0, AZ5, AE0, AE5 output contact

P

OCR TYPE	
P	Power meter

C

Communication & Ground fault detection	
C	Communication
K	Communication + Ground fault detection
X	Communication + External CT Ground fault
A	Communication + Pre-Trip Alam

1

Control power supply & Frequency	
1	AC/DC 110V~220V, 60Hz
2	DC 24V~48V, 60Hz
6	AC/DC 110V~220V, 50Hz
7	DC 24V~48V, 50Hz

∗Ground fault detection (internal CT Vector Sum)
∗Communication (Not available without control power supply
∗Application to protect motor

S

OCR TYPE	
S	Supreme meter

C

Communication & Ground fault detection	
C	Communication
K	Communication + Ground fault detection
X	Communication + External CT Ground fault
A	Communication + Pre-Trip Alam

1

Control power supply & Frequency	
1	AC/DC 110V~220V, 60Hz
2	DC 24V~48V, 60Hz
6	AC/DC 110V~220V, 50Hz
7	DC 24V~48V, 50Hz

∗Ground fault detection
∗Communication (Not available without control power supply
∗Not applicable for METASOL(AN, AS)
∗Applicable to protect motor

Cradle

AN

Type Name
LS ACB CRADLE

N16D

Rated current & FRAMESIZE	
N16D	AN-06-16D
S16D	AS-06-16D
H16D	AH-06-16D
H20D	AS-200 AH-200
N32E	AN-06-32E
S32E	AS-06-32E
H32E	AH-06-32E
H40E	AS-40E AH-40E
S50F	AS-50F
S50G	AS-40-50G
H50G	AH-40-50G

3

No. of pole	
3	3 poles
4	4 poles

J

Installation	
J	No automatic connection
A	Automatic connection

H

Installation	
H	Top / Bottom horizontal Type (H20D Not available)
V	Top / Bottom vertical type
M	Top horizontal / Bottom vertical type (H20D Not available)
N	Top vertical / Bottom horizontal type (H20D Not available)
P	Top / Bottom horizontal Type (40E, 50FG, 63G Not available)
L	Separate order Installation on user's side

E

Safety shutter	
E	No shutter
F	Shutter

N

Arc cover	
N	No ARC COVER
S	ARC COVER

4. Ratings

Susol Series Ratings

TYPE					AH - D, W						
					AH- 06D	AH- 08D	AH-10D	AH-13D	AH-16D	AH-20D	
Ampere Frame		(AF)			630	800	1000	1250	1600	2000	
Rated current (In max)		(A)	at 40℃		200 400 630	400 630 800	1000	1250	1600	2000	
Rated operating voltage		(Ue)	(V)		690						
Rated insulation voltage		(Ui)	(V)		1000						
Frequency		(Hz)			50 / 60						
Number of poles		(P)			3, 4						
Rated current of neutral pole		(A)			630	800	1000	1250	1600	2000	
Rated breaking capacity (Icu) (Sym)		(kA)	IEC 60947-2 AC KS C 8325	690V / 600V / 550V	65						
				500V / 480V / 460V	85						
				415V / 380V / 230V / 220V	85						
Rated service breaking capacity(Ics)		(kA)		※ % * Icu	100						
Rated making capacity (Icm) (peak)		(kA)	IEC 60947-2 AC KS C 8325	690V / 600V / 550V	143						
				500V / 480V / 460V	187						
				415V / 380V / 230V / 220V	187						
Rated Short-time capacity(Icw)		(kA)		1 Sec	65						
				2 Sec	60						
				3 Sec	50						
Rated impulse withstand voltage(Uimp)		(kV)			12						
Operating time(t)		(ms)		Maximum total breaking time	40						
				Closing time	80						
Life cycle	ACB	(time)	Mechanical	Without maintenance	12000						
				With maintenance	20000						
			Electrical	Without maintenance	5000						
				With maintenance	10000						
Weight (3P/4P)		(kg)	Draw-out type	Main Body (with cradle) Motor charging type	63 / 74					70 / 85	
				Main Body (with cradle) Manual charging type	61 / 72					68 / 83	
				Cradle only	29 / 32					33 / 40	
			Fixed type	Motor charging type	34 / 44					38 / 47	
				Manual charging type	32 / 42					36 / 45	
External dimension	Draw-out type	(mm)	H:430(460), D:375	W(3P/4P)	334 / 419						
	Fixed type	(mm)	H:300, D:295	W(3P/4P)	300 / 385						

	AH - E, X									AH - G, Z		
	AH- 06E	AH- 08E	AH-10E	AH-13E	AH-16E	AH-20E	AH-25E	AH-32E	AH-40E	AH-40G	AH-50G	AH-63G
	630	800	1000	1250	1600	2000	2500	3200	4000	4000	5000	6300
	400 630	400 630 800	1000	1250	1600	2000	2500	3200	4000	4000	5000	6300
	690									690		
	1000									1000		
	50 / 60									50 / 60		
	3, 4									3, 4		
	630	800	1000	1250	1600	2000	2500	3200	4000	4000	5000	6300
	85									100		
	100									150		
	100									150		
	100									100		
	187									220		
	220									330		
	220									330		
	85									100		
	75									100		
	65									100		
	12									12		
	40									40		
	80									80		
	10000									5000		
	20000									10000		
	5000									2000		
	10000									5000		
	87 / 103								104 / 147	181 / 223		186 / 230
	85 / 101								102 / 145	179 / 221		184 / 228
	44 / 55								53 / 70	97 / 117		102 / 124
	44 / 55								63 / 100	98 / 123		103 / 130
	42 / 53								61 / 98	96 / 121		101 / 128
	412 / 527									785 / 1015		
	378 / 493									751 / 981		

4. Ratings

Metasol AS / AN Series Ratings

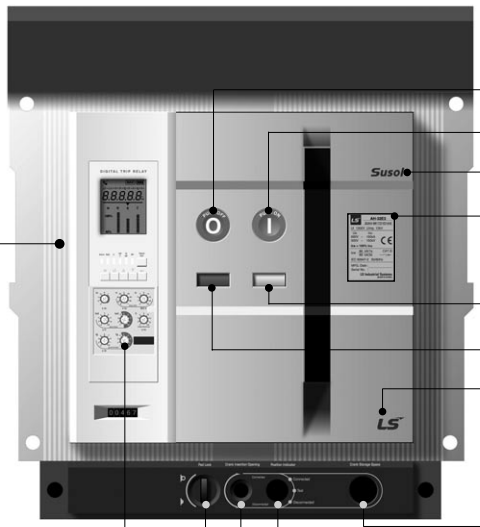
TYPE					AS - D, W						AS - E, X	
					AS-06D	AS-08D	AS-10D	AS-13D	AS-16D	AS-20D	AS-20E	
Ampere Frame	(AF)				630AF	800AF	1000AF	1250AF	1600AF	2000AF	2000	
Rated current (In max)	(A)	at 40℃			200 400 630	400 630 800	1000	1250	1600	2000	630,800 1000,1250 1600,2000	
Rated operating voltage	(Ue)	(V)			690						690	
Rated insulation voltage	(Ui)	(V)			1000						1000	
Frequency	(Hz)				50 / 60						50 / 60	
Number of poles	(P)				3, 4						3, 4	
Rated current of neutral pole	(A)				630	800	1000	1250	1600	2000	630,800 1000,1250 1600,2000	
Rated breaking capacity (Icu) (Sym)	(kA)	IEC 60947-2 AC KS C 8325		690V / 600V / 550V	65						85	
				500V / 480V / 460V	70						85	
				415V / 380V / 230V / 220V	70						85	
Rated service breaking capacity(Ics)	(kA)			※ % * Icu	100						100	
Rated making capacity (Icm) (peak)	(kA)	IEC 60947-2 AC KS C 8325		690V / 600V / 550V	143						187	
				500V / 480V / 460V	154						187	
				415V / 380V / 230V / 220V	154						187	
Rated Short-time capacity(Icw)	(kA)			1 Sec	65						85	
				2 Sec	55						75	
				3 Sec	50						65	
Rated impulse withstand voltage(Uimp)	(kV)				12						12	
Operating time(t)	(ms)			Maximum total breaking time	40						40	
				Closing time	80						80	
Life cycle ACB	(time)	Mechanical		Without maintenance	12000						10000	
				With maintenance	20000						20000	
		Electrical		Without maintenance	5000						5000	
				With maintenance	10000						10000	
Weight (3P/4P)	(kg)	Draw-out type	Main Body (with cradle)	Motor charging type	63 / 74					70 / 85	87 / 103	
				Manual charging type	61 / 72					68 / 83	85 / 101	
			Cradle only		29 / 32					33 / 40	44 / 50	
		Fixed type		Motor charging type	34 / 44					38 / 47	44 / 55	
				Manual charging type	32 / 42					36 / 45	42 / 53	
External dimension	Draw-out type	(mm)	H:430(460), D:375	W(3P/4P)	334 / 419						412 / 527	
	Fixed type	(mm)	H:300, D:295	W(3P/4P)	300 / 385						378 / 493	

	AS - E, X			AS-F,Y		AS - G, Z			AN - D, W					AN - E, X		
	AS-25E	AS-32E	AS-40E	AS-40F	AS-50F	AS-40G	AS-50G	AS-63G	AN-06D	AN-08D	AN-10D	AN-13D	AN-16D	AN-20E	AN-25E	AN-32E
	2500	3200	4000	4000	5000	4000	5000	6300	630AF	800AF	1000AF	1250AF	1600AF	2000	2500	3200
	2500	3200	4000	4000	5000	4000	5000	6300	200 400 630	400 630 800	1000	1250	1600	630,800 1000,1250 1600,2000	2500	3200
	690			690		690			690					690		
	1000			1000		1000			1000					1000		
	50 / 60			50 / 60		50 / 60			50 / 60					50 / 60		
	3, 4			3, 4		3, 4			3, 4					3, 4		
	2500	3200	4000	4000	5000	4000	5000	6300	200 400 630	400 630 800	1000	1250	1600	630,800 1000,1250 1600,2000	2500	3200
	85			85		100			50					65		
	85			100		120			65					70		
	85			100		120			65					70		
	100			100		100			100					100		
	187			187		220			105					143		
	187			220		264			143					154		
	187			220		264			143					154		
	85			85		100			50					65		
	75			75		90			42					50		
	65			65		85			36					42		
	12			12		12			12					12		
	40			40		40			40					40		
	80			80		80			80					80		
	10000			5000		5000			12000					10000		
	20000			10000		10000			20000					20000		
	5000			2000		2000			5000					5000		
	10000			5000		5000			10000					10000		
	87 / 103		104 / 147	145 / 173		181 / 223		186/230	63 / 74					87 / 103		
	85 / 101		102 / 145	143 / 171		179 / 221		184/228	61 / 72					85 / 101		
	44 / 50		58 / 70	78 / 90		97 / 117		102/124	29 / 32					44 / 50		
	44 / 55		63 / 100	76 / 94		98 / 123		103/130	34 / 44					44 / 55		
	42 / 53		61/ 98	74 / 92		96 / 121		101/128	32 / 42					42 / 53		
	412 / 527			629 / 799		785 / 1015			334 / 419					412 / 527		
	378 / 493			597/ 767		751 / 981			300 / 385					378 / 493		

A

5. Externals and Inscriptions

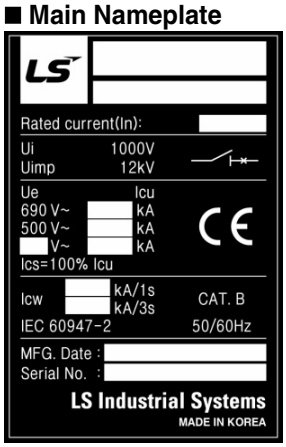
External View and Inscriptions



OFF Button
ON Button
Product Series Name
Main Nameplate
Charge Discharge Display
ON/OFF Display
Company CI
Draw-in/out Handle Storage Space
Position Indicator
Draw in/out Handle Insertion Opening
Draw-in/out pad lock
Digital Trip Relay
Secondary Nameplate

Nameplate Features

■ **Main Nameplate**



Acronym Explanation

Ui : Rated Insulation Voltage

Uimp : Impulse Withstand Voltage

Ue : Rated Operational Voltage (AC base)

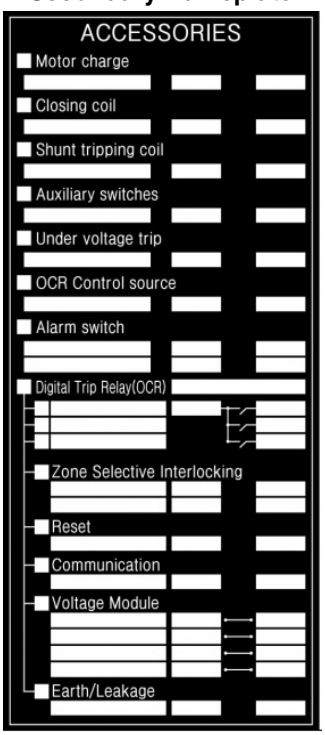
Icu : Ultimate Breaking Capacity

Ics : Service Breaking Capacity

Icw : Short Time Withstand Current

MFG. Date: Manufacturing Date

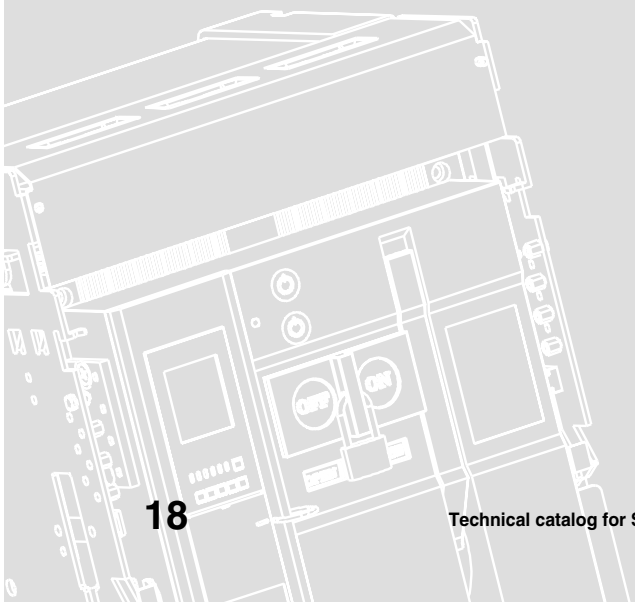
■ **Secondary Nameplate**



Explanation of Terminologies

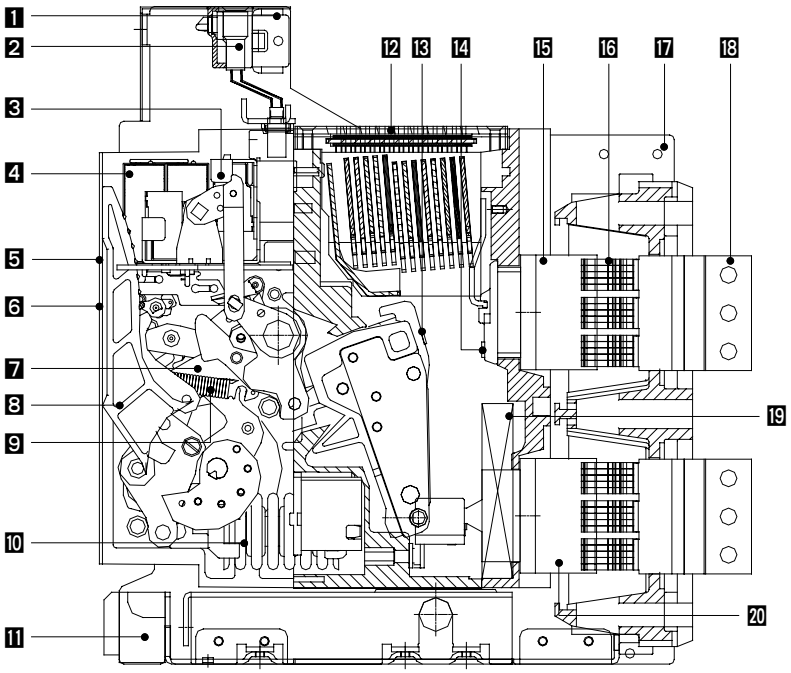
Motor charge Closing coil Shunt tripping coil	Control Power and Connecting Terminal Indication
Auxiliary switches :	Contact Quantity and Connecting Terminal Indication
Under voltage trip OCR control source	Control Power and Connecting Terminal Indication
Alarm switch :	Alarm Presence and Connecting Terminal Indication
Digital trip relay :	Switch Connecting Diagram Display
Z.S.I :	Input/Output Terminal Indication and
Reset :	Connecting Terminal Indication
Communication :	Communication and Connecting Terminal Indication
Voltage Module :	Each phase Voltage and Symbol Indication
Earth / Leakage:	Ground fault / Earth leakage Sensor Terminal Indication

B. Structure and Operation



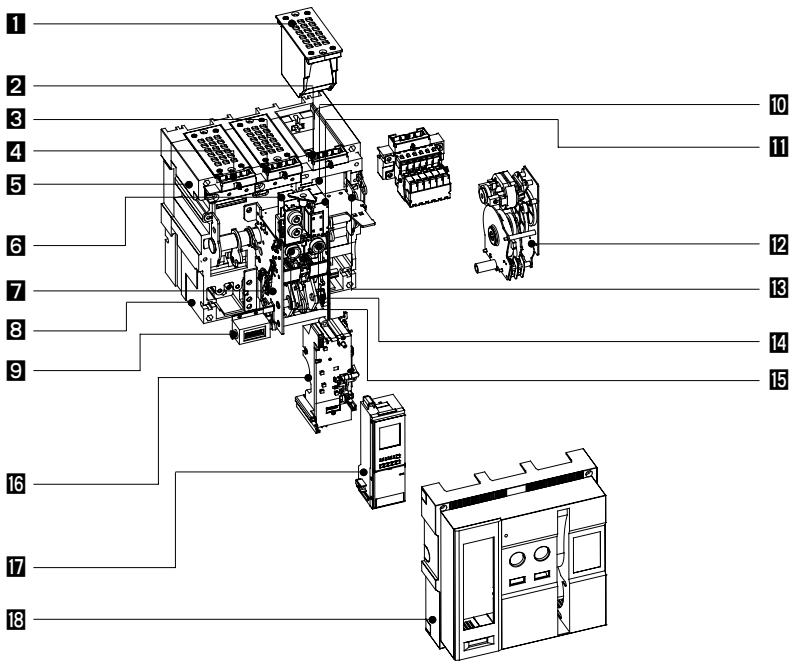
1. Internal Structure and Components

Internal Configuration



1 Control terminal block
2 Control terminal
3 Auxiliary switches
4 Closing, Trip, UVT Coil
5 Trip Relay
6 Front Cover
7 Mechanism
8 Charge Handle
9 Trip spring
10 Closing spring
11 Draw-in / Out device
12 Arc extinguishing part
13 Moving contact
14 Fixed contact
15 Conductor on Source side
16 Cradle Finger
17 Cradle
18 Connecting conductor to circuit breakers
19 Power supply CT
20 Conductor on load side

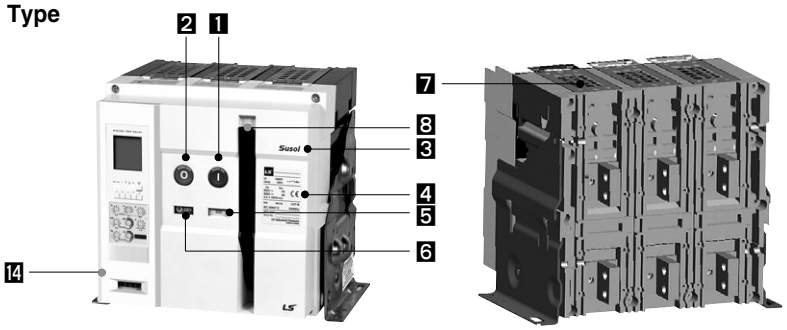
Components



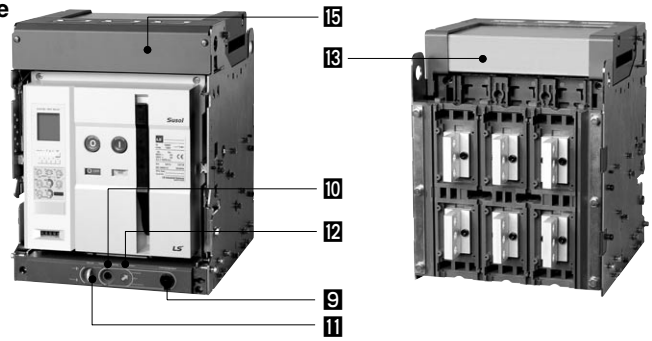
1 Arc chute
2 Aux. switch control terminal
3 Control power supply terminal
4 OCR control terminal
5 Carrying grip
6 Closing Coil
7 Mechanism
8 Main body
9 Counter
10 UVT coil
11 Trip coil
12 Motor Ass'y
13 Aux. switch
14 ON button
15 OFF button
16 MTD Base
17 OCR
18 Cover

Fixed Type / Draw-Out Type

■ **Fixed Type**



■ **Draw-out Type**



1 ON button
2 OFF button
3 Series name
4 Rated name plate
5 Charge Discharge indicator
6 ON/OFF indicator
7 Arc box
8 Charge handle
9 Drawout handle
10 Handle storage space
11 Pad lock button
12 Position indicator
13 Arc Cover
14 Digital trip relay
15 Terminal cover

B

Terminal Configuration

There are many possible terminal configurations when connecting bus bar of distribution panel, vertical, horizontal, plane type, etc.


Fig.1 Horizontal type


Fig. 2 Vertical type

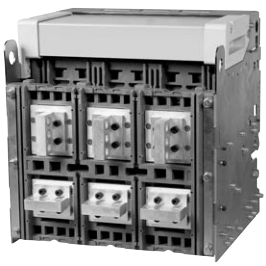


Fig.3 Horizontal/Vertical type

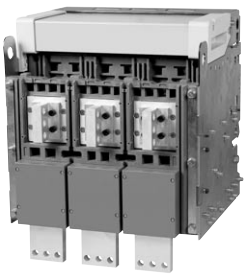


Fig.4 Vertical/Front type

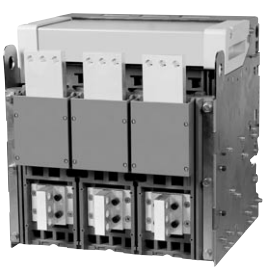


Fig.5 Front/Vertical type

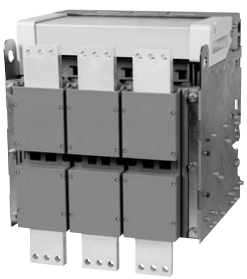


Fig.6 Front type

2. Basic Function and Breaking Operation

ACB Prevents a Fire, a Property Damage, the Breakage of an Electrical Equipment on Load capital side by Protecting a Circuit from the capital 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) (e.g. Motor takes in 7~8times of In for a few seconds).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 tobreak it.

3. Circuit Opening, Current Breaking

1) Current can be broken manually or remotely by voluntary operation on mechanism.
2) 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.)
3) 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.
1) A maximum leakage current test under rated using voltage (Max. Ue)
2) An impulse voltage

There are Following Breaking Principles Regarding Over Current.

1. Instantaneous Trip

When short-circuit current flows in, ACB 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, ACB keeps the conducting condition for a regular time and break the current if it is continuously remained. In case of short-circuit, ACB 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.

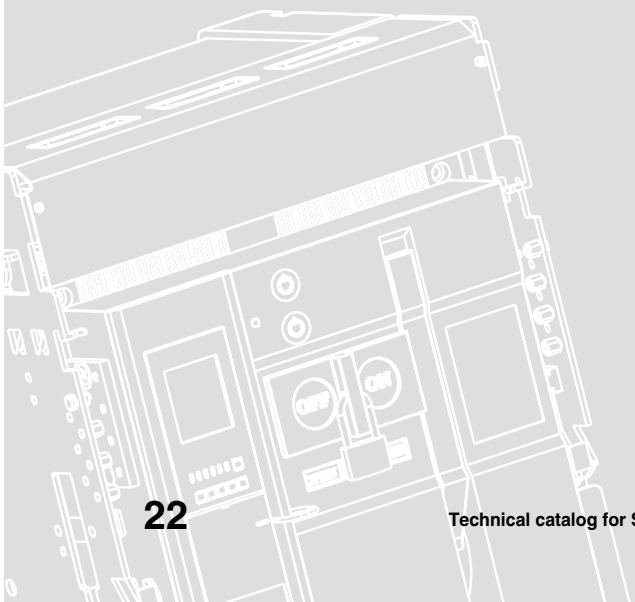
3. Overload Trip

If the current which exceeds the rated current flows in continuously, the cable is getting hotter and it causes the big fire. Therefore, ACB 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.

C. Internal Electrical Accessories



1. Closing and Shunt Coil

• It is a control device which closes or trips a circuit breaker from remote place when applying voltage continuously or instantaneously to coil terminals (C1, C2).

Rated Voltage and Characteristics of Closing / Shunt coil

Rated Voltage [Vn]		Operating Voltage Range [V]		Power Consumption (VA or W)		Trip Time [ms]	
DC [V]	AC [V]	Closing Coil	Shunt Coil	Inrush	Steady-State	Closing Coil	Shunt Coil
24 ~ 30	-	0.75 ~ 1.1 Vn	0.6 ~ 1.1 Vn	200	5	Less than 40ms	Less than 65ms
48 ~ 60	48	0.75 ~ 1.1 Vn	0.6 ~ 1.1 Vn				
100 ~ 130	100 ~ 130	0.75 ~ 1.1 Vn	0.56 ~ 1.1 Vn				
200 ~ 250	200 ~ 250	0.75 ~ 1.1 Vn	0.56 ~ 1.1 Vn				
-	380 ~ 480	0.75 ~ 1.1 Vn	0.56 ~ 1.1 Vn				

∗Note) Operating voltage range is the min. rated standard for each rated voltage (Vh).

The Specification of Using Wire

Refer to the below table regarding the length of wire when using trip coil with 24~30[V] or 48~60[V] of rated voltage as power consumption due to inrush current is about 200VA for coil operation. Coil can be non-operating in case of not corresponding with the wire specification listed below.

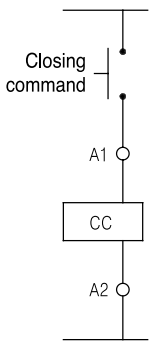
The Recommended Max. Wire Length

Wire type		Rated Voltage [Vn]			
		DC 24~30 [V]		DC/AC 48 [V]	
		#14 AWG (2.08mm²)	#16 AWG (1.31mm²)	#14 AWG (2.08mm²)	#16 AWG (1.31mm²)
Operating voltage	100%	95.7 m 314 ft	61 m 200 ft	457.8 m 1,503 ft	287.7 m 944 ft
	85%	62.5 m 205 ft	38.4 m 126 ft	291.7 m 957 ft	183.2 m 601 ft

External Configuration and Wiring Diagram

Closing Coil

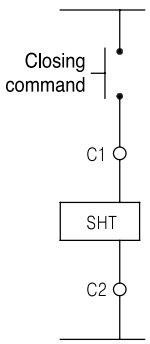
External Configuration



Wiring Diagram

Shunt Coil

External Configuration



Wiring Diagram

2. Under Voltage Trip device, UVT

- UVT installed inside of the circuit breaker opens the circuit breaker when its supply or control voltage drops below the specified voltage. Please connect with UVT time-delay device in order to present the time-delay function because UVT is technically instantaneous type.
- The closing of a circuit breaker is impossible mechanically or electrically if control power not supplied to UVT. To close the circuit breaker, 65~85% of rated voltage should be applied to both terminals of UVT coil (D1, D2).

Rated Voltage and Characteristics of UVT

Rated Voltage[Vn]		Operating Voltage Range [V]		Power Consumption(VA or W)		Trip Time [ms]
DC [V]	AC [V]	Pick-Up	Drop-Out	Inrush	Steady-State	
24 ~ 30	-	0.65 ~ 0.85 Vn	0.4 ~ 0.6 Vn	200	5	Less than 50ms
48 ~ 60	48					
100 ~ 130	100 ~ 130					
200 ~ 250	200 ~ 250					
-	380 ~ 480					

∗Note) Operating voltage range is the min. rated standard for each rated voltage (Vh).

The Specification of Using Wire

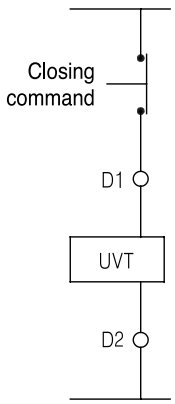
Refer to the below table regarding the length of wire when using trip coil with 24~30[V] or 48~60[V] of rated voltage as power consumption due to inrush current is about 200VA for coil operation. Coil can be non-operating in case of not corresponding with the wire specification listed below.

The Recommended Max. Wire Length

Wire Type		Rated Voltage [Vn]			
		DC 24~30 [V]		DC/AC 48 [V]	
		#14 AWG (2.08mm²)	#16 AWG (1.31mm²)	#14 AWG (2.08mm²)	#16 AWG (1.31mm²)
Operating Voltage	100%	48.5 m 159 ft	30.5 m 100 ft	233.2 m 765 ft	143.9 m 472 ft
	85%	13.4 m 44 ft	8.8 m 29 ft	62.5 m 205 ft	39.3 m 129 ft

External Configuration and Wiring Diagram

External Configuration



Wiring Diagram

3. UVT Time Delay Controller

- Use UVT time delay controller to prevent the trip of a circuit breaker due to the operation of instantaneous type UVT when voltage dips occurred instantly on main or control power supply.
- If combining UVT time delay controller and instantaneous type UVT mounted in circuit breaker, it makes a trip operation after a certain time when its main or control voltage drop below specified value to prevent the unexpected trip operation caused from instant blackout.
- It is the outdoor type and can be used by mounting to inside distribution panel or the cradle of circuit breaker.
- It provides control signal (output contact) to indicate the trip status of circuit breaker caused from UVT operation for indoor type. If control voltage supplied to UVT under normal operation, b contact is conducted and if circuit breaker is tripped due to UVT operation, a contact is conducted.

Rated Voltage and Characteristics of UVT Time Delay Controller

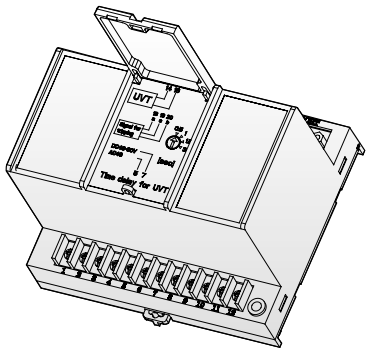
Rated Voltage[Vn]		Operating Voltage Range [V]		Power Consumption(VA or W)		Trip Time [s]
DC [V]	AC [V]	Pick-Up	Drop-Out	Inrush	Steady-State	
24 ~ 30	48	0.65 ~ 0.85 Vn	0.4 ~ 0.65 Vn	200	5	0.5, 1, 1.5, 3
100 ~ 130	100 ~ 130					
200 ~ 250	200 ~ 250					
-	380 ~ 480					

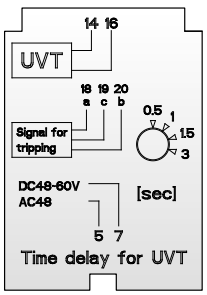
* Note) Operating Voltage Range is the min. rated standard for each rated voltage (Vh).

Rated Output Contact

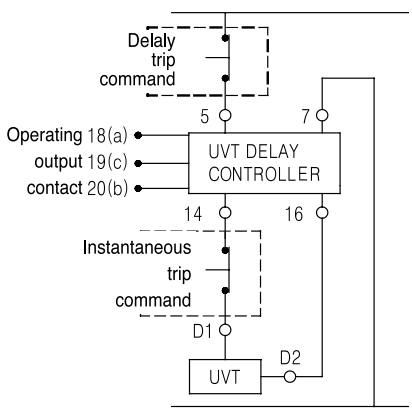
Rated Voltage[V]	Rated Current(A), Resistive Load	Max. Switching Voltage(V)	Max. Switching Current(V)
24V DC	12	110V DC 250V A C	15
120V AC	12		
250V AC	10		

External Configuration and Wiring Diagram





External Configuration



Wiring Diagram

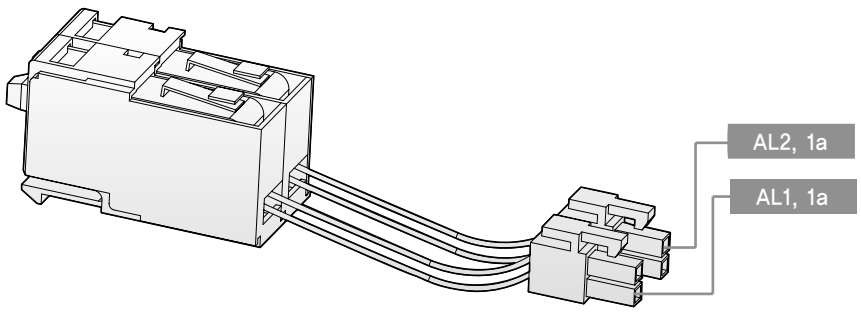
4. Trip Alarm Switch, AL

- In case a circuit breaker is tripped by OCR which operates against the faulty current (Over Current Relay), Trip Alarm switch provides the information regarding the trip of circuit breaker by sending the electrical signal from the mechanical indicator on main cover of main circuit breaker or internal auxiliary switch.
- When a circuit breaker tripped by faulty current, a mechanical trip indicator (MRB, Manual Reset Button) pops out from the main cover and the switch (AL) which sends control signal electrically is conducted to output the information occurred from faulty circuit breaker.
- MRB can be operated only by OCR but not by OFF operation of circuit breaker.
- To re-close a circuit breaker after a trip, press MRB to reset it for closing.
- 2pcs of Electrical trip switch (AL_1, AL_2, $1a$) are provided (OPTION)

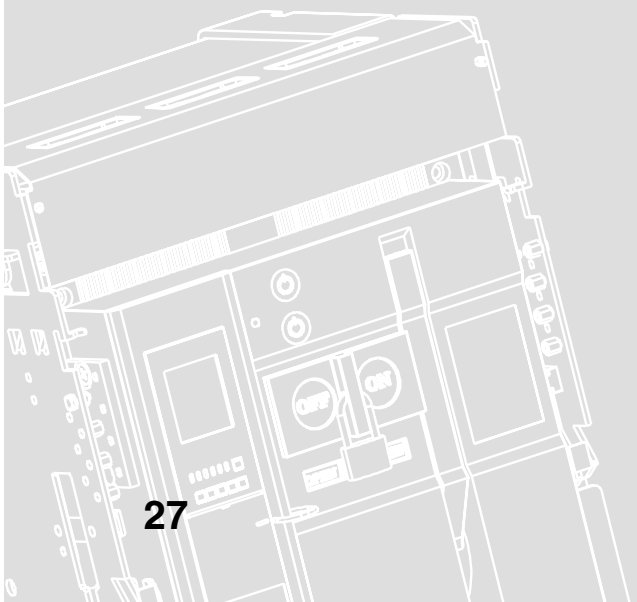
Electrical Characteristics of AL Switch

Rated Voltage [Vn]	Non-Inductive Load (A)		Rated Voltage		Inrush Current
	Resistive Load	Lamp Load	Inductive Load (A)	Motor Load	
8V DC	11	3	6	3	MAX. 24A
30V DC	10	3	6	3	
125V DC	0.6	0.1	0.6	0.1	
250V DC	0.3	0.05	0.3	0.05	
250V AC	11	1.5	6	2	

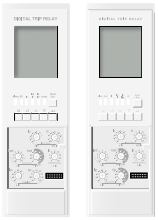
Externals



D. Digital Trip Relay



1. Comparison Table upon Types

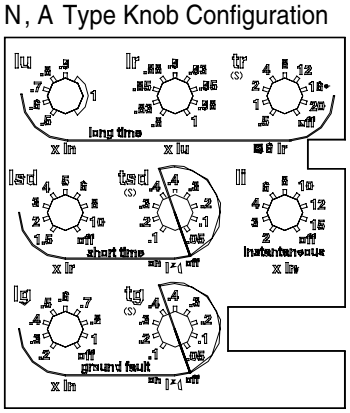
	N Type	A Type	P Type Note 1)	S Type Note 1)
Externals				
Current Relays	• L / S / I / G / Thermal • Override / MCR	• N type current relay +ZSI (Protective coordination)	• A type function +Thermal (Linear Hot Start)	• Same with P type
Optional Relays		• Earth leakage/Ground Fault • External CT ground fault	• A type optional + • Over/Low voltage • Over/Low frequency • Unbalance relay (Voltage/Current) • Reverse power relay	• Same with P type
Measurement Function		• Current (R / S / T/ N)	• 3 phase voltage/ Current Rms/ Vector • Power (P, Q, S), PF (3-phase) • Energy (Positive/ Negative) • Frequency, Demand	• P type function + Harmonics 63rd - 3 phase voltage/current • 3 phase waveforms • THD, TDD, K-Factor
Fine Adjustment			• Fine adjustment for long / short time delay / instantaneous / ground fault	• Same with P type
Pre Trip Alarm			• Overload protection relays → DO output (Alarm) • Ground fault is not available when using PTA.	• Same with P type
IDMTL Relay			• Compliance with IEC60255-3	• Same with P type
Comm.		• RS 485/ MODBUS	• Same with A type	• Same with A type
Power Supply	• Self Power (Power source works over 20% of load current.)	• Self Power +AC/DC 93 ~ 253V DC 24/48V →External power source are required for comm.	• Same with A type Under Self-Power, current relay only operates →External power source required for optional relays and measurement function	• Same with A type
Timer	• Available	• Available	• Available	• Available
LED for Trip Info.	• Long time delay • Short time delay / Instantaneous/ Ground fault SP(Analogue trip)	• Same with N type	• Same with N type	• Same with N type
Fault Record		• Records 10 faults (Fault/ Current / Date and Time)	• 256 records	• P type function +The latest fault waveform(3phases)
Event Record			• 256 records for changes of device status (Content, Status, Date)	• Same with P type
Operating Button	• Reset button	• Reset, Menu Up/Down, Left/Right, Enter	• Same with A type	• Same with A type

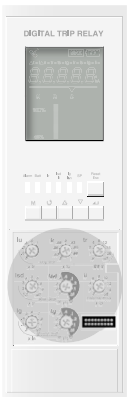
Note1) S/ P Type are only applicable to Susol Series.

2. Externals and Configuration

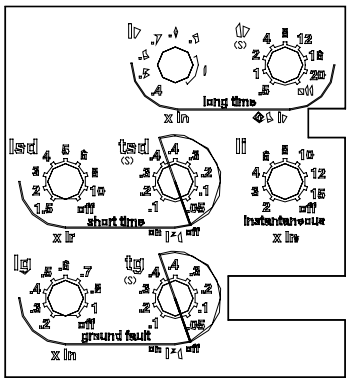
N, A / S Type Knob Configuration

N, A Type Knob Configuration





S Type Knob Configuration



D

N, A type Knob Information

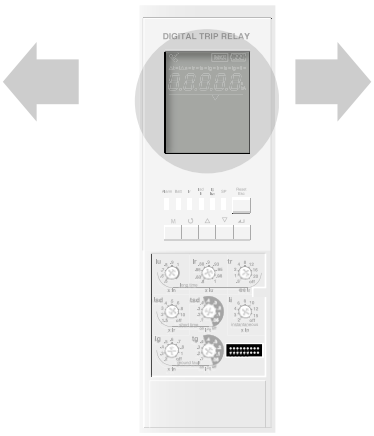
No	Type of Knob	Mode	Setting Step
①	Long-time current setting	**Iu**	(0.5-0.6-0.7-0.8-0.9-1.0)×In
②	Long-time current setting	**Ir**	(0.8-0.83-0.85-0.88-0.89-0.9-0.93-0.95-0.98-1.0)×Iu
③	Long-time tripping delay	**tr**	(0.5-1-2-4-8-12-16-20-off)×Ir@6Ir
④	Short-time current Setting	**Is**	(1.5-2-3-4-5-6-8-10-off)×Ir
⑤	Short-time tripping delay	**tsd**	I^2t off : (0.05-0.1-0.2-0.3-0.4)×Ir I^2t on : (0.1-0.2-0.3-0.4)×Ir
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**	I^2t off : (0.05-0.1-0.2-0.3-0.4) I^2t on : (0.1-0.2-0.3-0.4)

S type Knob Configuration

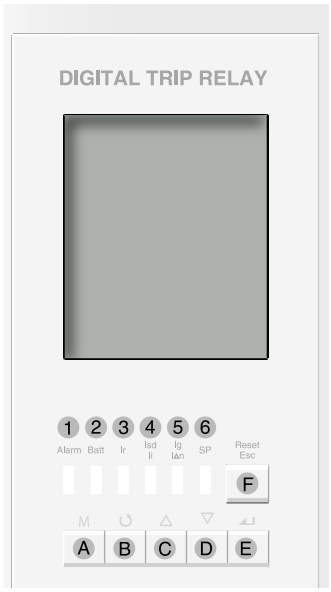
No	Type of Knob	Mode	Setting Step
①	Long-time current setting	**Ir**	(0.4-0.5-0.6-0.7-0.8-0.9-1.0)×In
②	Long-time tripping delay	**tr**	(0.5-1-2-4-8-12-16-20-off)×Ir@6Ir
③	Short-time current Setting	**Is**	(1.5-2-3-4-5-6-8-10-off)×Ir
④	Short-time tripping delay	**tsd**	I^2t off : (0.05-0.1-0.2-0.3-0.4)×Ir I^2t on : (0.1-0.2-0.3-0.4)×Ir
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**	I^2t off : (0.05-0.1-0.2-0.3-0.4) I^2t on : (0.1-0.2-0.3-0.4)

N Type KEY / LED / A, P, S Type KEY / LED

N Type KEY / LED



A, P, S Type KEY / LED



LED Information

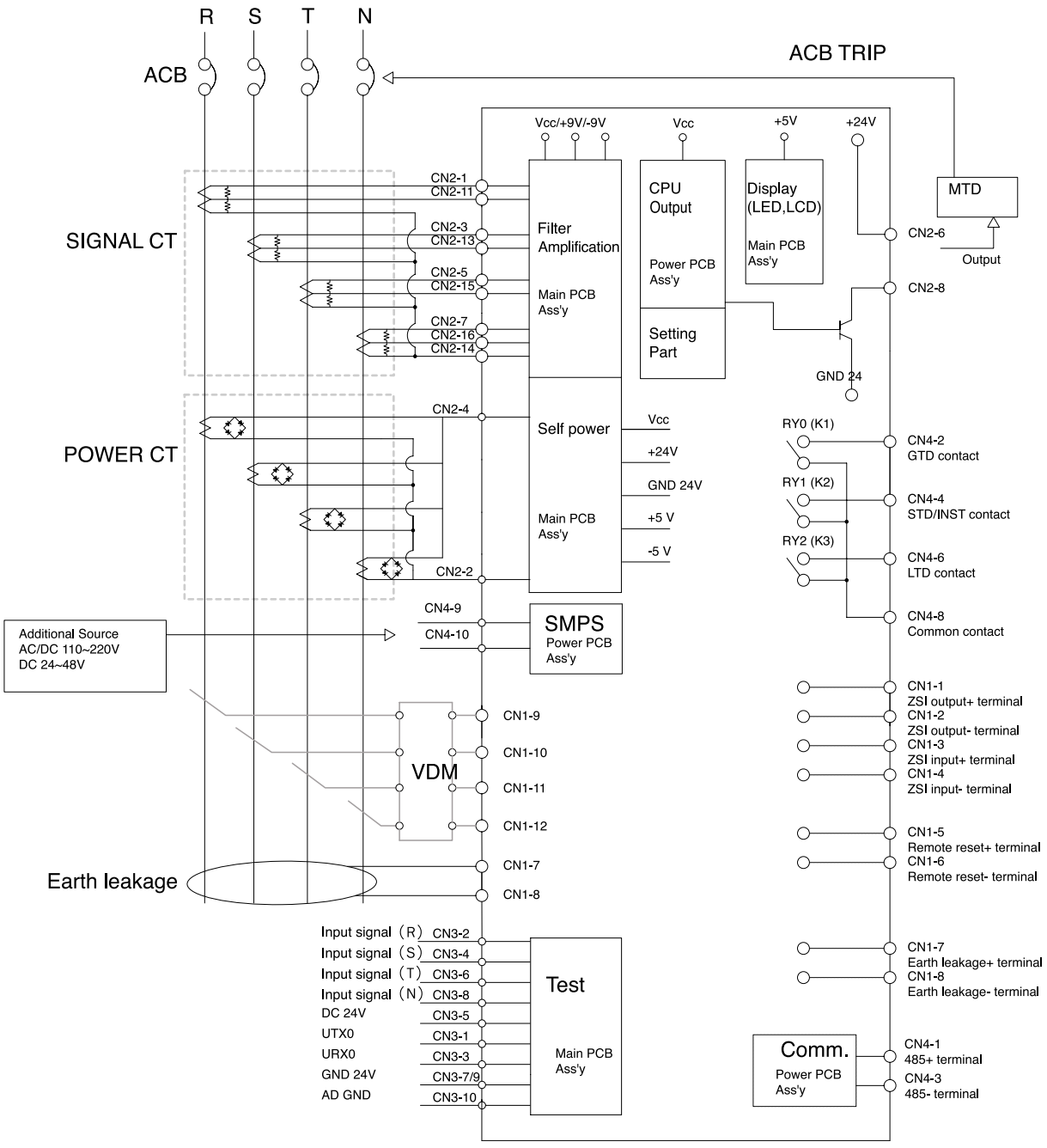
No	LED Type	Operational Mode
①	Alarm	LED Indicating an overload (Turn on above 90%, Blink above 105%)
②	Batt/SP	Self-Protection LED and Battery test LED
③	Ir	LED Indicating long-time delay
④	Isd/Ii	LED indicating short-time or instantaneous tripping
⑤	Ig	LED indicating ground-fault
⑥	COMM	LED indicating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

Key Configuration

No	LED Type	Function
ⓐ	Menu	Measurement display →Menu Display, Menu display →Measurement Display
ⓑ	TAP	Fixed Display : A Type / Move the Screen(Left / Right) : P, S Type
ⓒ	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. Internal Circuit Diagram

Internal Circuit Diagram



4. Relay Function

Long- Time Delay Relays

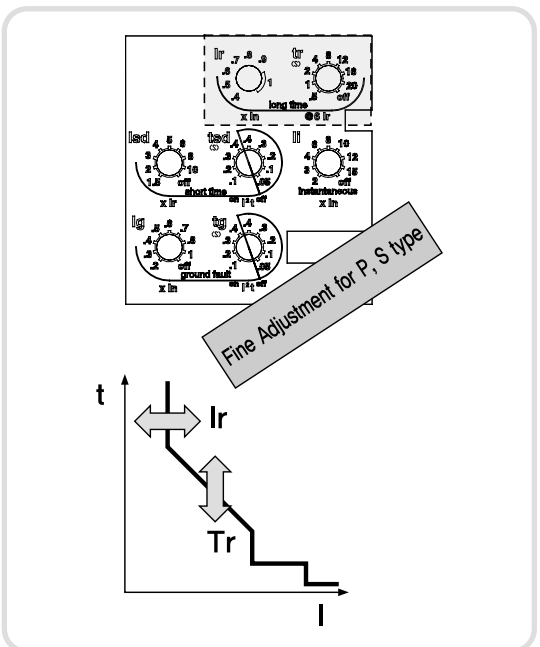
	Current Setting(A) (1.15 × Ir)	Ir = In × ...		0.4	0.5	0.6	0.7	0.8	0.9	1.0		
Long-Time Delay(L)	Maximum time delay(sec) Accuracy:±15% or below 100ms	tr @ (1.5× Ir)		12.5	25	50	100	200	300	400	500	off
		tr @ (6.0× Ir)		0.5	1	2	4	8	12	16	20	off
		tr @ (7.2× Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	off
	Continuous Thermal Memory Time											
Short-Time Delay(S)	Current Setting(A) Accuracy:±10% or below 50ms	Isd=Ir× ...		1.5	2	3	4	5	6	8	10	off
	Maximum time delay(s) @ 10× Ir		I2T off	0.05	0.1	0.2	0.3	0.4				
			I2T on		0.1	0.2	0.3	0.4				
		Tsd	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous(I)	Current Setting(A)	Ii=In× ...		2	3	4	6	8	10	12	15	off
	Tripping time	below 50ms										
Ground Fault	Current Setting(A) Accuracy:±10%(Ig≥0.4In) ±20%(Ig≥0.4In) or below 50ms	Ig=In× ...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	off
	Maximum time delay(s) @ 1× In		I2t off	0.05	0.1	0.2	0.3	0.4				
			I2t on		0.1	0.2	0.3	0.4				
		tg	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				

1. Long- Time Delay

The function for overload protection which has time delayed characteristic in inverse ratio to fault current. (T = I^2 / K).

1) Standard current setting Knob-Ir
   • Setting range : (0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0) × In
2) Time delay setting Knob-Tr
   • Standard operating time is based on the time of 6Ir.
   • Setting range : 0.5/ 1/ 2/ 4/ 8/ 12/ 16/ 20/ Off sec (9 modes)
3) Relay starting current
   • When current over (1.15) × Ir flows in, relay is picked up.
4) Long-Time Delay Operating Characteristic Formula
   • $T = \tau \times \ln(I^2 \times Ip^2)/(I^2 \times K^2)$
     T = Operating time [ms] τ = 29250*Tr
     I = Overload rate Ip = Load rate before Overload
     K = 1.10(Service Factor)
5) Relay operates basing on the largest load current among R/S/T/N Phase.
6) Rated current can be adjustable by Fine Adjustment Note1)

Note1) Fine Adjustment
The function for adjusting relay operating current much more detailed than the value of knob



D

4. Relay Function

Short-Time Delay Relays

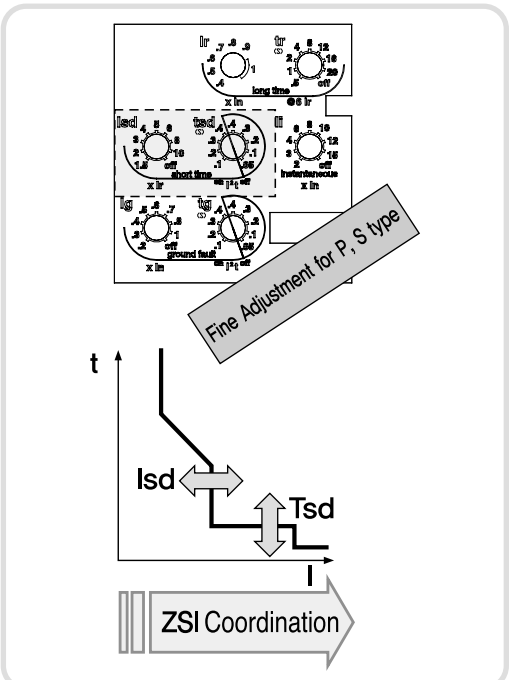
	Current Setting(A) (1.15 X Ir)	Ir = In X ...		0.4	0.5	0.6	0.7	0.8	0.9	1.0		
Long-Time Delay(L)	Maximum time delay(sec) Accuracy : ± 15% or below 100ms	tr @ (1.5× Ir)		12.5	25	50	100	200	300	400	500	off
		tr @ (6.0× Ir)		0.5	1	2	4	8	12	16	20	off
		tr @ (7.2× Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	off
	Continuous Thermal Memory Time											
Short-Time Delay(S)	Current Setting(A) Accuracy : ± 10% or below 50ms	Isd = Ir × ...		1.5	2	3	4	5	6	8	10	off
	Maximum time delay(s) @ 10 × Ir		I2T off	0.05	0.1	0.2	0.3	0.4				
			I2T on		0.1	0.2	0.3	0.4				
		Tsd	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous(I)	Current Setting(A)	Ii = In × ...		2	3	4	6	8	10	12	15	off
	Tripping time	below 50ms										
Ground Fault	Current Setting(A) Accuracy : ± 10%(Ig ≥ 0.4 In) ± 20%(Ig ≥ 0.4 In) or below 50ms	Ig = In × ...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	off
	Maximum time delay(s) @ 1 × In		I2t off	0.05	0.1	0.2	0.3	0.4				
			I2t on		0.1	0.2	0.3	0.4				
		tg	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				

1. Short-Time Delay

The function for fault current (over current) protection which has time delayed and definite time characteristic 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 10Ir.
   • Inverse time (I2T On) : 0.1/0.2/0.3/0.4 Sec
   • Definite time (I2T Off) : 0.05/0.1/0.2/0.3/0.4 Sec
3) Short-Time Delay Operating Characteristic Formula
   • $T = td / I^2$
     T= Operating time [ms] Td = 1000*Tsd
     I = Overload rate (Over current/Ir)
4) Relay operates basing on the largest load current among R/S/T/N Phase.
5) Relay operating current can be adjustable by Fine Adjustment
6) Relay can operate at instantaneous current through ZSI note1)

Note1) ZSI : Zone Selective Interlocking
The Lowest equipment pre-arranged with ZSI will operate instantaneously regardless of time delay setting.



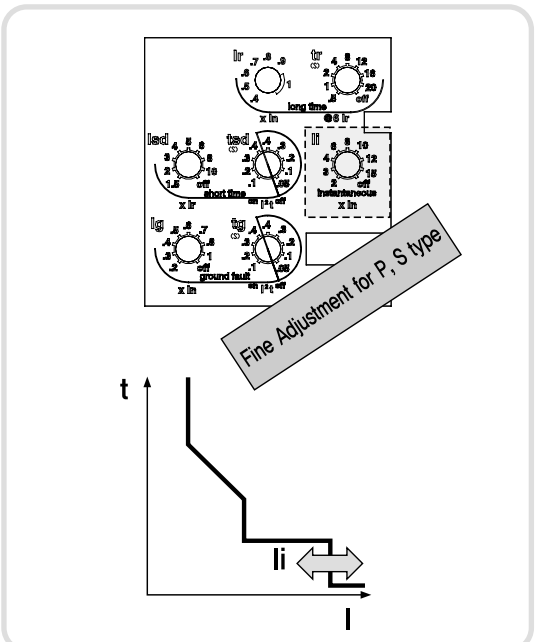
Instantaneous

	Current Setting(A) (1.15 × Ir)	Ir = In × ...		0.4	0.5	0.6	0.7	0.8	0.9	1.0		
Long-Time Delay(L)	Maximum time delay(sec) Accuracy : ± 15% or below 100ms	tr @ (1.5× Ir)		12.5	25	50	100	200	300	400	500	off
		tr @ (6.0× Ir)		0.5	1	2	4	8	12	16	20	off
		tr @ (7.2× Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	off
	Continuous Thermal Memory Time											
Short-Time Delay(S)	Current Setting(A) Accuracy : ± 10% or below 50ms	Isd = Ir × ...		1.5	2	3	4	5	6	8	10	off
	Maximum time delay(s) @ 10 × Ir		I2T off	0.05	0.1	0.2	0.3	0.4				
			I2T on		0.1	0.2	0.3	0.4				
		Tsd	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous(I)	Current Setting(A)	Ii = In × ...		2	3	4	6	8	10	12	15	off
	Tripping time	below 50ms										
Ground Fault	Current Setting(A) Accuracy : ± 10%(Ig ≥ 0.4 In) ± 20%(Ig ≥ 0.4 In) or below 50ms	Ig = In × ...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	off
	Maximum time delay(s) @ 1 × In		I2t off	0.05	0.1	0.2	0.3	0.4				
			I2t on		0.1	0.2	0.3	0.4				
		tg	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				

1. Instantaneous

The function for breaking faulty 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 to ×In
2. Relay operates basing on the largest load current among R/S/T/N Phase.
3. Total breaking time is below 50ms
4. Relay operating current can be adjustable by Fine Adjustment



D

4. Relay Function

Ground Fault

	Current Setting(A) (1.15 × Ir)	Ir = In × ...		0.4	0.5	0.6	0.7	0.8	0.9	1.0		
Long-Time Delay(L)	Maximum time delay(sec) Accuracy : ± 15% or below 100ms	tr @ (1.5× Ir)		12.5	25	50	100	200	300	400	500	off
		tr @ (6.0× Ir)		0.5	1	2	4	8	12	16	20	off
		tr @ (7.2× Ir)		0.34	0.69	1.38	2.7	5.5	8.3	11	13.8	off
	Continuous Thermal Memory Time											
Short-Time Delay(S)	Current Setting(A) Accuracy : ± 10% or below 50ms	Isd = Ir × ...		1.5	2	3	4	5	6	8	10	off
	Maximum time delay(s) @ 10 × Ir		I2T off	0.05	0.1	0.2	0.3	0.4				
			I2T on		0.1	0.2	0.3	0.4				
		Tsd	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				
Instantaneous(I)	Current Setting(A)	Ii = In × ...		2	3	4	6	8	10	12	15	off
	Tripping time	below 50ms										
Ground Fault	Current Setting(A) Accuracy : ± 10%(Ig ≥ 0.4 In) ± 20%(Ig ≥ 0.4 In) or below 50ms	Ig = In × ...		0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	off
	Maximum time delay(s) @ 1 × In		I2t off	0.05	0.1	0.2	0.3	0.4				
			I2t on		0.1	0.2	0.3	0.4				
		tg	Min. Trip Time(ms)	20	80	160	260	360				
			Max. Trip Time(ms)	80	140	240	340	440				

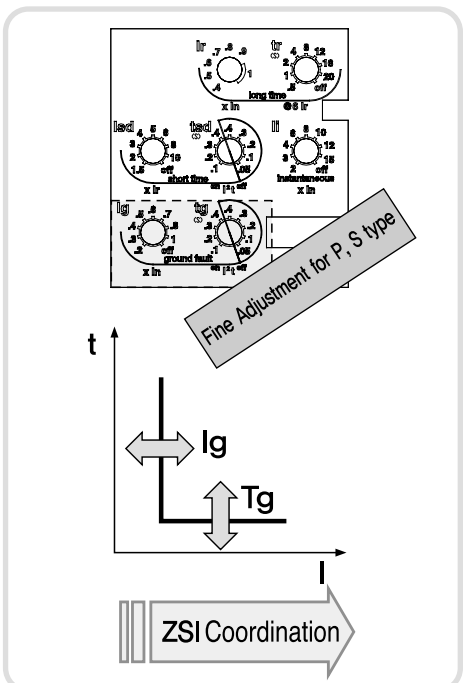
1. Ground Fault

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

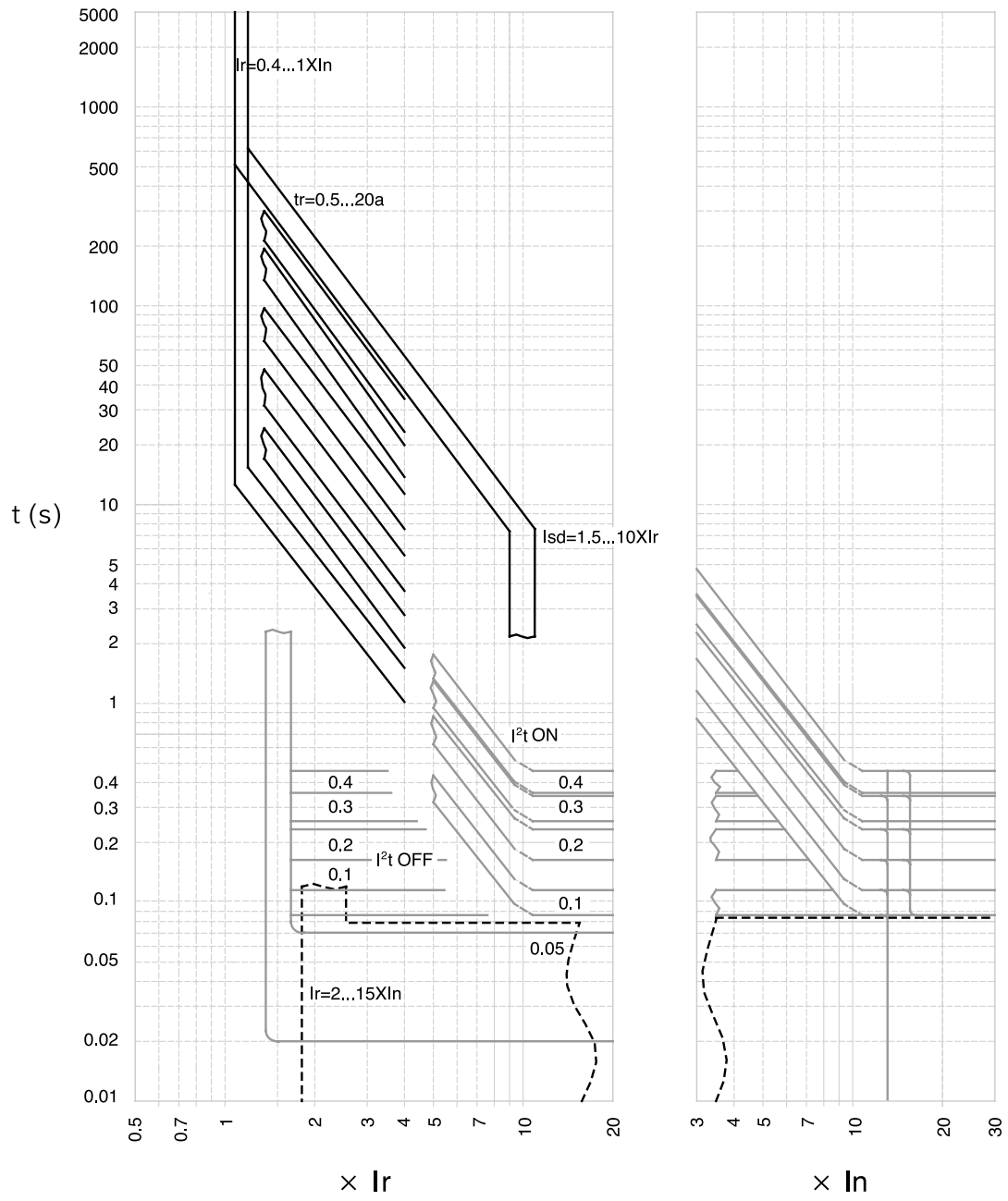
1. Standard current setting Knob-Ig
   - Setting range: 0.2/0.3/0.4/0.5/0.6/0.7/0.8//1.0/OFF × In
2. Time delay setting Knob-Tg
   - Inverse time (I2T On) : 0.1/0.2/0.3/0.4 Sec
   - Definite time (I2T Off) : 0.05/0.1/0.2/0.3/0.4 Sec
3. Ground Fault Operating Characteristic Formula • $T = td / I^2$
   T= Operating time [ms] Td = 1000*Tsd
   I = Overload rate (Ground fault current/Standard current)
4. Ground Fault Current = R + S + T + N (Vector Sum)
5. Relay operating current can be adjustable with detailed setting.
6. Relay can operate at instantaneous current through ZSI.
7. Categorize Internal CT Type (Standard Type)note1) and External CT Type (Separate Order)note2)

Note1) Internal CT Type : Correct relay as the vector sum of CT on internal R/S/T/N phase

Note2) External CT Type : Install an external CT to be suitable for the value of ground fault current and then connect to inside of ACB. In this case, arrange 5A for secondary rating output of CT and set 5A for standard rating of relays.



Long-time, Short-time and Instantaneous Protection



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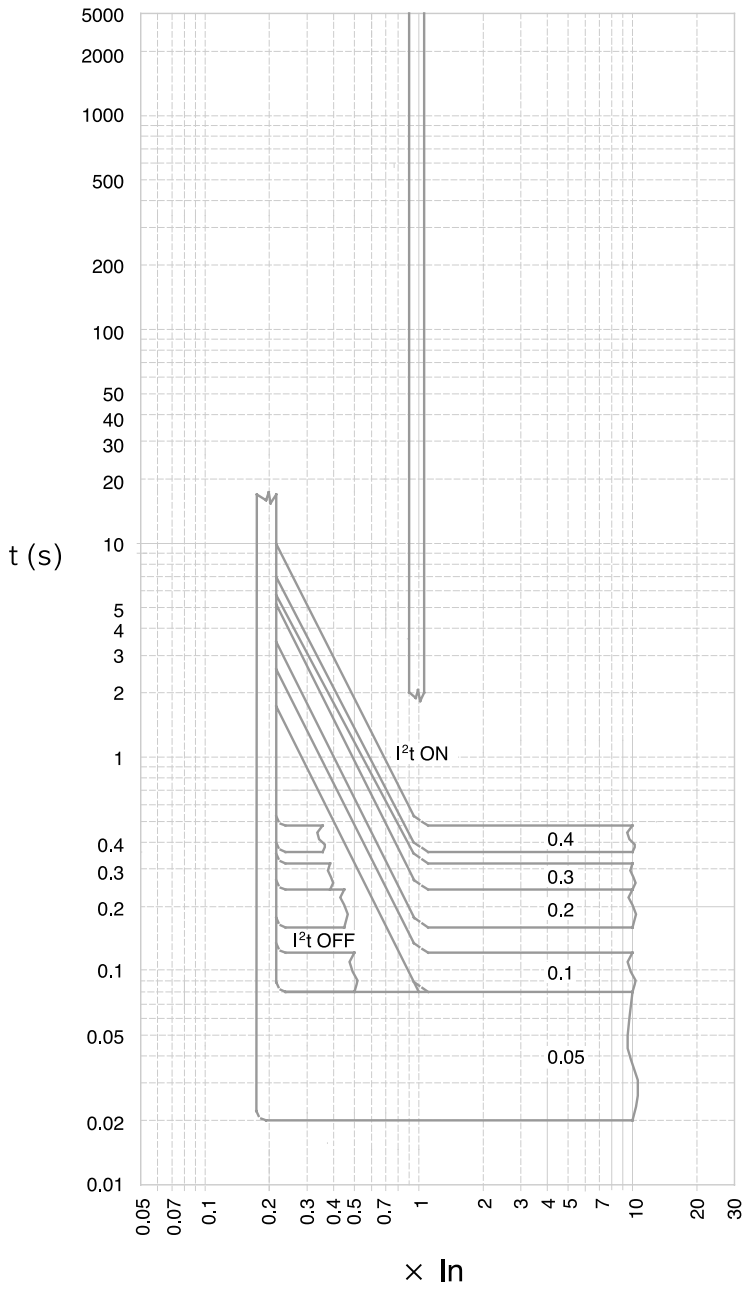
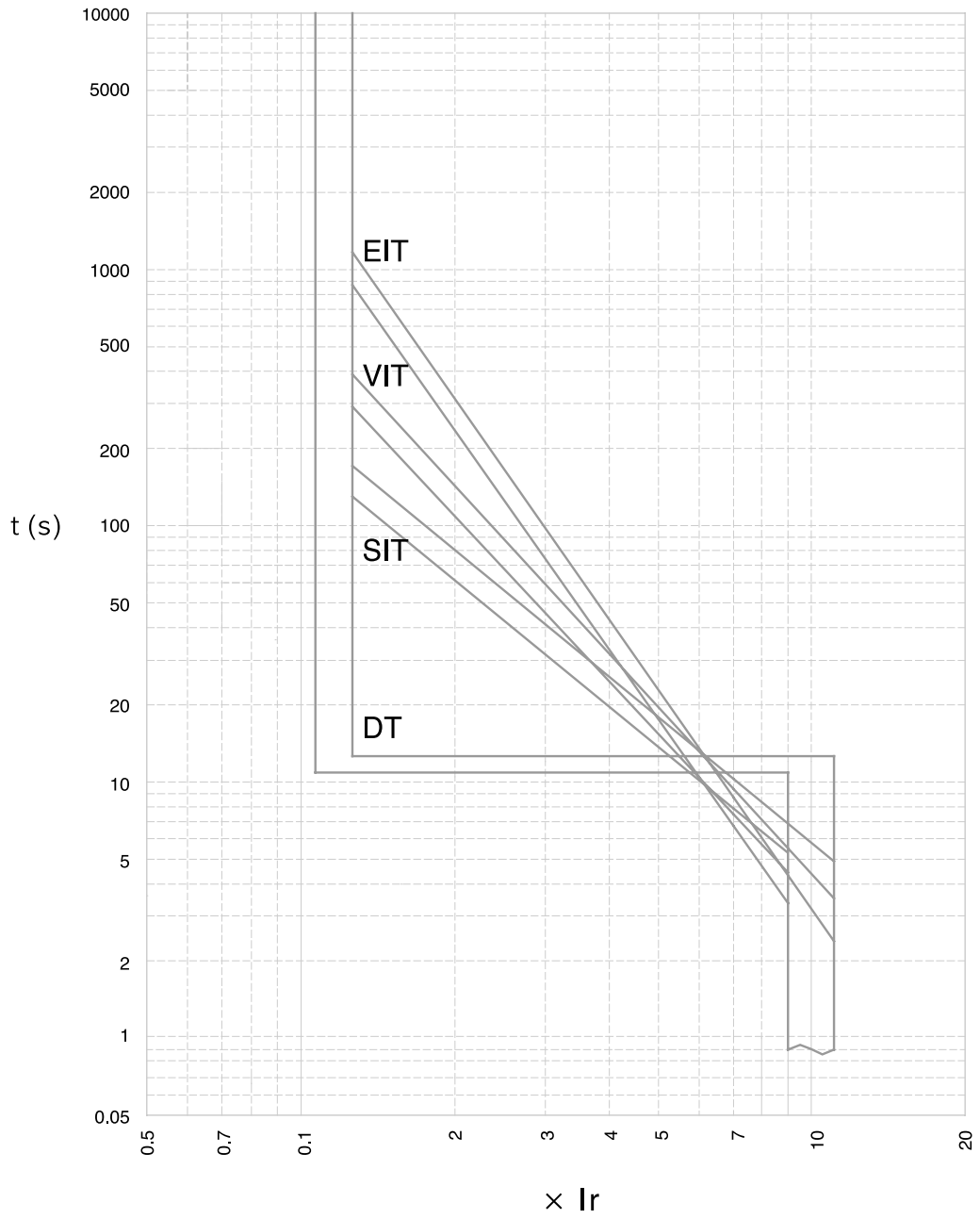
4. Relay Function

Ground Fault Protection



IDMTL


10000
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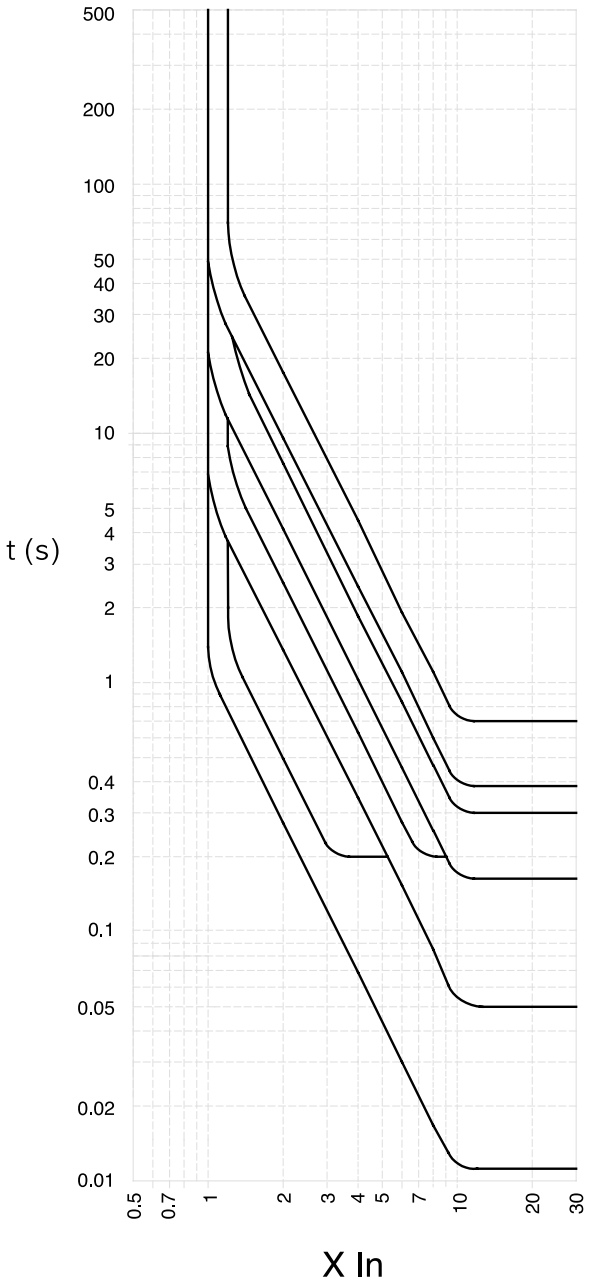
4. Relay Function

PTA Curve



Relay Selection Standard Table

		Pickup Setting Range	Pickup Accuracy	Adj. Unit	Delay	Adj. Unit	Operating Time Accuracy
UV, under voltage		80V ~ OV_pickup	±5%	1V	1.2 ~ 40 sec	0.1 sec	±0.1 sec
OV, over voltage		UV_pickup ~ 980V	±5%	1V			
Vunbal, Voltage Unbalance		6% ~ 99%	±2.5% or *±10%	1%			
rP, Reverse Power		10 ~ 500kW	±10%	1kW			
Lunbal, Current Unbalance		6% ~ 99%	±2.5% or *±10%	1%			
OF, over frequency	60Hz	UF_pickup ~ 65	±0.1Hz	1Hz			
	50Hz	UF_pickup ~ 55	±0.1Hz	1Hz			
UF, under frequency	60Hz	55Hz ~ OF_pickup	±0.1Hz	1Hz			
	50Hz	45Hz ~ OF_pickup	±0.1Hz	1Hz			

Optional Relays for P,S Type - OV, UV, rPower

1. UVR - Under Voltage Relay

Off/Alarm/DO is available when under voltage occurs to one of the 3 phases.

1) Pickup standard voltage setting (UV_pickup): 80 ~ OVR_PickUp [Note1]) V (Step: 1V)
2) Delay Time (tuvp): 1.2 ~ 40 sec (Step : 0.1 sec)
3) Relay error: Pickup value ±5%, Operating time ±0.1sec.
4) Remark: From 3P Voltage, Max. voltage operate at above 60V.

2. OVR - OVER Voltage Relay

Off/Alarm/DO is available when under voltage occurs to one of the 3 phases.

1) Pickup standard voltage setting (OV_pickup): UV_pickup [Note2]) ~ 900V (Step: 1V)
2) Pickup time delay setting (tovp): 1.2 ~ 40 sec (Step: 0.1 sec)
3) Relay error: Pickup value ±5%, operating time ±0.1 sec.

3. rPower - Reverse Power Protection

Off/Alarm/DO setting available when total active power of 3P flows reverse above the setting.

1) Pickup setting: 10 ~ 500kW (Step: 1kW)
2) Pickup time delay setting: 1.2 ~ 40 sec (Step: 0.1 sec)
3) relay error: Pickup value ±10%, Operating time ±0.1sec.
4) Calculating formula and Remark: absolute power phase angle difference
(Voltage phase difference- Current phase difference) 0 ~ 60°

Note 1) OVR_PickUp - OVR Pickup setting voltage
2) UV_PickUp - UVR Pickup setting voltage

4. Relay Function

Optional Relays for P,S Type - Vunbal, Lunbal, OFR, UFR

1. Vunbal - Voltage Unbalace Protection

Off/Alarm/DO setting available when unbalance over set value occurs to 3P voltage.

1) Pickup setting: 6% ~ 99% (Step: 1%)
2) Delay Time: 1.2 ~ 40 sec (Step : 0.1 sec)
3) Relay error: Pickup value ±2.5% or * ±10%, Operating time ±0.1 sec.
4) Calculating formula and Remark:
   Voltage unbalance percentage = (Reverse phase voltage value)/(Normal voltage value)*100%
   Relay voltage range: above 80V ~ less than 900V (Min. 1 phase among 3 phase)

2. Lunbal - Current Unbalace Protection

Off/Alarm/DO setting available when unbalance over set value occurs to 3P current.

1) Pickup setting: 6% ~ 99% (Step : 1%)
2) Pickup time delay setting: 1.2 ~ 40 sec (Step: 0.1 sec)
3) Relay error: Pickup value ±2.5% or * ±10%, Operating time ±0.1sec.
4) Calculating formula and Remark:
   Current unbalance percentage = (Negative phase current value)/(Normal voltage value)*100%
   Relay current range: In (rated current) above 30% ~less than 120%

3. OF - Over Frequency Protection

Occurs when frequency of R phase voltage is above set value. Off/Alarm/DO setting available.

1) Pickup freq. setting (OF_pickup): UF_pickup[Note1]) ~ 65 (Step: 1Hz) / 60Hz system
   Pickup freq. setting (OF_pickup): UF_pickup ~ 55 (Step: 1Hz) / 50Hz system
2) Pickup time delay setting (tof_pickup): 1.2 ~ 40 sec (Step: 0.1 sec)
3) Relay error: Pickup value ±0.1Hz, Operating time ±0.1sec
4) Calculating formula & Remark: relay voltage range: R phase voltage above 80V ~ less than 900V

4. UF - Under Frequency Protection

Occurs when frequency of R phase voltage is below set value. Off/Alarm/DO setting available.

1) Pickup freq. setting(UF_pickup): 55Hz ~ OF_pickup[Note2]) (Step:1Hz) / 60Hz system
   Pickup freq. setting(UF_pickup): 45Hz ~ OF_pickup (Step:1Hz) / 50Hz system
2) Pickup time delay setting (tuf_pickup): 1.2 ~ 40 sec (Step:0.1 sec)
3) Relay error: Pickup value ±0.1Hz, Operating time ±0.1 sec
4) Calculating formula & Remark: relay voltage range: above 80V ~ less than 900V

Note 1) UF_PickUp - UFR Pickup setting voltage
2) OF_PickUp - OFR Pickup setting voltage

D

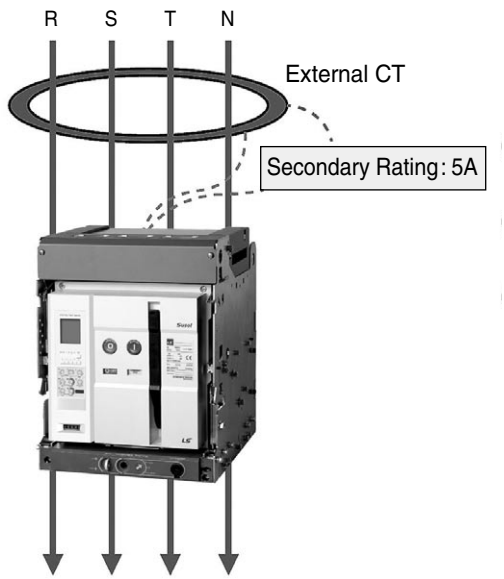
Optional Relay - External CT Earth Leakage

1. Earth Leakage Relay with External CT

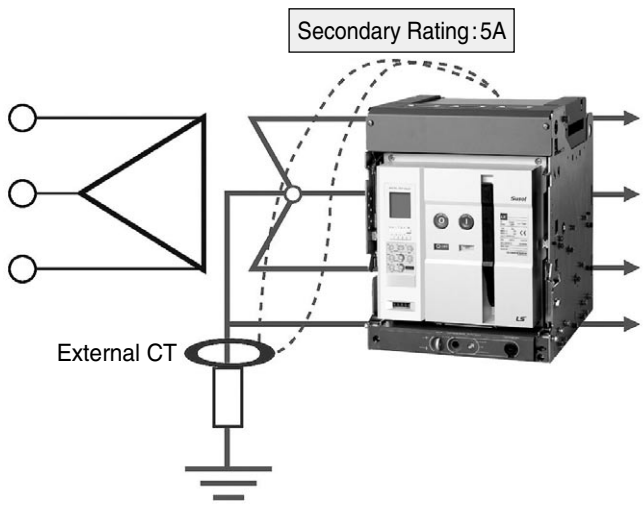
The necessity of earth leakage relay with external CT

- Earth leakage relay with Internal CT (standard) operates in the range of 20% ~ 100% of the rated current.
- Thus, if the rated current of ACB increases, the standard operating current of earth leakage relay also increases.
  ex) 400AF ACB of Min. earth leakage relay current, 400A*20% = 80A
  4000AF ACB of Min. earth leakage relay current, 4000A*20% = 800A
- As shown from the example, the actuality of earth leakage relay drops when the rated current of ACB increases.
- Thus, Susol ACB provides a solution with CT which can be installed externally to adjust sensibility of earth Leakage current and which can operate relay. (separate purchase)

External CT Type Wiring 1



External CT Type Wiring 2



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4. Relay Function

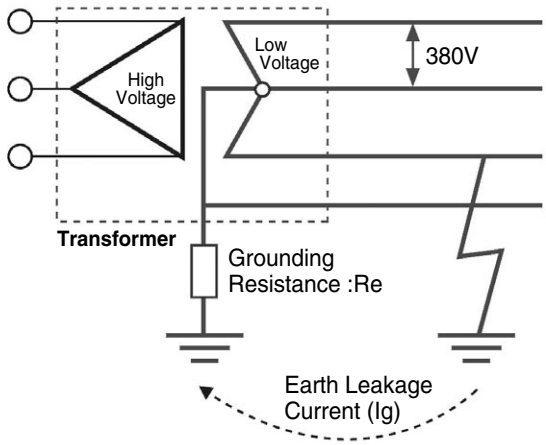
Optional Relay - Earth Leakage (EL)

1. Earth Leakage Relay Standard Table

	Current setting (A)	I⊿n	0.5	1	2	3	4	5	7	10	20	30
Earth Leakage Protection (ZCP Needed)	Time Delay(ms) Accuracy : ±10%(I⊿n≥1A) ±20%(I⊿n=0.5A)	Setting	D1	D2	D3	D4	D5					
		⊿t Min Trip Time(ms)	60	140	230	350	800					
		⊿t Max Trip Time(ms)	140	200	320	500	1000					

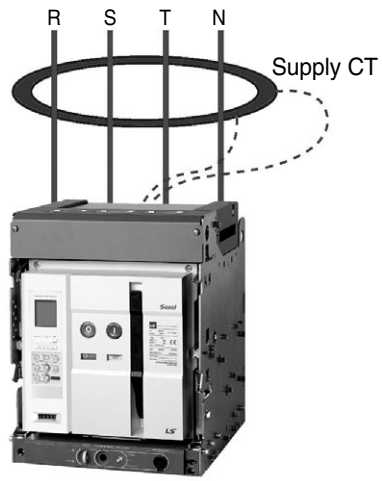
2. Earth Leakage Relay

In low voltage 3P4W, when resistance gets added between the transformer's neutral wire and ground(resistance grounding method) and complete EL occurs to the phase, EL current becomes phase voltage/grounding resistance. Normally, when this current is below 30A, EL can be detected via EL relay by using the CT that LSIS provides. EL relay is a separate purchase, When placing order, an external CT which can detect leakage current is provided. Refer to the below figure for installing the supplied CT.

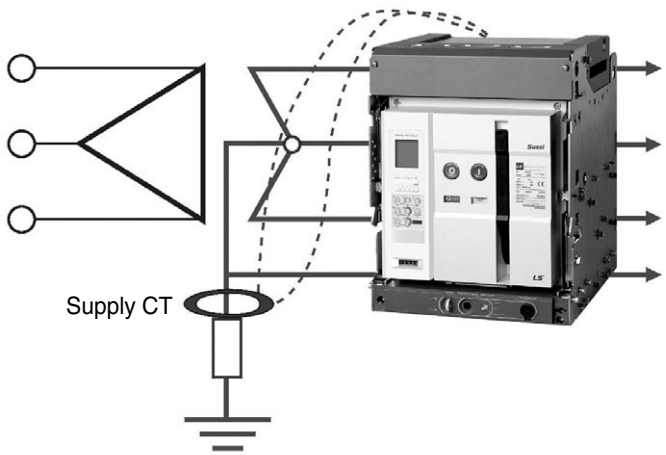


- **EL Current**
  Ig = 220V/Re
  EL current when Re is 10 ohm: 22A
  (When complete grounding occurs)

Wiring 1



Wiring 2



5. Measurement Function

Measurement Accuracy for A (Current), P, S Type

Class.	Measurement Element	Detailed Relay Element	Accuracy	Remarks
Voltage	Line voltage	Vab,Vbc,Vca	1%	F/S
	Phase voltage	Va,Vb,Vc	1%	F/S
	Normal voltage	V1(no accuracy)		
	Reverse voltage	V2(no accuracy)		
Current	Line current	Ia,Ib,Ic	3%	F/S
	Normal current	I1(no accuracy)	-	
	Reverse current	I2(no accuracy)	-	
Phase Angle	line-to-line, current-to-current	∠VabIa, ∠VabIb, ∠VabIc, ∠VabVbc, ∠VabVca	1°	3P3W
	phase-to-phase	∠VaVb, ∠VaVc	1°	3P4W
	Phase-to-current	∠VaIa, ∠VbIb, ∠VcIc	1°	3P4W
Power	Active power	Pa(ab), Pb(bc), Pc(ca), ΣP	3 %	F/S
	Reactive power	Qa(ab), Qb(bc), Qc(ca), ΣQ	3 %	F/S
	Apparent power	Sa(ab), Sb(bc), Sc(ca), ΣS	3 %	F/S
Electric Energy	Active electric energy	WHa(ab), WHb(bc), WHc(ca), ΣWH	3 %	F/S
	Reactive electric energy	VARHa(ab), VARHb(bc), VARHc(ca), ΣVARH	3 %	F/S
	Reverse active electric energy	rWHa(ab), rWHb(bc), rWHc(ca), ΣrWH	3 %	F/S
Freq.	Frequency	Frequency(Hz)	0.05Hz	
Power Factor	Power factor(PF)	PFa(ab), PFb(bc), PFc(ca), PF	-	-
Harmonics	Voltage harmonics	1nd~63th harmonics anTHD of Va(ab), Vb(bc), Vc(ca)	-	-
	Current harmonics	1nd ~ 63th harmonics and THD, TDD, K-Factor of Ia, Ib, Ic	-	-
Demand	Active power	Peak demand	-	-
	Current Demand	Peak demand	-	-

5. Measurement Function

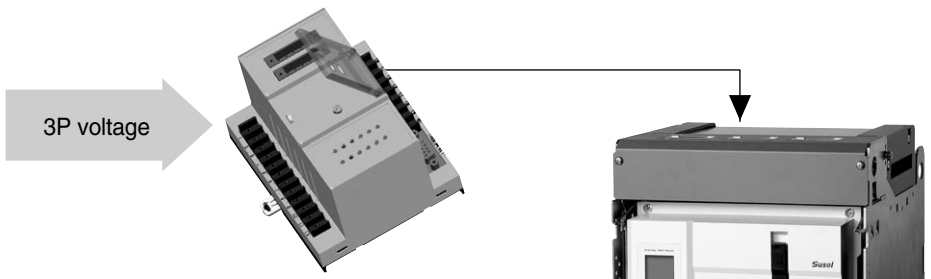
Voltage Input / Specification for P, S Type

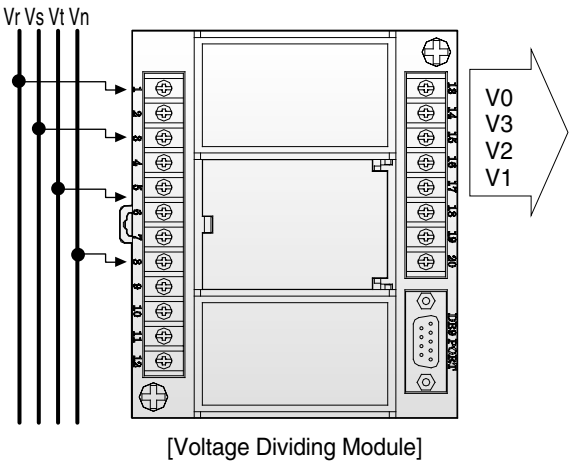
1. Voltage Input

1) Rated voltage input
- Measurement range 60V ~ 690V
- Relay range 80V ~ 900V

2) Voltage input method
- 3P4W : Connect R/S/T/N phase to the corresponding terminal of voltage dividing module
- 3P3W : Attach voltage of S phase to the terminal of N phase after connecting R/S/T phase to the corresponding terminal of voltage dividing module

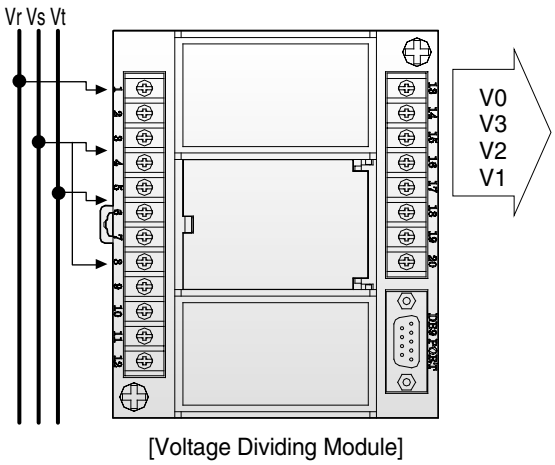
3) Voltage accuracy : 1.0% (F/S) (min. indication unit: 1V)





[Voltage Dividing Module]

3P 4W Voltage Wiring



[Voltage Dividing Module]

3P 3W Voltage Wiring

Voltage / Current RMS Value for P, S Type

1. RMS Values

Measurements that is required for every over current relay of P and S type are based on RMS values.

1) Low voltage system enclose much of harmonics elements due to non-linear loads at the feeder level.
2) Harmonics current overheats loads and equipments from its thermal element.
3) Hence, low voltage relay based on thermal element should include harmonics.
4) RMS values include every harmonics elements
5) Hence, over current/ fault current relay of P and S type react to harmonics.

$$I_{rms} = \sqrt{\frac{1}{32}\sum_{k=0}^{31} i(k)^2} = \sqrt{\sum_{h=1}^{15} I_h^2}$$

- i(k): Instantaneous value of current waveform (Sampling Value) Assume that current RMS is calculated with 32 sampling in a cycle.
- Ih : Harmonics element (I1:fundamental, I2:2 harmonics...)
- Choosing 32 samplings per a cycle to transform analogue frequency of current to digital signals will allow to measure as much as 15 harmonics. Therefore, after 15 harmonics can not be taken into consideration for measurement.

2. Phasor Value - Fundamental Frequency Element Size

P and S type's voltage relay (under voltage, over voltage) operate by using phasor value.

1) Voltage is relatively low on harmonics comparing with current.
2) Voltage Relay is using fundamental frequency excluding effects from harmonics.
3) P and S type's OUR and OVR operate based on fundamental frequency excluding effects from harmonics

$$V_{phasor} = \int_0^T V(t) \times e^{-jwt}\, dt = \sum_{k=0}^{31} V(k) \times (e_{\cos}(k) + j e_{\sin}(k))$$

$$e^{jwt} = \cos(wt) + j\sin(wt)$$

- V phasor : phasor value size
  Assume that current RMS is calculated with 32 Samplings in a cycle.
- T: time taken for 1 cycle
- ecos, esin : Sine, Cos Map for fundamental frequency

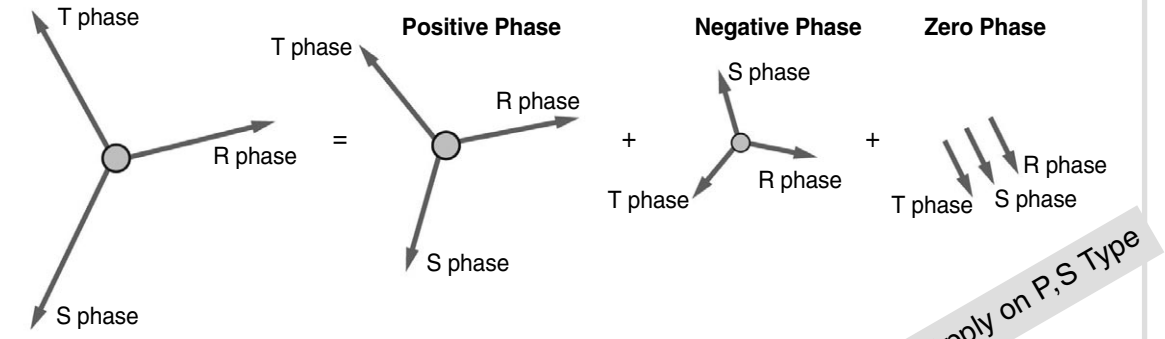
D

5. Measurement Function

Voltage / Current Unbalance for P, S Type

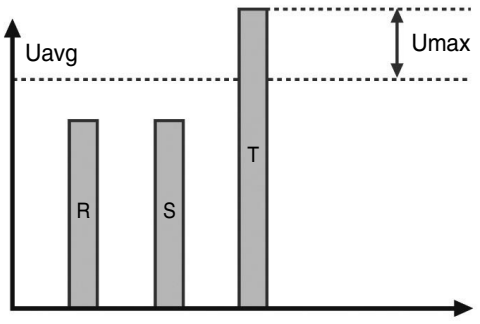
1. Definition of Unbalance Factor 1

1) Positive-phase-sequence component means a fundamental phase rotation of power system.
2) Negative-phase-sequence component means a phase rotation inversely to power system.
3) Zero-phase-sequence component means in-phase on R/S/T phases regardless of phase rotation of power system.
4) 3 phase system in power system can be displayed as positive-phase + negative-phase + zero-phase-sequence component.
5) After interpreting 3 phase as positive-phase, negative-phase, and zero-phase sequence component, and define negative/positive phase as unbalance.
6) Even though the concept is based on definition, there is unstable part in figure due to complexity of mathematic.



2. Definition of Unbalance Factor 2

1) Umax is the largest value among 3 phase system (R, S, T)
2) Uavg is average of 3 phase system((R + S + T) / 3)
3) Unbalance percentage is defined as (Umax - Uavg) / Uavg.
4) It can be used for simple and practical purposes, but can not imply meanings behind phase.



$$U_{avg} = \frac{U_R + U_S + U_T}{3}$$

Power calculation for P, S Type

1. Active Power Calculation

1) Active power is V ×I and it is defined as an integrated average about 1 cycle.
2) Therefore, according to the pulse angle difference between V and I, the active power could be consumed or produced.
3) Hence, the sample value during 1 cycle have to be operated or transacted separately.

$$P=\sqrt{\frac{1}{N}\sum_{k=0}^{N-1} i(k)\times v(k)}$$

- i(k) : Instantaneous value of current waveform (Sampling value)
- v(k): Instantaneous value of voltage waveform (Sampling value)
- N : Sampling value of 1 cycle

2. Reactive Power Calculation

1) Reactive power is V ×Q (current) and it is defined as an integrated average about 1 cycle.
2) Q (current) means the current delayed by 90°. Correctly speaking, it is not transferring the fundamental waveform by 90° but transferring all harmonics by 90°.
3) Therefore, transferring all the elements of the frequency by 90° is available when current is processed into the frequency area, do conjugation[1] process (transferring by 90°) with the frequency, and then reproduce it into a waveform after moving it to the time area again.
4) Above process needs numerous calculations for these steps: waveform → FFT[2] → conjugation about all the frequency →IFFT[3] →Q (waveform).
5) In case of P/S type, to solve difficulties above, it executes 90° phase transfer of voltage instead of current compared to the base of the fundamental wave. It is used with the current to get the reactive power.
6) Therefore, reactive power is processed with Q (voltage) ×I.

$$Q=\sqrt{\frac{1}{N}\sum_{k=0}^{N-1} i(k)\times Q(\mathrm{v}(k))}$$

1) Conjugation: process a complex number R+jX →R →jX
2) FFT : Fast Fourier Transformation
3) IFFT: Inverse Fast Fourier Transformation

- i(k) : Instantaneous value of current waveform (Sampling value)
- Q(v(k)) : Instantaneous value of voltage waveform after a 90° phase transfer (Sampling value)
- N : Sampling value of 1 cycle

D

5. Measurement Function

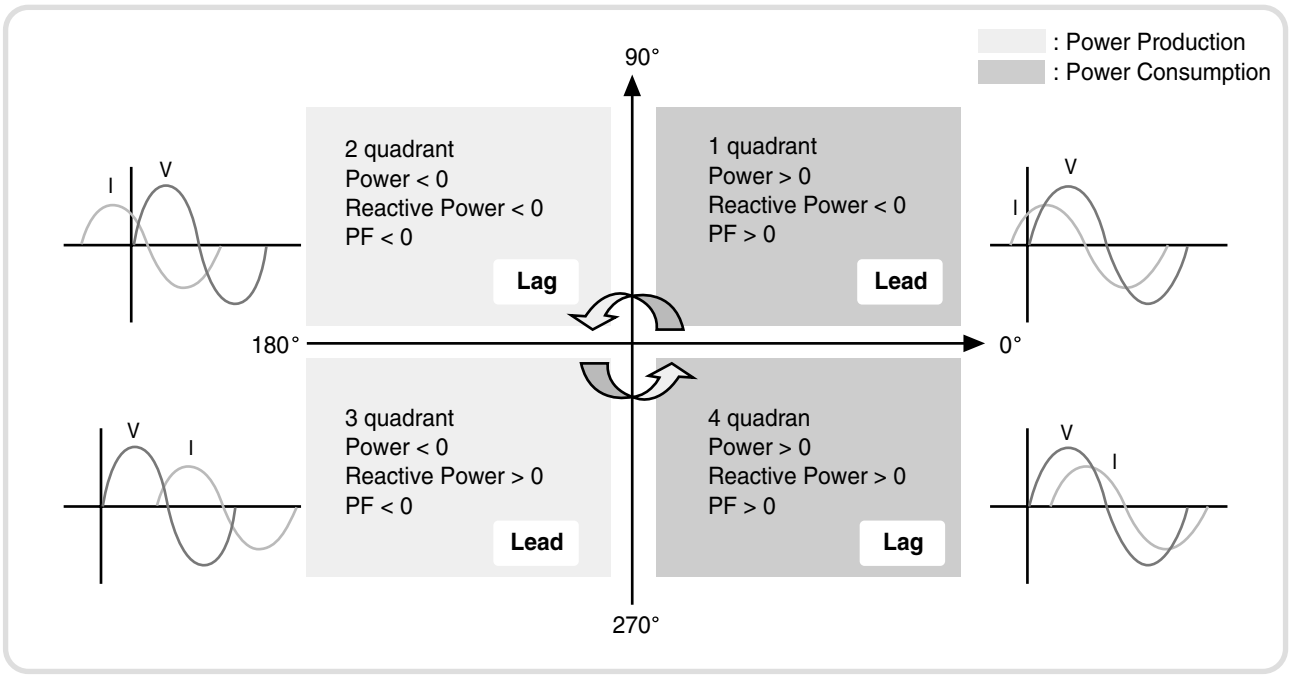
3. Apparent Power Calculation

1) Apparent power defines as current RMS value x voltage RMS value.
2) In case of no harmonic factors, the power equation $S=\sqrt{P^2+Q^2}$ formulates.
3) However, if harmonic is included, the equation of power does not formulate.
4) Thus, to avoid confusion of P and S type users, evaluate active and reactive power first and then evaluate apparent power by using, not by using $S=\sqrt{P^2+Q^2}$ current RMS value x voltage RMS value.

4. Power Factor Calculation

1) Evaluate the size of power factor with the Pf = active power/apparent power equation.

5. Indication of Power and Power Factor According to Phase



6. Electric Energy - Bidirectional Metering

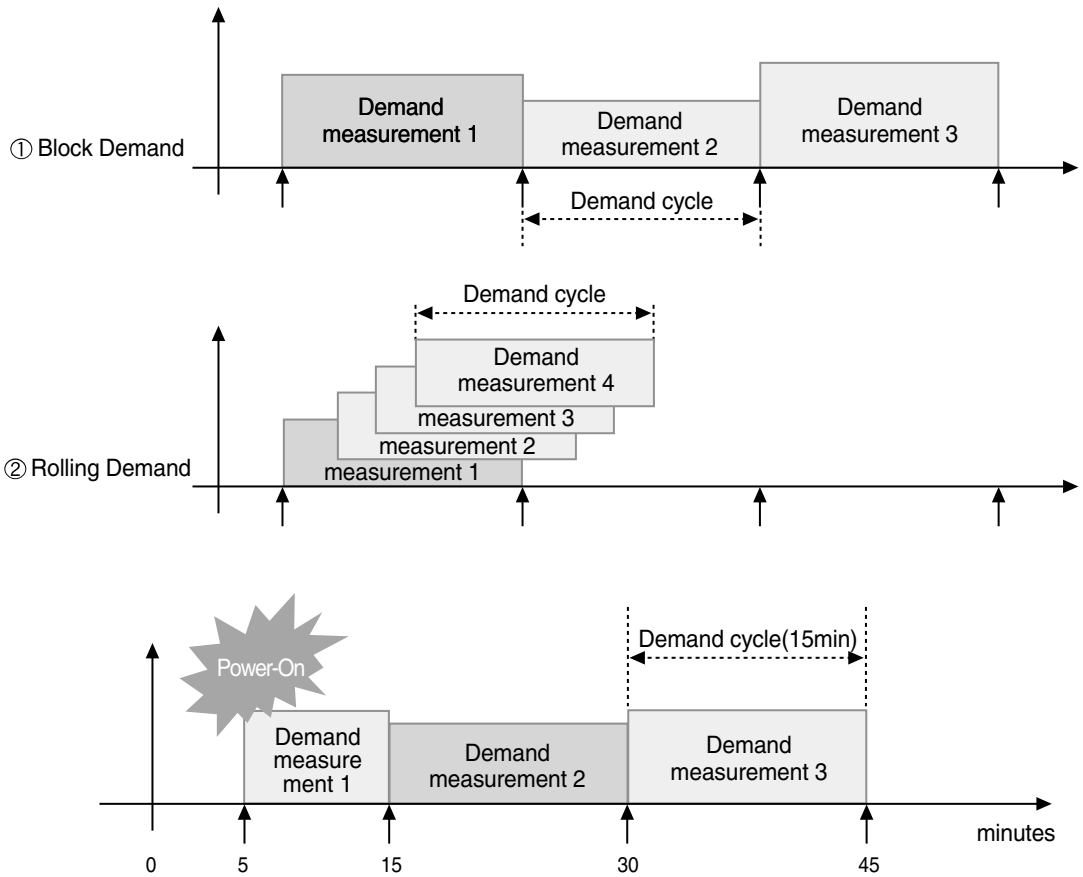
Integrate separately by classifying power into receiving and transmission.

1. Active electric energy, reactive electric energy, reverse active electric energy, reverse reactive electric energy
2. Refer to above figure for classification of corresponding factors.
3. Concerning the size of power factor, the symbols have the meaning as the above figure.

Demand / Peak Demand for P, S Type

1. Demand Measurement, Peak Demand Record

1) P and S type Demands are calculated with an average of the active power during the Demand cycle.
2) Demand cycle can be set by divisors of 60 minutes (1, 2, 3, 4, 5, 6, 10, 15, 20, 30, 60 minutes).
3) These are ①Block Demand and ②Rolling Demand for the Demand measuring method.
   P and S type only provide Block Demand for Demand method.
4) Block Demand measures by synchronizing with the minutes of internal timer of the P and S type.
   In short, under condition of Demand cycle is set as 15 minutes, if it is turned on at 11:05, Demand can be measured on 11:15 by using the average power during 10mins. After that, Demand can be measured again by using the average power during 15mins on 11:30.
5) The maximum Demand value measured from every cycle is set as Peak Demand and its occurred date and the value are recorded at nonvolatile memory.



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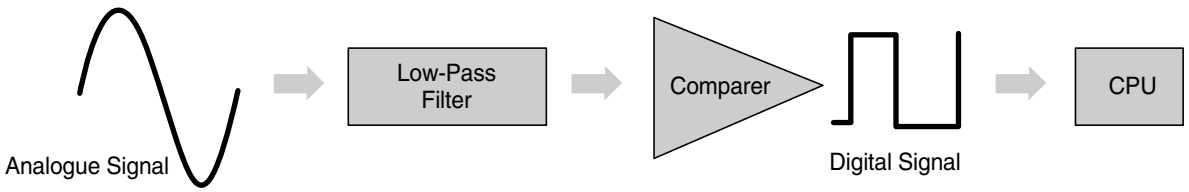
5. Measurement Function

Frequency Measurement and Harmonics Calculation for P, S Type

1. Frequency Measurement

1) P and S type frequency is measured through the Zero-Crossing method based on hardware style.
2) Zero-Crossing method has a fatal disadvantage for the harmonics, hence frequency detecting circuit is arranged by passing Low-Pass Filter to make Cut-Off under 100Hz.
3) Frequency ensures the accuracy from 45Hz to 65Hz.
4) The corresponding Hardware Circuit operates at R phase voltage.
5) Frequency detection operates when R phase voltage which is input into voltage dividing module is more than 80V at least. For the voltage below the value, the operation could be unstable and it indicates a frequency with '0 'Hz in case the voltage value is below 50V.



2. Harmonics Calculation

1) S type can measure the 63rd degree harmonics through 128 samplings per cycle.
2) Harmonics spectrum bar on display indicates values up to 31st degree, and the detailed value of harmonics includes all values up to 63rd degree.
3) Frequency spectrum bar and the value of THD is indicated when R, S, T phase turns over.
4) It displays the shape of waveform used for harmonics analysis after capturing the waveform as it is.
5) For 3P 4W type harmonics are analyzed with phase-to-phase voltage and for 3P 3W harmonics are analyzed with line-to-line voltage.

$$X(k) = \sum_{m=0}^{(\frac{N}{2}-1)} x_1(m) W_{N/2}^{mk} + W_N^k \sum_{m=0}^{(\frac{N}{2}-1)} x_2(m) W_{N/2}^{mk}$$

$$W_{N/2}^{mk} = e^{-j(\frac{2\pi}{N/2})km} = \cos(\frac{2\pi km}{N/2}) - j\sin(\frac{2\pi km}{N/2})$$

- X(k) : The complex number of k degree's harmonics (ex k⟶1 fundamental wave, k⟶2 : 2 harmonics)
- N : Sampling cycle (The square number of 2, 2^5, 2^6.....)
- x1(m) : x(2m). m=0, 1, 2.....(N/2)-1 even variable sampled
- x2(m) : x(2m+1). m=0, 1, 2.....(N/2)-1 odd variable sampled

THD (Total Harmonic Distortion), TDD (Total Demand Distortion) for P, S Type

1. THD Definition

1) THD is a single value which expresses the total harmonic distortion.
2) THD value measured is getting higher when total harmonics increases. THD value comes into '0' under no harmonics state.
3) The THD has two formulas. One is the ratio of a harmonics value to the fundamental wave and the other is the ratio of a harmonics value to the RMS value.
4) S type calculates THD by the ratio of a harmonics value to the fundamental wave.
5) THD is calculated on each phase of voltage and current.
6) For 3P4W, THD is calculated from phase-to-phase voltage and for 3P3W, THD is calculated from line voltage.

$$THD = \frac{\sqrt{\sum_{k=2}^{\infty} U_k^2}}{U_{rms}} \qquad THD = \frac{\sqrt{\sum_{k=2}^{\infty} U_k^2}}{U_1}$$

Apply on S Type

D

2. TDD Definition

1) TDD is a different way to show the total harmonic distortion of current.
2) The value of THD is supposed to be very high when non-linear loads are used such as computer under the circumstance of almost no load. Actually, a harmonics value is much lower comparing to normal condition, but when load current is relatively low at some point, it has no meaning as an index.
3) TDD is an index to show the total harmonic distortion to solve the problem described above. As TDD is the total harmonics distortion of Peak Demand current, it is available to show the harmonics distortion regardless of the load current at some point.

$$TDD = \frac{\sqrt{\sum_{k=2}^{\infty} U_k^2}}{U_{Peak\,Demand}} \qquad K\text{-}Factor = \frac{\sqrt{\sum_{k=2}^{\infty} K^2 U_k^2}}{U_{rms}}$$

2. K-Factor Definition

1) The K-Factor is an index that indicates harmonics for the temperature rise of transformer. It is defined by standard ANSI/IEEE C57.110.
2) In other words, the 3rd harmonics and 7th harmonics have the different temperature rise of transformer. 7th harmonics generates much higher heat than 3rd harmonics.
3) Heat capacity becomes the standard ratings for transformer capacity and the ratings does not include the harmonics (fundamental frequency). But, load current actually includes various harmonics which heats the transformer much higher than fundamental frequency. Therefore, 100% of transformer capacity will not be used when it includes harmonics.
4) K-Factor indicates as '1' without harmonics. As mentioned previously, even under the harmonics which has the same value, harmonics with higher degree has a higher K-Factor. Namely, the K-Factor of 7th harmonic is much higher than K-Factor of 3rd harmonic under the same value.

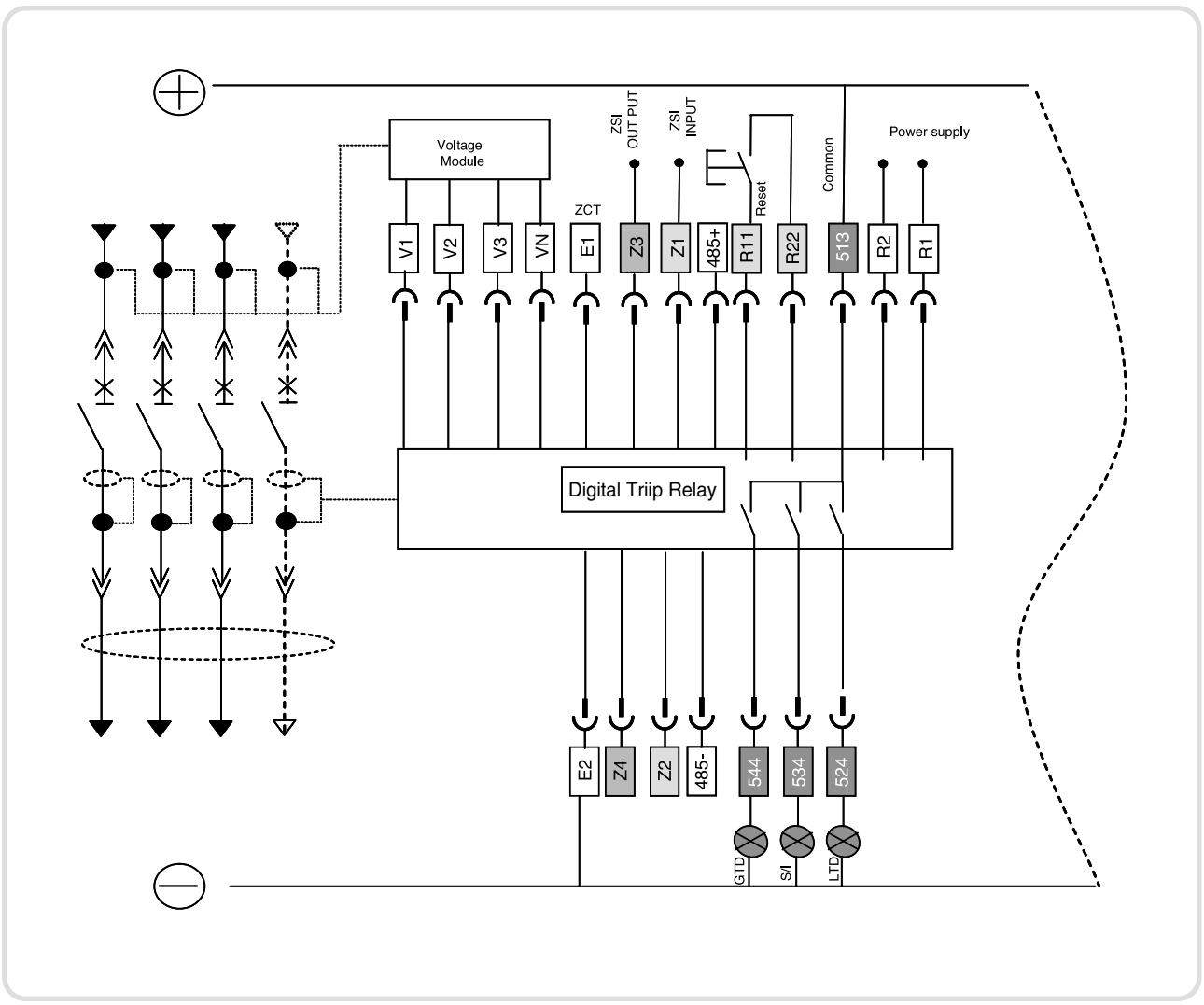
6. IO (Input-Output) Port

IO type and Configuration

P and S type have DI(Digital Input, 2 terminals) and DO(Digital Output, 4 terminals).

1) DO 4 terminals is composed of two types (Open-Collector 1terminal, Solid Relay 3 terminals)
   - 524-534-544-513 (Solid Relay 3 pieces, 513 is relay's common terminal.)
   - Z3-Z4 (ZSI output, Open-Collector, Z3-Collector, Z4-Emitter)
2) DI 2 terminals are all Dry Contacts, contact input voltage is 3.3V.
   - R11-R12 (Remote Reset)
   - Z1-Z2 (ZSI input)

   To make contact get recognized, just short-circuit them.
   Be aware of direction when short-circuiting with Open Collect.
   (It is required to connect Collector of Open Collector Terminal to Z1, R11)
3) 485+, 485- are connecting terminals for MODBUS/RS-485.
4) E1, E2 are connecting terminals for external CT on OCGR and earth leakage detective purpose CT.

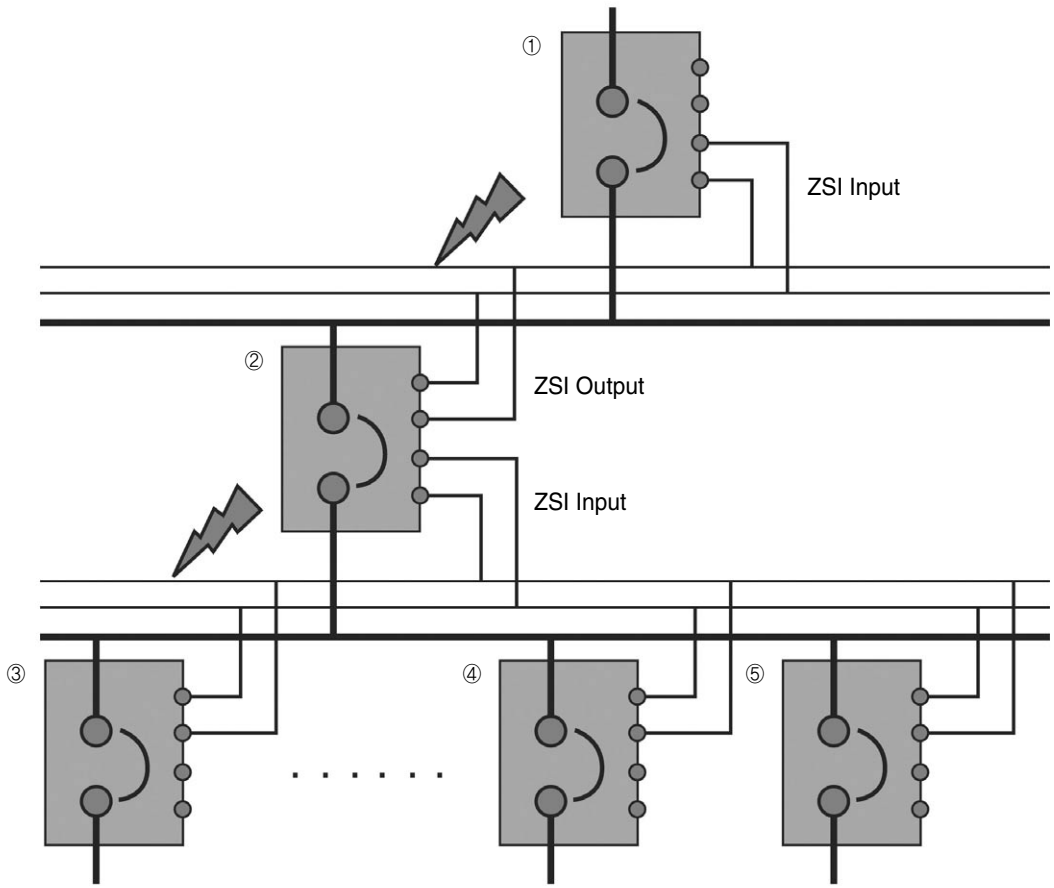


1. What is ZSI?

Zone-selective interlocking diminishes time-delay that cause problems for machines. It is used to minimize pressure on all kinds of electric machineries under high-demanding conditions.

1) While short time-delay or ground fault accidents are happening at ZSI built-in system, the machinery at accident sites is sending a signal through its lines to halt upperstream machinery's operation.
2) Then to eliminate a breakdown, it activates its trip operation without any time delayed.
3) The upperstream machinery that received ZSI signal adhere to pre-set short time-delay or ground fault time-delay for protective coordination in the system, however upperstream machinery that did not receive its signal will trip instantaneously.
4) For ordinary ZSI operation, it should arrange operation time accordingly so that downstream circuit breakers will react before upperstream ones under overcurrent/short time delay/ground fault situations.
5) ZSI connecting line is signal operation at TTL Level, therefore it needs to be formed within 3m.
6) ZSI output can be connected up to 12 lines (MAX) to ZSI input.

2. ZSI Configuration



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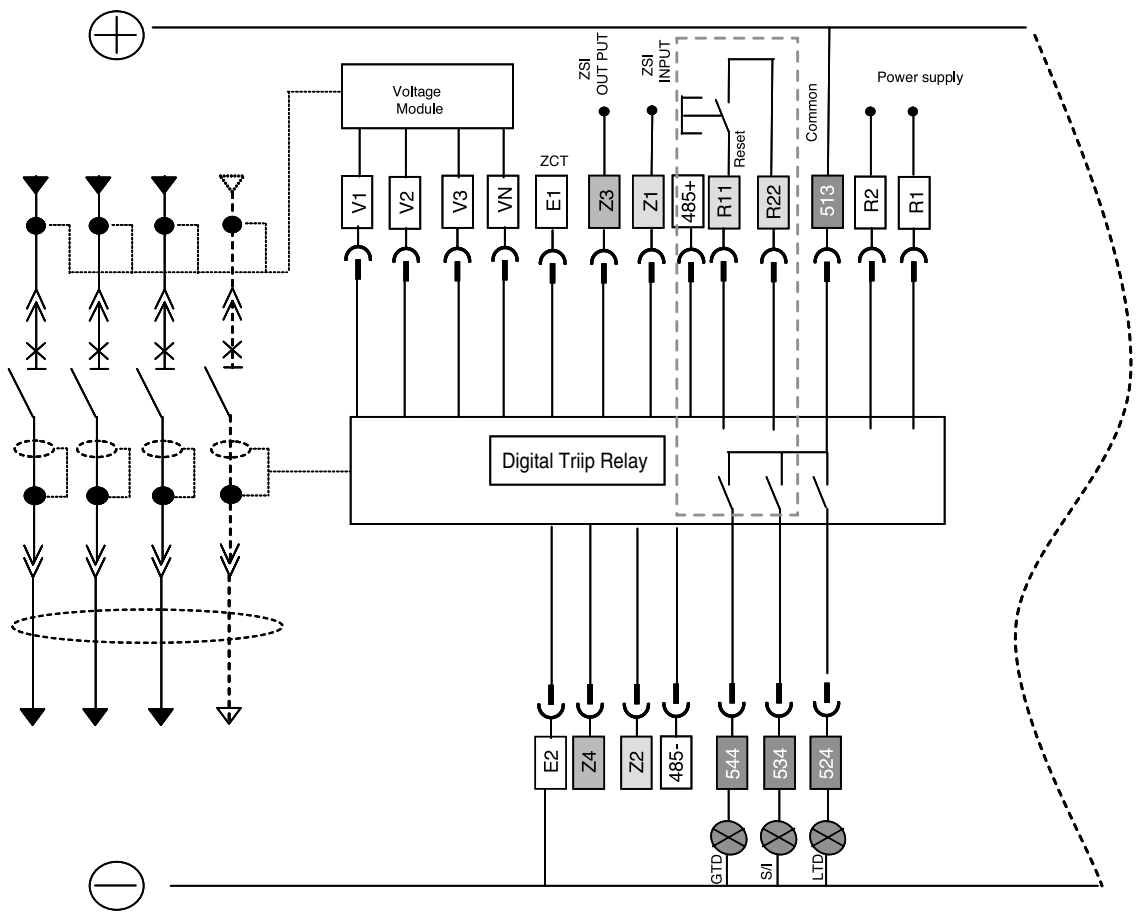
6. IO (Input-Output) Port

The use of Remote Reset

In case the ACB operates due to accidents or over current, the OCR indicates the information of the accident through the LCD and LED. To operate it for the next accident, the P and S type have to be Reset.

1) Methods to Reset the P and S type are to push the Reset button and to Reset by short-circuiting Remote Reset. Therefore, the Remote Reset does the same action as the Reset Key on the frontal side of the OCR.
2) Short-circuiting terminals R11-R22 resets.
3) R11-R22 are Dry Contacts that hold 3.3V of recognition voltage. When short-circuiting with SSR (Solid State Relay) or Open-Collector, connect Collector (Drain) to R11.
4) For general Solid Relays, attach contacts disregarding directions.



1. The use of Solid Relay

P and S type are equipped with 3 Solid Relays.

1) Terminal number is 524-534-544-513 (513 is Relay common terminal) and are contacts at Normal Open state.
2) Relay of 3 can be variously (overlapping) used by setting the environment.
   - Accident indication (Long/short time delay, instantaneous, ground fault, UVR, OVR, UFR, OFR, rPower, Vunbal, Iunbal)
     → Closes set Relay when corresponding accident occurs.
     (Maintains state as Latch form until user pushes Reset)
   - For overload alarm (Closes corresponding Relay at over 90%)
   - General purpose DO (Can remotely Close/Open the corresponding Relay)

2. Rated Output

Classification		Applied range	Remarks
Relay for signal	Contact switching capacity	AC230V 12A / DC25V 12A	Resistance load cos ø=1
	Max. switching capacity	2760VA, 300W	
	Contact switching capacity	AC230V 6A / DC25V 6A	Induction load (cos ø=0.4, L/R=7ms)
	Max. switching capacity	1880VA, 150W	

3. Possible Relay Composition

	Overload Alarm	Long	Short	Inst.	Ground	OVR	UVR	rPower	Vunbal	Iunbal	OFR	UFR
DO#1												
DO#2					Overlapped Setting Possible							
DO#3												

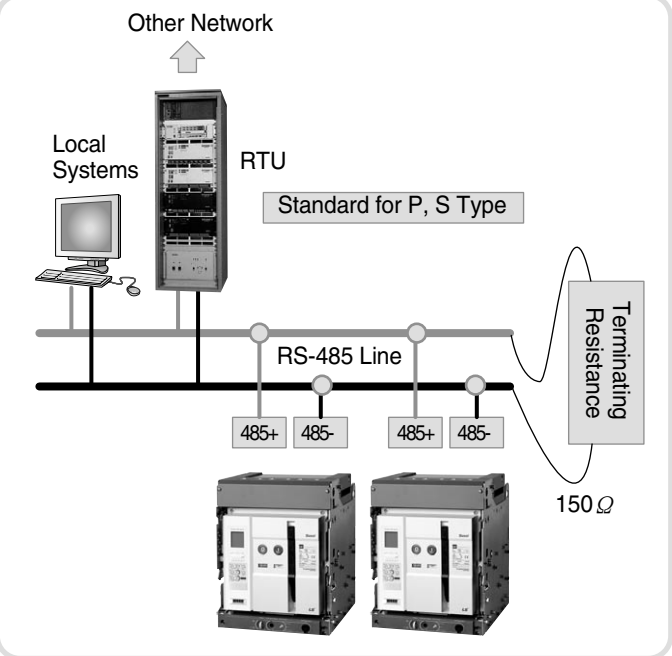
D

6. IO (Input-Output) Port

4. RS-485 MODBUS COMM.

P and S type are equipped with RS-485 communication terminal.

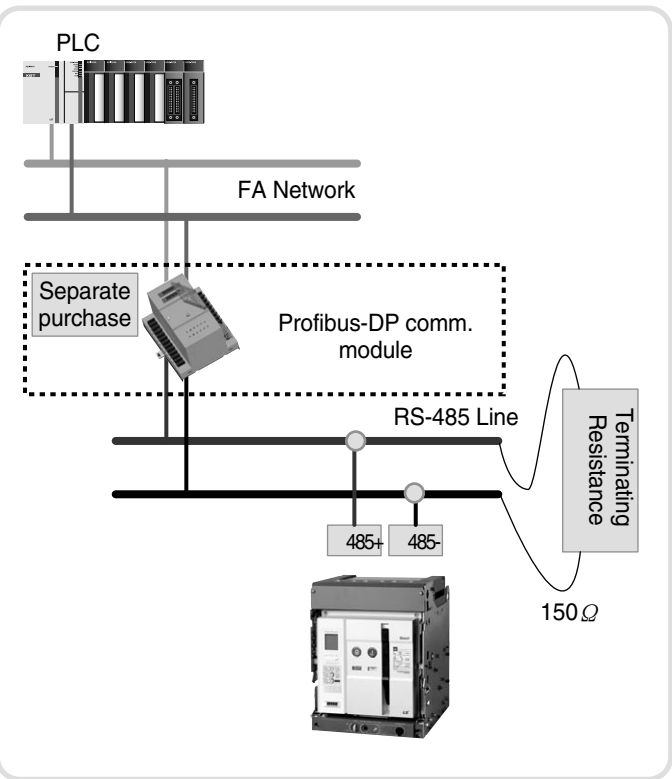
1) Terminal number is 485+ 485-.
2) Communication available at speed of 9600bps, 19200bps, 38400bps, 57600bps.
3) There is no terminating resistance within the device. Thus, add a 150Ω terminating resistance at the end after composing RS-485 line.
4) Monitoring all the measurement item and recording elements of P/S type are available via communication.
5) MODBUS communication map is put in a separate manual. (Refer to P/S type MODBUS map)
6) Various data of P, S type can be initialized and reset, when the device is set at Remote. Also, DO related control can be performed.



2. Profibus -DP COMM.

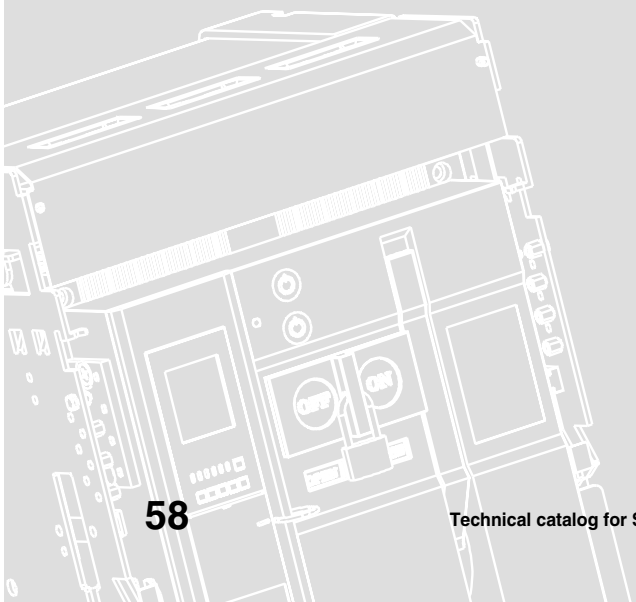
P and S type are equipped with RS-485 communication terminal.

1) Terminal number is 485+ 485-.
2) Possible to transmit data by installing Profibus-DP module on the exterior, which is often used in factor automation.
3) There is no terminating resistance within the device. Thus, add a 150Ω terminating resistance at the end after composing RS-485 line.
4) For details on Profibus-DP communication, refer to Profibus-DP communication module manual.



D

E. Digital Trip Relay Accessory

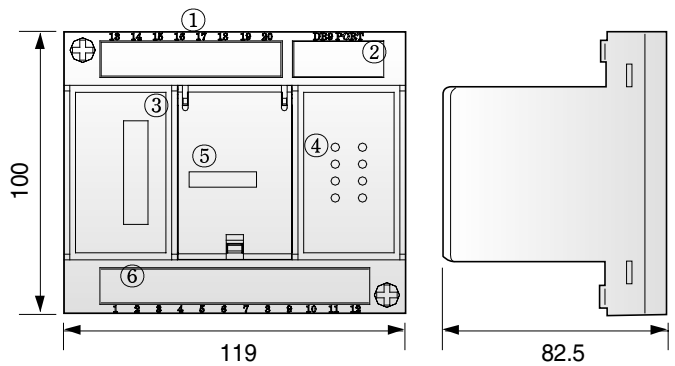


1. TRIO Unit

Function and Characteristics

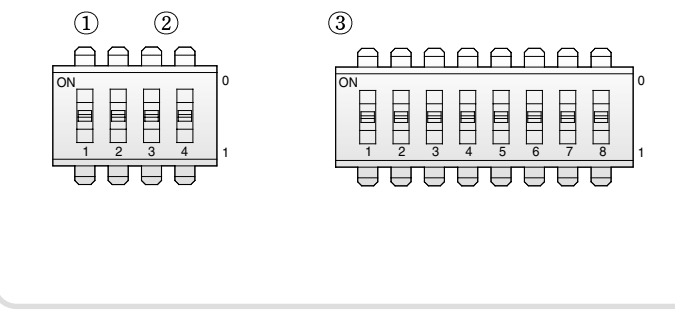
1) Temperature and Remote I/O Unit (Below TRIO Unit) has remote closing, breaking, and temperature monitoring functions.
2) TRIO Unit aim for the open network selected by international communication protocol standard.
3) TRIO Unit can transfer information collected from ACB using RS-485/MODBUS and Profibus-DP communication.
4) TRIO Unit can detect ACB's abnormal temperatures through its temperature monitoring function.
5) It establishes communication speed automatically according to master's communication speed, thus maintain flexible communication relationships.
   • But, only when Profibus-DP was applied.
   • When MODBUS communication is being used, speed is decided upon its applied deep switch operation.
6) TRIO Unit obtain reliability by adding SBO (Select Before Operation).

External View and Composition



No	Subject	Function
1	Communication Terminal Block	CB / DO control, Communication
2	RS-485	Profibus-DP, MODBUS
3	LED	Temperature Information Indication
4	LED	CB / DO condition TRIOU condition Indication
5	DIP Switch	Communication Speed Setting (MODBUS Mode), Address Setting
6	Power Terminal Block	Control power, DI, and Temperature Sensor Terminal

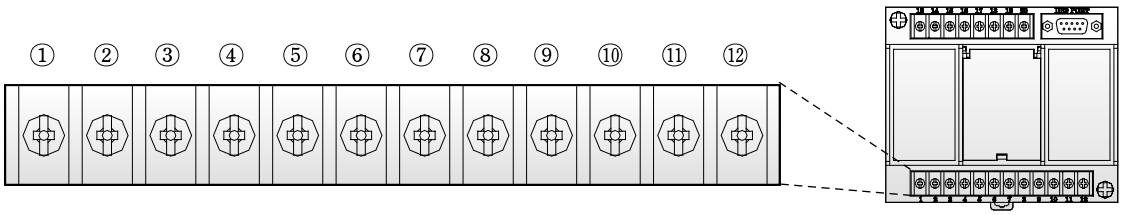
Switch Setting



No	Function		Explanation
1	DO Setting		00 : No use 01 : Connect to DI #1 10 : Connect to DI #2 11 : Temperature Indication and Connection
2	Baud Rate Setting*		11 : 9600 bps 10 : 19200 bps 00 : 38400 bps (Default)
3	Address Setting**	MODBUS	1~255 (decimal)
		Profibus	3~124 (decimal)

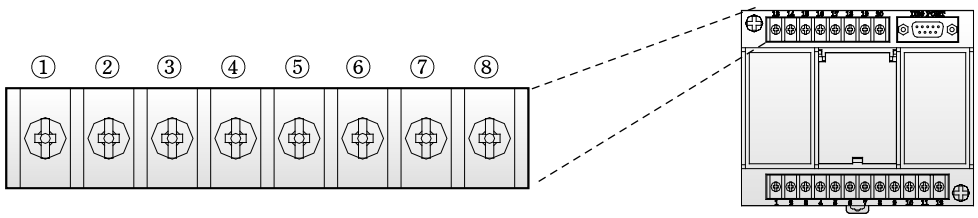
* Supports when MODBUS Communication is used. • Profibus-DP is automatically arranged according to master.
** Supports on both system(MODBUS and Profibus-DP).

Terminal Configuration 1



No	Mark	Explanation
1	Power(+)	Power Input Terminal (+)
2	Power(-)	Power Input Terminal (-)
3	CB Close (+)	Circuit Break Close Terminal (+)
4	CB Open (+)	Circuit Break Open Terminal (+)
5	Digital input #1 (+)	Digital Input #1 Terminal (+)
6	Digital input #2 (+)	Digital Input #2 Terminal (+)
7	CB, Digital Input Com	CB, Digital Input Common Terminal
8	Temperature Sensor #1	Temperature Sensor
9	Temperature Sensor #2	Temperature Sensor
10	Temperature Sensor #3	Temperature Sensor
11	Temperature Sensor #4	Temperature Sensor
12	Temperature Sensor COM	Temperature Sensor Common Terminal

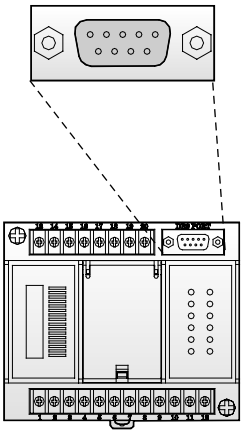
Terminal Configuration 2

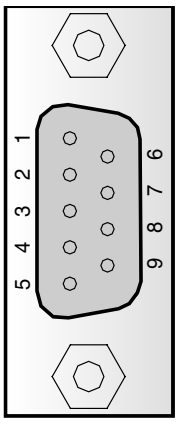


No	Mark	Explanation
1	CB Close Relay (+)	Circuit Break Close Relay Terminal (+)
2	CB Close Relay (-)	Circuit Break Close Relay Terminal (-)
3	CB Open Relay (+)	Circuit Break Open Terminal (+)
4	CB Open Relay (-)	Circuit Break Open Terminal (-)
5	Digital Out Relay (+)	Digital Out Relay (+)
6	Digital Out Relay (-)	Digital Out Relay (-)
7	RS-485 (-)	RS-485 Communication Connecting Terminal (-)
8	RS-485 (+)	RS-485 Communication Connecting Terminal(+)

1. TRIO Unit

Terminal Configuration 3

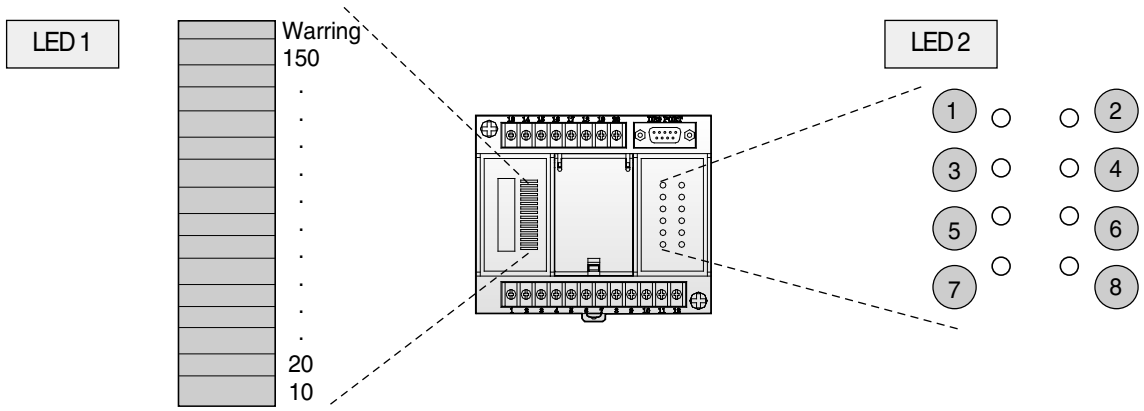


No	Pin	Explanation	
		MODBUS	Profibus - DP
Female 	1	No use	No use
	2	No use	No use
	3	Tx (+)	RED B
	4	No use	RTS*
	5	No use	GND
	6	No use	5V (+)
	7	No use	No use
	8	Tx (-)	Green A
	9	No use	No use

* Connect only when using repeater.

E

LED Configuration



LED 1

Mark	Explanation
10~150, Warning Display	Maximum Temperature Value

LED 2

No	Mark	Explanation
1	Digital Input #1	Indicate Digital Input #1 condition
2	Digital Input #2	Indicate Digital Input #2 condition
3	Digital Out close	Indicate Digital Out Close condition
4	Digital Out open	Indicate Digital Out Open condition
5	CB On	Indicate Circuit Break Close condition
6	CB Off	Indicate Circuit Break Open condition
7	Run	TRIOU run condition
8	CB Control Err	Indicate Circuit Break Terminal Disconnection / Control Err Condition

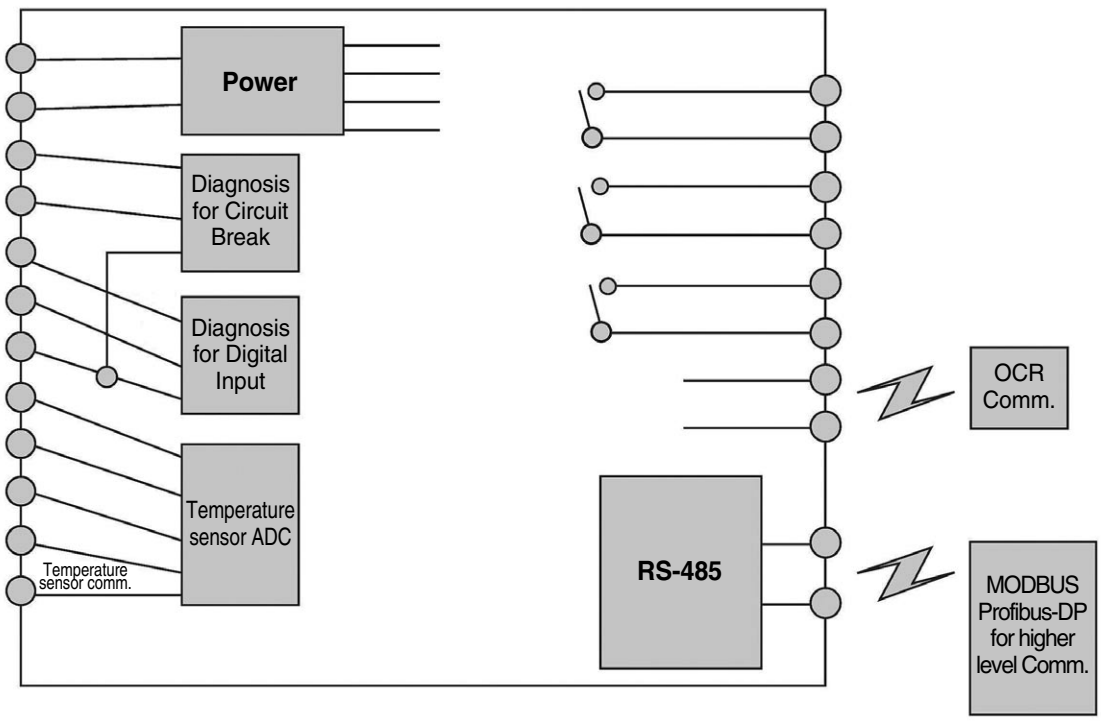
Product Input Rating

Category	Scope	Note
Apply Voltage	220V	
Rated Frequency	60Hz	
Rated Control Power	AC 92 ~ 253V (Free Voltage)	
CB Condition General Type DI	TTL, Dry Type [Voltage 3.3V~5V]	
Power Consumption	Normal : Below 5W Operation : Below 10W	In Operation - Relay Output

Product Output Rating

Category		Scope	Note
CB Control Relay	**Contact Switching Capacity**	AC230V 16A / DC30V 16A	
	Maximum Switching Capacity	3680VA, 480W	
Alarm, Control Relay	**Contact Switching Capacity**	AC230V 6A / DC25V 6A	Inductive load (cos ø=0.4, L/R=7ms)
	Maximum Switching Capacity	1880VA, 150W	

Internal Configuration



E

2. Profibus - DP Communication

Profibus - DP Communication Introduction

Profibus is selected, applied, and produced independently by the manufacturer (Vender-independence). It is approved for vender's independence and openness according to Profibus standard EN50170 which is a open field-bus standard that is extensively used in a process automation. Among them, DP is the most commonly used communication profile. It is applicable for Master-Slave communication between Master automation device which has a device level and decentralized slave I/O device to optimize the communication speed and price with the network which is suitable for FA service condition of Field Level.
For more details on Profibus-DP, please refer to "Korean Profibus Association" Homepage.
(http://www.profibus.co.kr)

Communication Standard

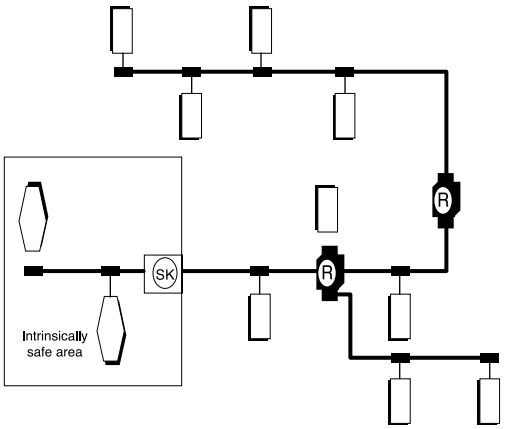
Category	TRIOU
Module Type	Slave
Network Type	Profibus-DP
Standard	EN50170 / DIN 19245
Media Access	Master-Slave (passive station)
Communication Method	Bus
Communication Cable	Shielded Twisted Pair
Communication Distance	1200m (9.6k ~ 187kbps)
	400m (500kbps)
	200m (1.5Mbps)
	100m (3M ~ 12Mbps)
I/O Data Length	32byte
Communication Parameter Setting*	Note (Setting its parameter through GMWIN high-speed link and Sycon)
Configuration Tool*	Note (Sycon)

Note. * Support through LSIS GM3/4/6 master modules.(G3L-PUEA/G3L-PUEB/G4L-PUEA/G4L-PUEB)
* When using other manufacturers' masters, use applicable parameter tool and configuration tool.

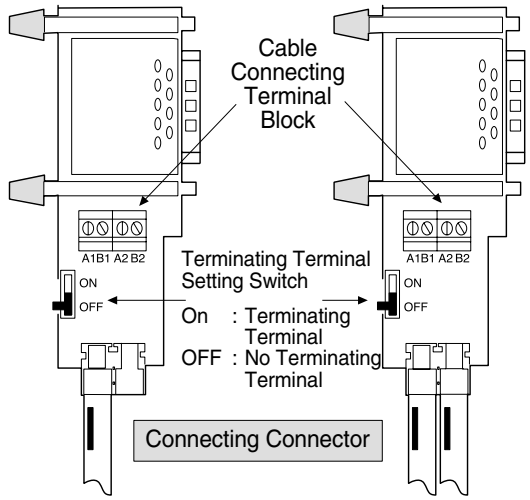
Network Configuration

Electric network can be composed of bus or tree.

- RS-485 transferring method : To connect profibus load, bus configuration is displayed using bus connector and bus terminal.
- Simple and standardized loading and connecting concept
- Easy installation



Electric Network



Terminating connection Branch connection

Communication Cable Standard

- Recommend Belden Network Cables.
  Type : Network Components
  Protocol : DP
  Certification : No
  Cable Order No : 3077F
  3079A

Category	Twinax
AWG	22
Type	BC-Bare Copper
Insulation	PE-Polyethylen
Insulation Intensity	0.035 (Inch)
Shield	Aluminum Foil-Polyester Tape / Braid shild
Electrostatic Capacity	8500 pF/ft
Characteristic Impedance	150 Ω
Number of Cores	Cores

Data Exchange

- Under TRIOU's data exchange condition, it exchanges data periodically at pre-defined communication speeds.
- It handles new data by comparing with previous ones.
- It is processed through using SBO function, when handling important commands such as breaker CB or DO control.
- TRIOU's output data will be sent to master every 1.5 second about its applicable information from trip relay without a master's command.

E

3. MODBUS

Protocol

Under RTU Mode, a data is processed on the bit-basis allowing to use only 8 bits when processing one data. More heavily condensed code will enable RTU Mode to handle large quantity of information comparing with other buses at the same transferring speed.

Physical Layer

Communication Port	RS-485
Asynchronous Format	A1 character = 10bit(1 start bit + 8 data bits + 1 stop bit)
Baud Rate	9600, 19200, 38400 bps
Data Bits	8 bits
Parity	No parity
Stop Bit	1 bit
Communication Method	Master - Slave

Data Link Layer

Description	Size
Slave Address	1 byte
Function Code	1 byte
Data	N byte
CRC	2 byte
Dead Time	3.5 bytes transmission time

- When master sends request-frame to slave, slave sends response-frame.

Master	SIZE		Response	Slave
Slave Address	Device Address	⟷	Device Address	Slave Address
Definition of Slave action	Function Code		Function Code	Echo or MSB=1
Additional information to perform requested actions from Slave	Data		Data	Requested data or Exception code
CRC	Error check		Error check	CRC

Communication Frame

Char. Time					Char. Time
START	Address 8bits	Function 8bits	Data	CRC 16bits	END

1. Address Range

- Valid slave device address range : 0~247 decimal
- TRIO Unit address range that is actually used : 1~247 decimal
- In case the slave device address of frame where Master request to Slave is in the range of zero, it is the address where Master device is broadcasting to all Slaves.
- When Master requests to Slave, transmit address field after filling it out with corresponding address.

2. Function Range

- It displays certain types of function that should be dealt by slave.
- TRIO Unit use 03, 04, 05, and 10 among its function codes.
- In case of no error, Slave turns back the value sent from Master, otherwise it gives a response after setting MSB of the value sent from Master as 1.

  EX) 0000 0001 ⇒ 0000 0001(normal)
  1000 0001(error)

3. CRC Range

Use 2 bits CRC check procedures. Each of 8 bit data's result (Address, Function, Data) is accumulated and CRC checked. Final data checked will be included in CRC field.

4. Temperature Sensor

TRIO Unit can measure temperatures among ACB's terminals, and detect its degree of loads from the heat.
In this equipment, it is possible to measure breaker's terminal temperature by using thermistor and RTD.

RTD Summary

Resistance Temperature Detector
Provide stable output from wide range of temperature
Re-adjustable while checking its precision
Steady for a long time
More linear characteristic than thermo couple
If highly sensitive, instruct precise temperature within small temperature ranges.

Temperature-rise Limit Regulation (IEC60947-2)

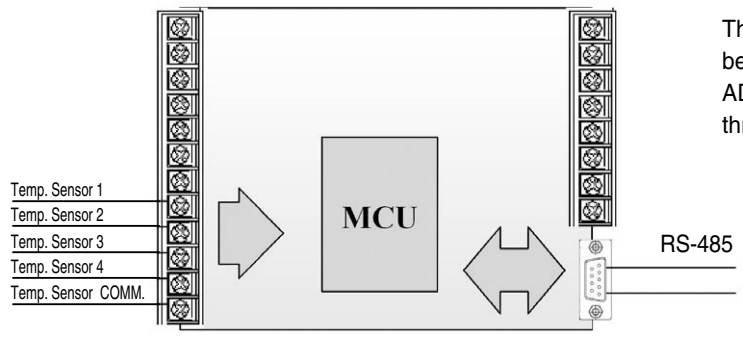
Components	Temp. Increase Limit (K)
External connecting terminal	80
Manual Operating Method • Metal • Non-Metal	 25 35
Contact is possible, but not by hands • Metal • Non-Metal	 40 50
Under normal operation, contact is not necessary • Metal • Non-Metal	 50 60

Ambient temperature subtracted from temperature measured is the Temperature-rise Limit.
Temperature-rise Limit for external connecting terminal is bound to 80° by the standard.
From TRIO Unit, it will send a warning message at 80° to user through its alarm.

E

TRIO Unit Temperature Measuring Operation

1. Operation Circuit

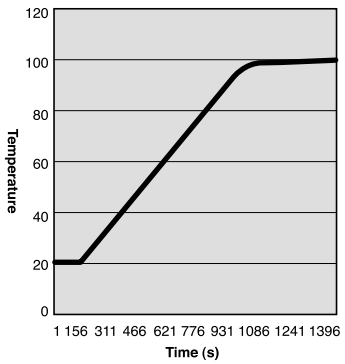


The measured value by a temperature sensor becomes a sampling through MCU's internal ADC, and exchange information with upstream through 485 communication line.

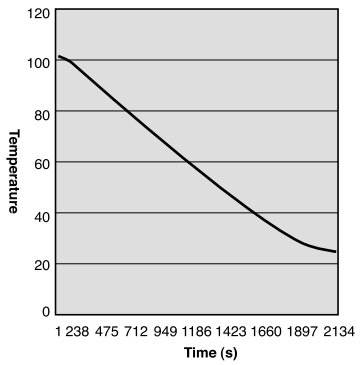
TRIOU Temp. Sensor Specification

Temperature Sensor	CS103FU (Thermistor)
Temperature Test Range	25° ~ 110°
Percentage of Error	Within ±4°
Measurable Temperature	20° ~ 120°

Measured Temp. Values (25°~110°)



Measured Temp. Values (110°~25°)



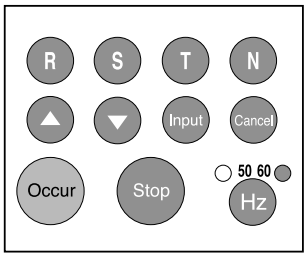
5. OCR Tester

OCR Tester Characteristic

Under no power condition, simple tests can be performed regarding trip relay's long time delay/short time delay / instantaneous / ground fault.

1. Maximum of 17In can be entered.
2. Enter current value size and phase on each of R/ S/ T/ N.
3. Frequency can be adjusted.
4. Test to see how precisely and accurately trip relay can operate to simulations.

Explanation on Function Key



R S T N — R, S, T, N phase signal input (Size/Phase)

Increase / Decrease Signal Input (Size / Phase)

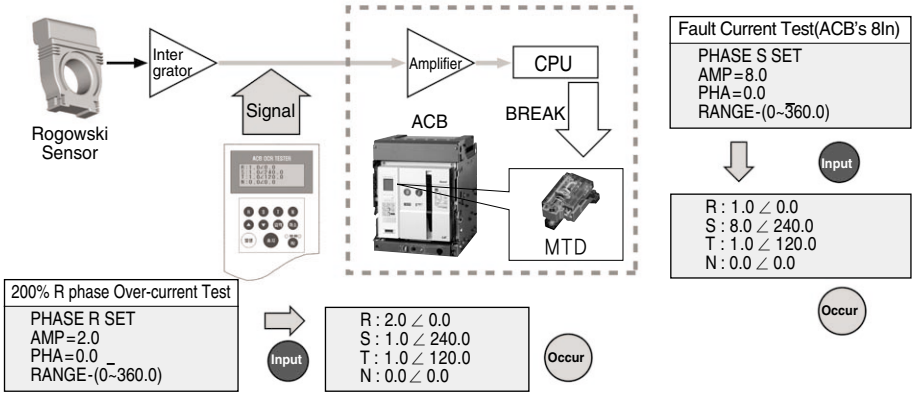
Input Cancel — Signal Input / Cancel

Occur Stop — Waveform occur and stop

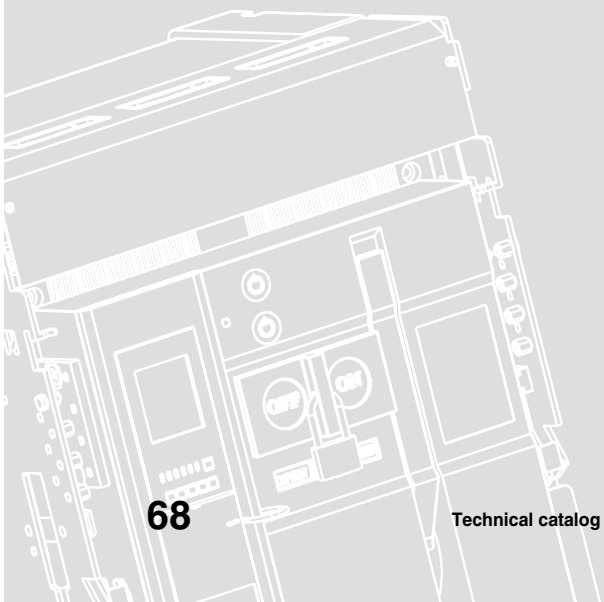
50 60 Hz — Select frequency

OCR Tester Check List

1. OCR Tester enter its signals between integrator and amplifier.
2. Therefore, devices after amplifier like CPU MTD (Magnetic Trip Device) and ACB operation can be checked.
3. But, it can not check for integrator or Rogowski sensor.



F. Installation and Service Condition



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 should be with suitable knowledge of installation, construction, operation, or maintenance of the equipment and the hazards involved.
In addition, this person should have 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, face shields, or 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	 Warning	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 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.

1. Be sure to tighten the terminal screws to the torque specified in the instruction manual.
2. Do not install in areas subject to high temperature, high humidity, dust, corrosive gas, vibrations, and shocks. To do so may result in malfunction or fire.
3. To get ACB tripped automatically, always clear the source of the malfunction before closing the ACB again. Failure to do so may result in fire.
4. Terminal screws should be checked and tightened periodically. Failure to do so may result in fire.
5. Use the ACB in 50/60Hz. Failure to do so may result in malfunction or fire.

Hazard of Bodidy Injury or Equipment Damage

1. Only qualified electrical workers with training and experience on high voltage circuits should perform work described in this set of instructions. These workers must understand the hazards involved in working with or near high voltage equipment. Such work should be performed only after reading this complete set of instructions.
2. The successful operation of Susol ACBs depends upon proper handling, installation, operation, and maintenance. Neglecting fundamental installation and maintenance requirements may lead to personal injury as well as damage to electrical equipment or other property.
3. Susol ACBs have features designed to prevent unsafe operation, but it is not possible to eliminate every hazard with these features. Therefore, the person using this device is responsible for recognizing the potential hazards, for wearing protective safety equipment, and for taking adequate safety precautions.
4. Do not make any adjustment to the equipment or operate the system with safety features removed. Contact your local LSIS representative for additional instructions if the Susol ACB does not function as described in this manual.
5. Before performing visual inspections, tests, or maintenance on this device, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, grounded, and connected. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feeding.
6. Before replacing covers or closing doors, carefully inspect the bus work area for tools and objects left inside the equipment. Use care while removing or installing panels so that they do not extend into energized bus.
7. Before making any electrical connection, take every precaution to see that all connections are de-energized and grounded.
8. Introducing foreign objects into this equipment can cause a short circuit which can result in severe damage, personal injury, or death. Short circuits can release large amounts of energy due to a rapid expansion of super-heated, ionized gases. Products of this instantaneous expansion can quickly engulf and burn personnel before preventive action can be taken. The short circuit source can cause additional injuries by propelling personnel or objects several feet from the equipment. Some foreign objects that can cause short circuits are tools, test leads and instruments not designed for high voltage circuits, wire, and other conducting or semi conducting materials. Workers must also be careful to keep clothing and body parts out of the equipment. Failure to observe these precautions could result in severe personal injury, death, or equipment

1. Safety Precaution

Receiving

A visual inspection - inside and out - should be performed immediately upon receipt of the ACB 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 30days after receipt of ACB. Failure to do so constitutes unqualified acceptance and a waiver of all such claims by the purchaser.

Handling

Removable lifting plates are provided on the top of the Susol ACB structure for insertion of hooks to lift the complete structure. This is the only recommended method of moving the Susol ACB structure. Extreme care should be used not to damage or deform the unit if other moving methods are employed.

Storage

If it is necessary to store the equipment before installation, keep it in a clean, dry location with ample air circulation and heat to prevent condensation. Like all electrical apparatus, these units contain insulation that must be protected against dirt and moisture. Outdoor units may be stored outside only if roof caps are installed, space heaters energized and any openings are enclosed.

Lifting Instructions

1. Do not pass cables or ropes through support holes.
2. Always use load rated shackles or safety hooks in support holes.
3. Rig so that legs of sling are no less than 45 degrees from horizontal.

Moving

A crane or hoist can also be used to handle the breaker, if the lifting device is not available. If a forklift is utilized, the following precautions should be taken when moving circuit breakers:

1. Keep the breaker in an upright position only.
2. Make sure the load is properly balanced on the forks.
3. Place protective material between the breaker and the forklift to prevent bending or scratching.
4. Securely strap the breaker to the forklift to prevent shifting or tipping.
5. Excessive speeds and sudden starts, stops, and turns must be avoided when handling the breaker.
6. Lift the breaker only high enough to clear obstructions on the floor.
7. Take care to avoid collisions with structures, other equipment, or personnel when moving the breaker.
8. Never lift a breaker above an area where personnel is.

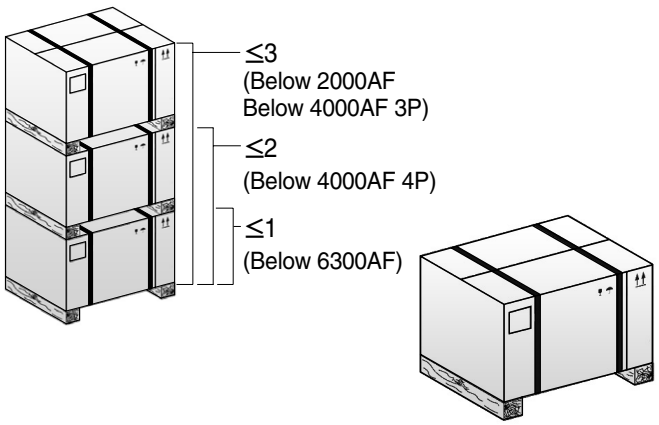
2. Receiving and Unpacking

Receiving

A visual inspection - inside and out - should be performed immediately upon receipt of the ACB 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 ACB. Failure to do so constitutes unqualified acceptance and a waiver of all such claims by the purchaser.

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.



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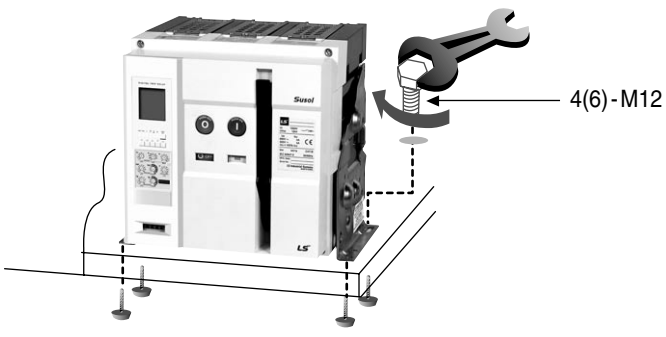
3. Installation Method

Installation of Fixed Type

Securely install the left and right mounting frames with M12 bolts (4EA).

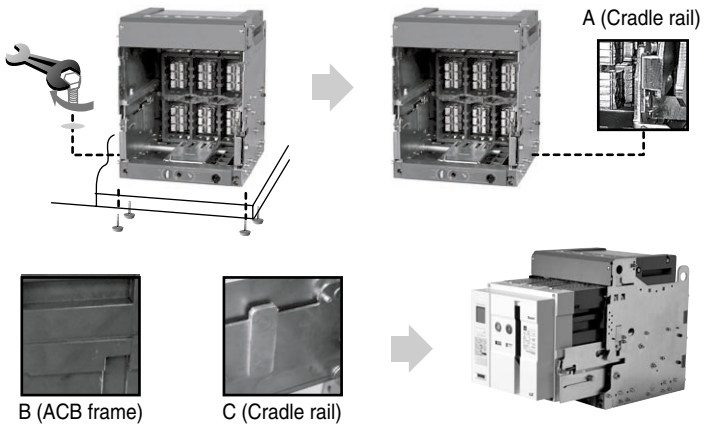


3. Installation Method

Installation of Draw-out Type

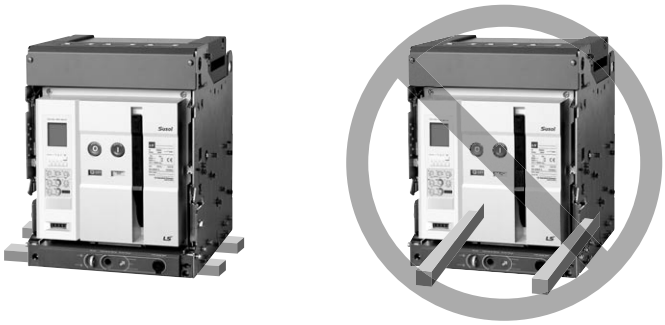
Install draw-out type according to the instruction given below.

1. Securely install the cradle at the bottom with M12 bolts (4EA).
2. Pull the extension rails of cradle forward.
3. Put the breaker on the rail as shown in picture by using lifting device.
4. Please check if the circuit breaker fits well to the cradle.
5. Slowly push the circuit breaker by moving the rail handle.



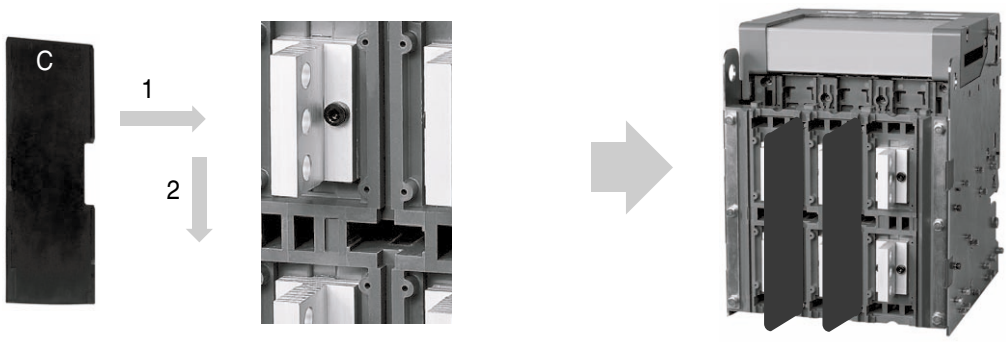
Caution

1. Do not lay down a breaker on the side or stand with the side of it.
2. Install a circuit breaker on perfect even ground. (Within 2mm of the level difference)
3. Do not install a circuit breaker with same direction of a rail when you use an angle.
4. Install a circuit breaker at a right angle to the direction of a rail to decentralize weight of the circuit breaker.



Installation of Insulation Barrier

Insert insulating barriers between the phases after installing of a circuit breaker for the safety. (option)



4. Service Condition

Normal Service Conditions

If under ordinary conditions the following normal working conditions are all satisfied, Susol ACB 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 Susol ACB, refer to catalogue or the installation instructions in the instruction manual.
5) Storage temperature : A range of max. +60° to min. -20° is recommended. However, the average temperature of 24 hours does not exceed +35°.
6) Replacement : Approx. 10 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. Contact us for further detail.

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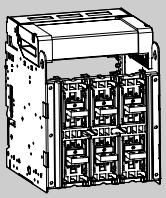
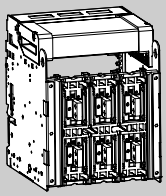
Table A. The Compensation of Rated Current According to Ambient Demperature

FRAME	Rated Current	ACB Terminal	Applicable Busbar Size										
				Horizontal Type					Vertical Type				
				40℃	45℃	50℃	55℃	60℃	40℃	45℃	50℃	55℃	60℃
2,000AF (AN, AS, AH-D)	200A	15t*50*1ea	5t*30*2ea	200A	200A	200A	200A	200A	200A	200A	200A	200A	200A
	400A			400A	400A	400A	400A	400A	400A	400A	400A	400A	400A
	630A		5t*40*2ea	630A	630A	630A	630A	630A	630A	630A	630A	630A	630A
	800A		5t*50*2ea	800A	800A	800A	800A	800A	800A	800A	800A	800A	800A
	1,000A		5t*60*2ea	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A
	1,250A		5t*80*2ea	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A
	1,600A		5t*100*2ea	1,600A	1,600A	1,600A	1,550A	1,500A	1,600A	1,600A	1,600A	1,600A	1,550A
	2,000A	15t*75*1ea	5t*100*3ea	2,000A	2,000A	1,950A	1,900A	1,850A	2,000A	2,000A	2,000A	1,950A	1,900A
4,000AF (AN, AS, AH-E)	630A	20t*75*1ea	5t*40*2ea	630A	630A	630A	630A	630A	630A	630A	630A	630A	630A
	800A		5t*50*2ea	800A	800A	800A	800A	800A	800A	800A	800A	800A	800A
	1,000A		5t*60*2ea	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A	1,000A
	1,250A		5t*80*2ea	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A	1,250A
	1,600A		5t*100*2ea	1,600A	1,600A	1,600A	1,600A	1,600A	1,600A	1,600A	1,600A	1,600A	1,600A
	2,000A		5t*100*3ea	2,000A	2,000A	2,000A	2,000A	2,000A	2,000A	2,000A	2,000A	2,000A	2,000A
	2,500A		5t*100*4ea	2,500A	2,500A	2,500A	2,400A	2,300A	2,500A	2,500A	2,500A	2,450A	2,350A
	3,200A		10t*100*3ea	3,200A	3,200A	3,100A	3,000A	2,900A	3,200A	3,200A	3,150A	3,050A	2,950A
	4,000A	10t*100*3ea	10t*100*4ea	4,000A	3,900A	3,800A	3,700A	3,600A	4,000A	3,950A	3,850A	3,750A	3,650A
5,000AF (AS-F)	4,000A	20t*125*2ea	10t*100*4ea	4,000A	3,900A	3,800A	3,700A	3,600A	4,000A	3,950A	3,850A	3,750A	3,650A
	5,000A		10t*125*4ea	5,000A	5,000A	4,900A	4,800A	4,700A	5,000A	5,000A	4,950A	4,850A	4,750A
6,000AF (AN, AS, AH-G)	4,000A	20t*125*2ea	10t*100*4ea	4,000A	4,000A	4,000A	3,900A	3,800A	4,000A	4,000A	4,000A	3,950A	3,850A
	5,000A		10t*125*4ea	5,000A	5,000A	5,000A	4,900A	4,800A	5,000A	5,000A	5,000A	4,950A	4,850A
	6,300A	20t*150*2ea	10t*150*4ea	6,300A	6,300A	6,200A	6,100A	6,000A	6,300A	6,300A	6,250A	6,150A	6,050A

4. Service Condition

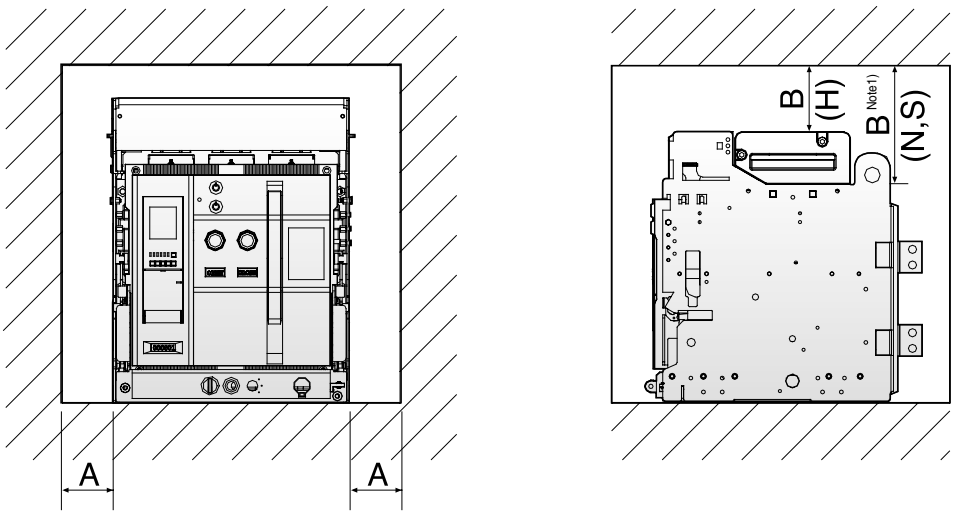
Altitude

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

Item \ Altitude [m]	2,000	3,000	4,000	5,000
Withstand voltage [V]	3,500	3,150	2,500	2,100
Average insulating voltage [v]	1,000	900	700	600
Max. using voltage [V]	690	590	250	460
Current compensation constant	1 × In	0.99 × In	0.96 × In	0.94 × In

Insulation Clearance

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



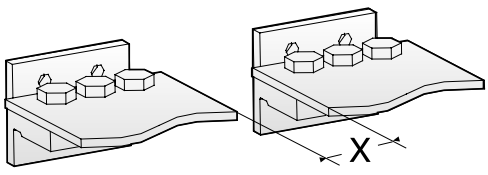
Type	Fixed [N/S/H]	Draw out [N/S]	Draw out [H]
A	50	50	50
B	150	150 Note1)	0

Note1) High Capacity(H type) Draw-Out type : Arc Space Zero(Option)

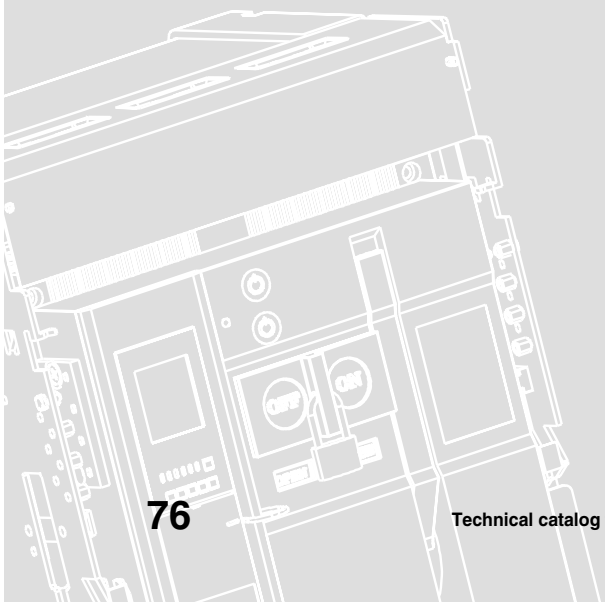
Minimum Insulation Clearance

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

Insulating Voltage (Ui)	Min. Insulation Clearance (X min)
600V	8mm
1,000V	14mm



G. Operation



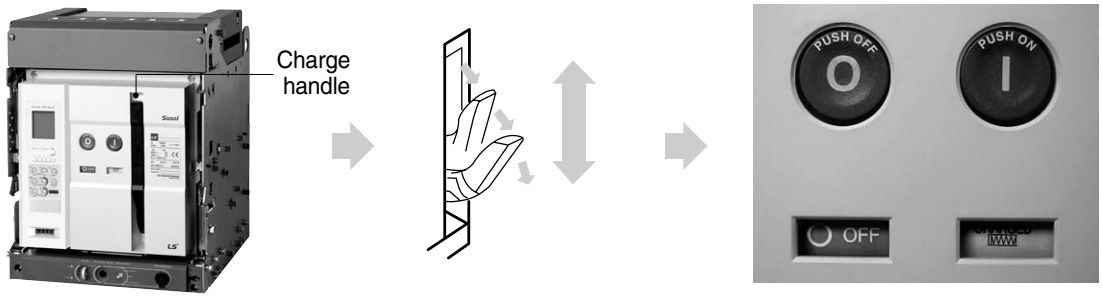
1. Manual Operation

Caution

Before opening or closing the breaker equipped with an under voltage tripping device, control voltage should be applied.

Manual Charging

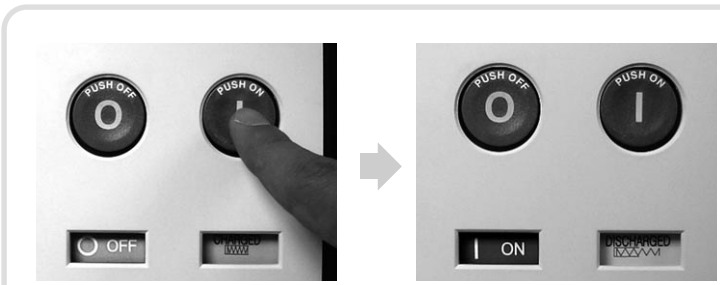
1. Charge the handle 7~ 8 times with full strokes.
2. When the closing spring is completely charged, the charging indicator shows “CHARGED”.



ACB off and charged

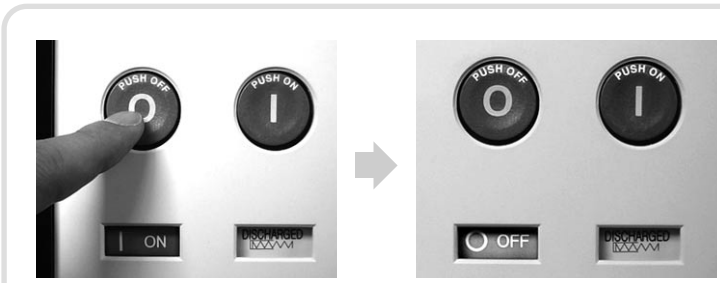
Manual Closing

1. Push ON button.
2. The breaker will be closed.
3. The ON/OFF indicator shows “ON” and the charging indicator shows “DISCHARGED”.



Manual Tripping

1. Push the OFF button and breaker will be tripped.
2. The ON/OFF indicator shows “OFF”



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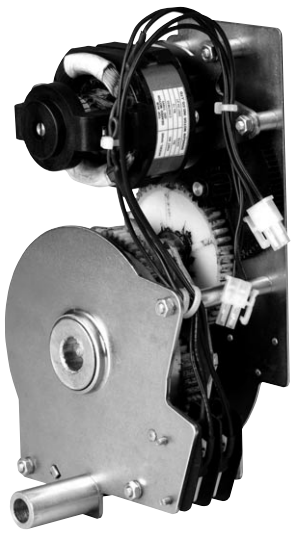
2. Electrical Operation

Electrical Operation

Closing operation is done by charging the closing spring from remote control. If pushing trip button, closing spring is automatically charged by a geared motor and a circuit breaker is closed by closing button.



Electrical Closing

1. Remote closing can be made by energizing the closing coil (CC). Apply the rated voltage to the control terminals A1 and A2 and close the breaker.

Electrical Trip

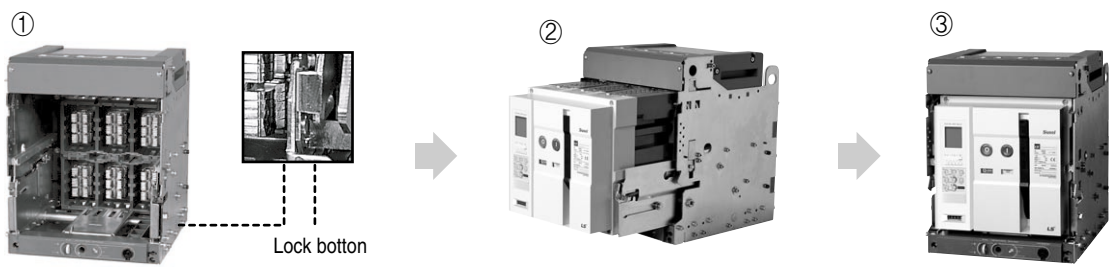
1. Remote opening can be made by energizing the shunt trip device or under voltage trip device.
2. In the case of SHT, apply the rated voltage to the terminal C1 and C2.
3. In the case of UVT, remote opening is also possible by applying a short - circuit across terminals D1 and D2 of the UVT controller.

G

3. Draw-in Operation

Draw-in Operation Procedure

1. Pull the extension rails of cradle forward
2. Put the breaker on the rail by using lifting device. Please check if the circuit breaker fits well to the cradle.
3. Slowly push the circuit breaker by moving the rail handle until it stops.

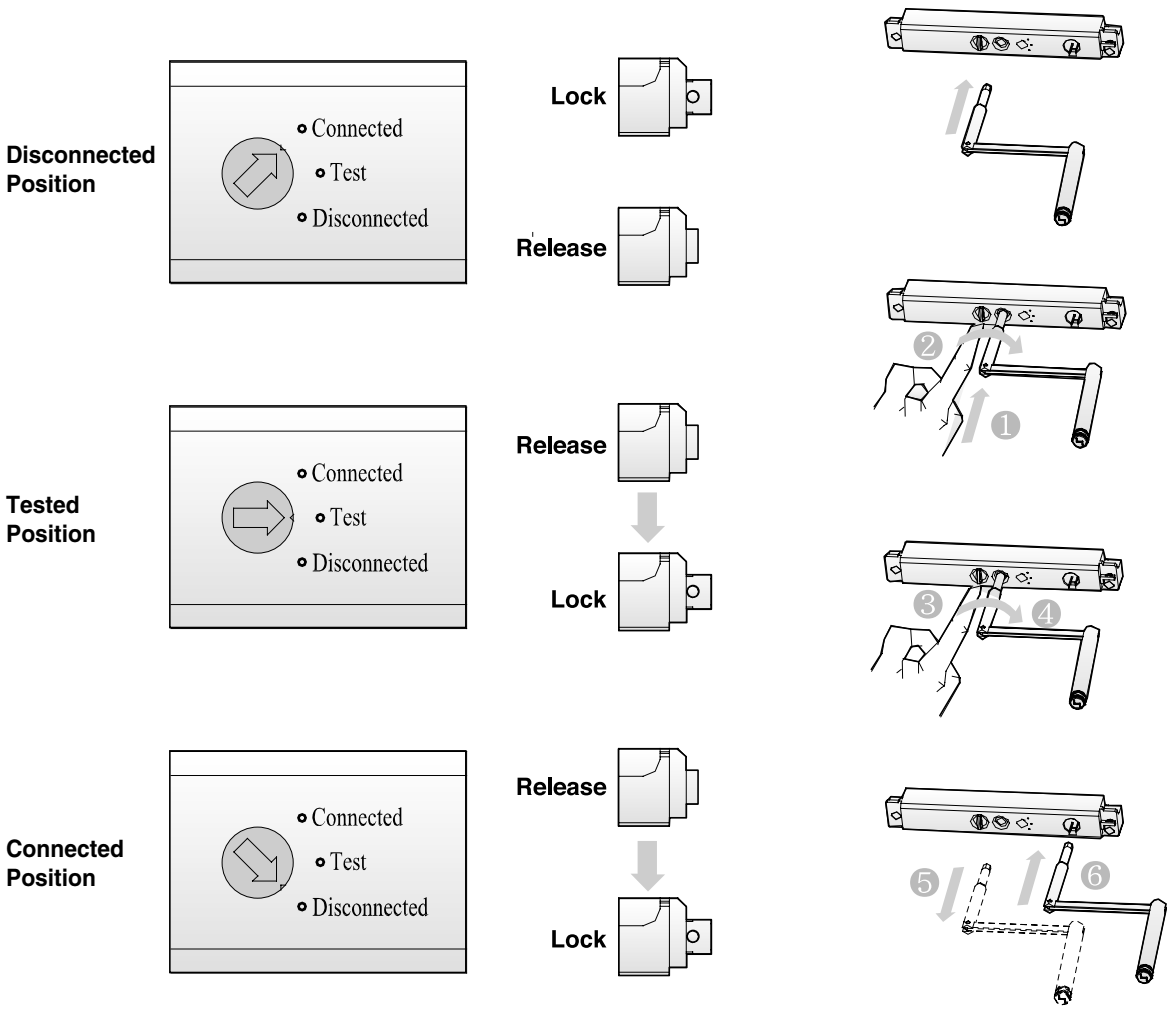


3. Draw-in Operation

Caution

1. Operating handle of cradle only can be inserted when pushing OFF button.
2. If locking device for draw in/out protrudes, stop handle operation and move to next procedure as it indicates the complete operation of ongoing process.

4. Keep pushing the OFF button when the circuit breaker in a trip condition, and insert a handle to the body of the circuit breaker.
5. Check the draw-out handle properly inserted and then push the lock plate and turn the draw-out handle clockwise in order to insert the breaker.
6. When the breaker reaches the TEST position, the lock plate automatically projects and the draw-out handle is locked.
7. Push in the lock plate and turn the draw-out handle again clockwise until the lock plate projects, the inserting operation is finished. At this time, the draw-out position indicator shows CONNECTED position.



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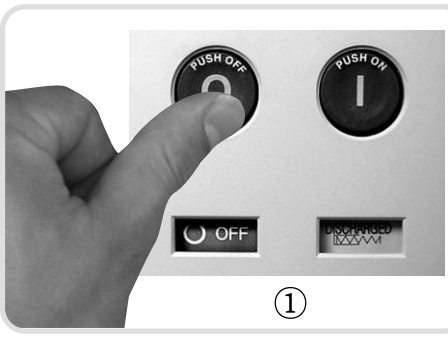
4. Draw-Out Operation

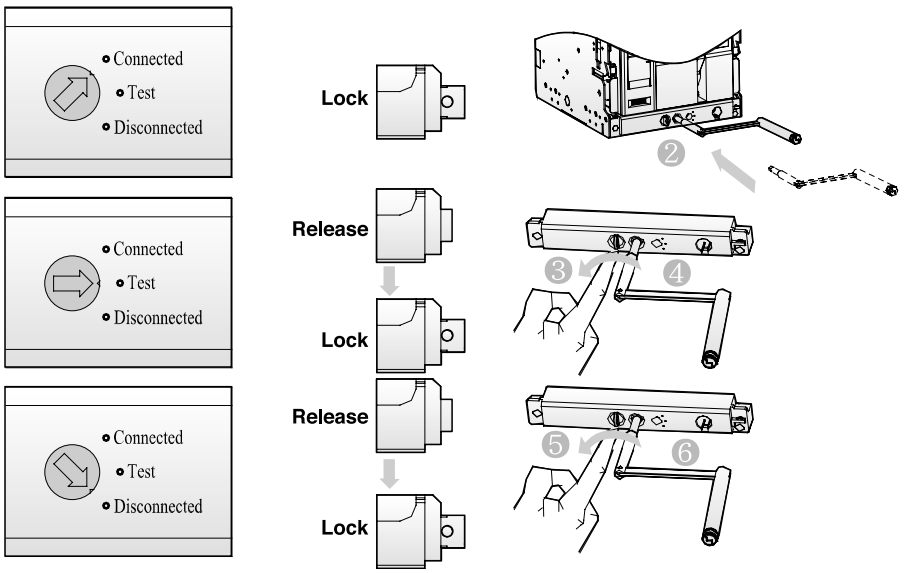
Caution

1. Please stop handle operation when draw in/out locking device protrudes.
2. Draw in or out by moving handle right or left side when draw in/out locking device can not be inserted.

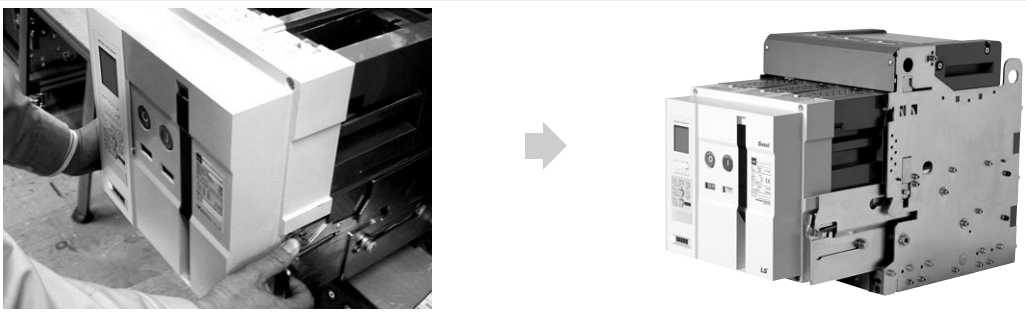
Draw-Out Operation Procedure

1. Keep pushing the OFF button when the circuit breaker in a trip condition, and insert a handle to the body of the circuit breaker.
2. Check the draw-out handle properly inserted and then push the lock plate and turn the draw-out handle counterclockwise in order to insert the breaker.
3. When the breaker reaches the TEST position, the lock plate automatically projects and the draw-out handle is locked.
4. Push in the lock plate and turn the draw-out handle again counter-clockwise until the lock plate projects, At this time, the draw-out operation is finished with indicator which shows DISCONNECTED position.





5. The circuit breaker indicated with 'DISCONNECTED' can be separated safely from the cradle by removing a draw in/out handle and releasing right and left locks.
6. Use a lifting hook to separate a circuit breaker from a cradle.



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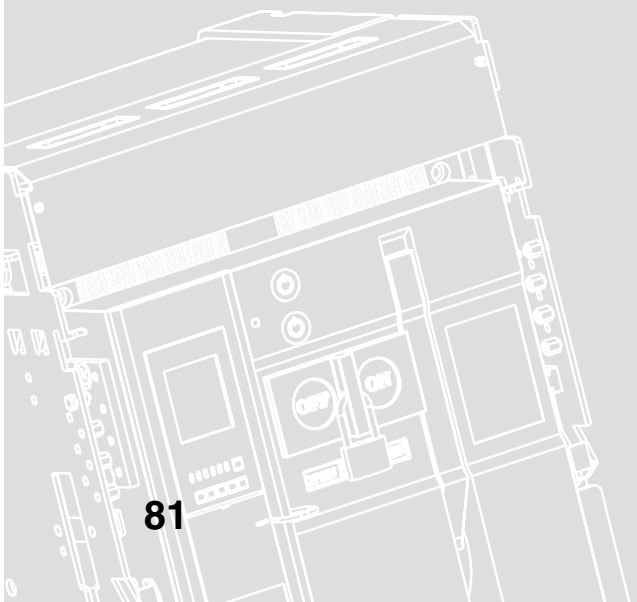
H. Protective Coordination



1. Protective Coordination

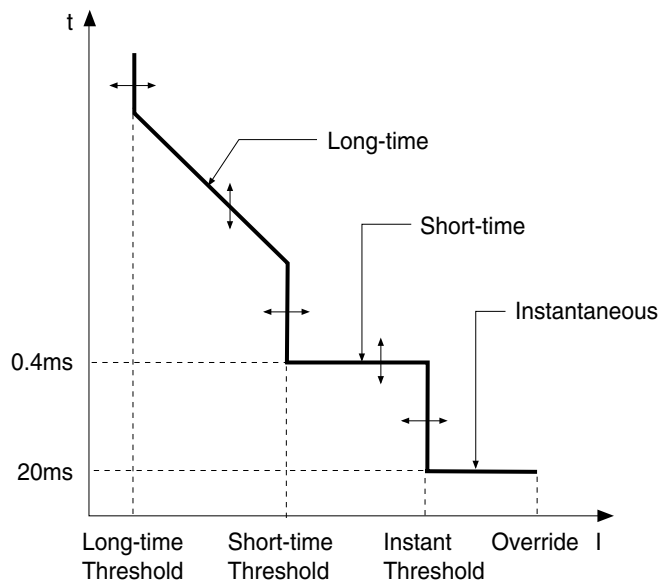
The recent development on low voltage protective device is on steady increase in quantity and high breaking capacity achievement is on the way by breakthroughs in technology to accommodate larger power supply system. Result from these process is a development of over 6000A product type and 150kA breaking capacity circuit breaker to satisfy requests from bigger power supply system. In addition, when building a power distribution system, it is critical to deliver and provide electricity to loads continuously along with maximum safe. To accomplish these principles, necessity of protective coordination using proper protective devices is being emphasized in the power system. When fault accident or overload conditions were detected by a protective device, it should disconnect quickly from the accident area, yet continue to supply electricity to unharmed circuits. It should also minimize damages on load machineries, and restore from the accident as soon as possible. In general, methods that are implemented in low voltage system for short protection coordination are 1)fully rated, 2)discrimination, and 3)cascading. It is feasible to build economical and reliable low voltage distribution protection system when these methods are properly implemented with load' s substance and nature. Before proceed with protective coordination explanations, structure of low voltage circuit breaker characteristic curve will be mentioned first. Below picture 1 illustrates typical low voltage circuit breaker' s characteristic curve.
Mainly characteristic curve can be divided into two parts.

1. Overload Protection

Classify as long time delay area. Within this section, there are thermal and electronic types for MCCB. However only the electronic type is available for ACB. And for thermal and electronic types have the same characteristics.

2. Short Protection

For electronic type case (include ACB), it is divided into short time delay and instantaneous operation area. For thermal type case, there is only instantaneous operation area. When performing protective coordination, it is guaranteeing that responsible breaker will operate according to its obligations under overload or short protection area.



Picture1. Low Voltage Circuit Breaker' s Characteristic Curve

H

2. Selectivity Techniques

There are three basic approach to build power protection system; fully rated, discrimination, and cascading (series -combination rated). Common goal of different approach is to protect system and machineries, yet installment expenses or continuity of power supply under accidents have discrepancies for each approach.

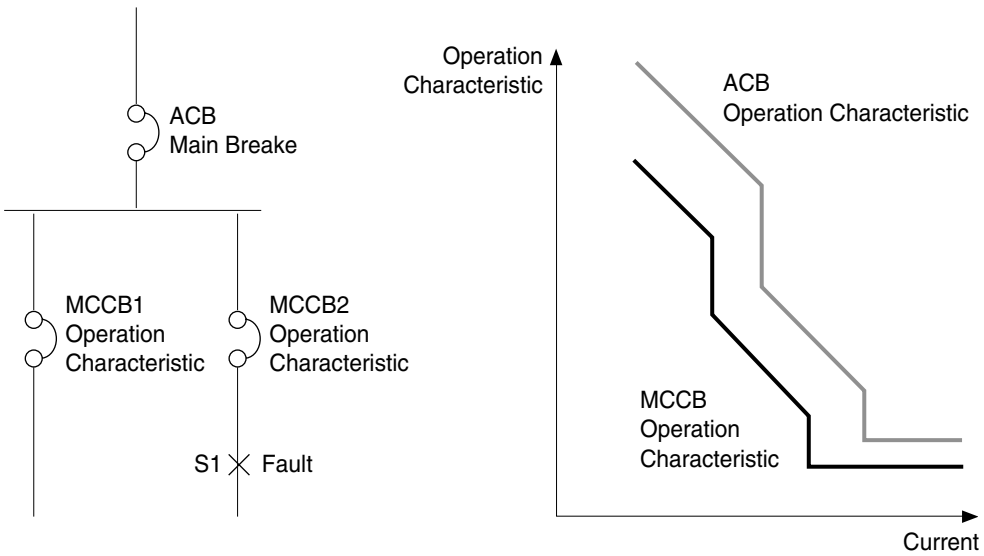
Fully Rated Protection

In fully rated system, every breaker is arranged to operate independently on its own rating. Breaker possess breaking capacity which can resolve maximum short current that can be happened near its installed spot in the power supply. This system is highly reliable, but discrimination function is limited to a few circumstances. And the drawback is expensive installment cost for branch breakers. Fully rated system is relatively inexpensive to discrimination system, however it is more expensive comparing to cascading. Every breaker should be able to handle the maximum short current that might arise in its applied area. Continuity of electricity supply is inferior to the discrimination system.

Discrimination Protection

Discrimination can be described as below picture #2. When the accident happens at S_1, only $MCCB_2$ will operate, leaving $MCCB_3$ or upstream $MCCB_1$ at rest. Discrimination is a method of protective coordination which will activate only the protective device that is directly related to the fault circuit, and leaving other normal circuits to be supplied with electricity continuously. By implementing the discrimination, this distribution system allows to minimizes areas of power failure. Thus it enhance reliability on power supply. To achieve discrimination coordination, MCCB should satisfy following conditions.

- Main breaker's trip operation launch time should be longer than branch breaker's total breaking time.
- In relation to main breaker's trip time rise, short time withstand current capacity and short time delay factor should be added to endure conducting peak current Ip and conducting energy I^2t.



Picture 2. Discrimination Coordination

By utilizing discrimination system, continuity of electricity supply can be maximized. Fully rated system require every breaker to have breaking capacity that can cover maximum fault current. However by applying discrimination system, breaker that is the closest to accident point will only be operated to disconnect the fault block from its power system.

The requirement from discrimination system is that each upstream breaker must have a short time delay trip unit. Upstream breaker should be able to withstand heat and magnetic stress without tripping while the other breaker that is close to accident point is activated to break fault current.

Using discrimination system, initial installment expense is relatively high to fully rated or cascading system. However total expense for the system can be reduced to certain level if partial discrimination is applied rather than whole discrimination. Discrimination system is the most expensive one from three of basic protecting methods. Every breaker should have fully rated and upstream breaker should contain short time delay control system, and also withstand heat and magnetic stress while downstream breaker operate its breaking function. Continuity of power supply is absolutely guaranteed.

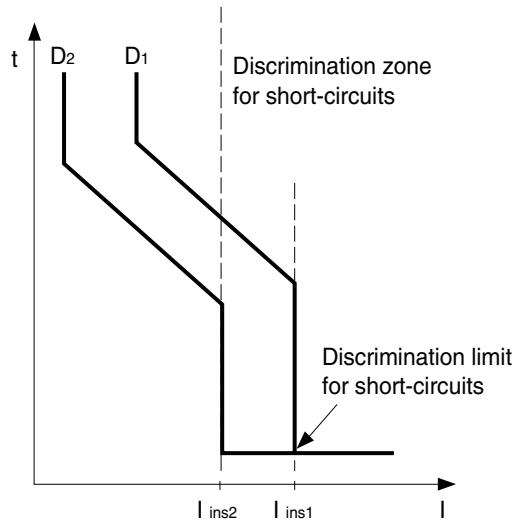
Discrimination method consists of 1)current discrimination that is based on fault current size at accident point, 2)time discrimination that is based on breaking time, 3)complete selectivity method that combines previous two discriminations, and 4)energy-based discrimination that is based on arc energy. Choosing the system out of these options varies according to initial power supply plan parameter.

1. Complete Selectivity

Upstream breaker requires more extensive trip operating time than downstream breaker for all values of the fault current, and guarantee selective discrimi nation to all fault current. In other words, to achieve complete selectivity, time-current curves of the two breaker should not cross each other. And also there should be sufficient time gap between the two curves. This time gap should provide enough time for the successive breaker to operate its breaking function correctly so that upstream breaker will not activate its trip unit.

2. Current Selectivity

Current selectivity is arranged when successive circuit-breaker's rating and instantaneous trip value are lower than its upstream breaker. Current selec tivity improves along with difference increase between two breaker's breaking ratings and instantaneous trip values. If current limiting breaker were used as a downstream breaker, selectivity can be improved further. Furthermore, current limiting breaker used at feeder level will reduce thermal, magnetic stress on a upstream breaker. Current selectivity concept is portrayed in picture 3.



Picture 3. Current Selectivity

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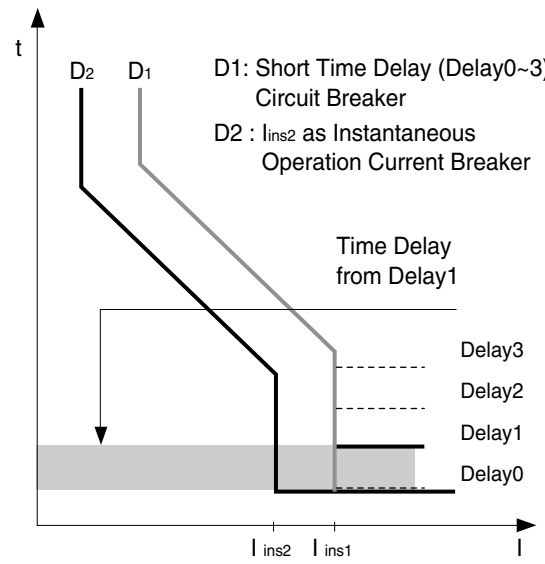
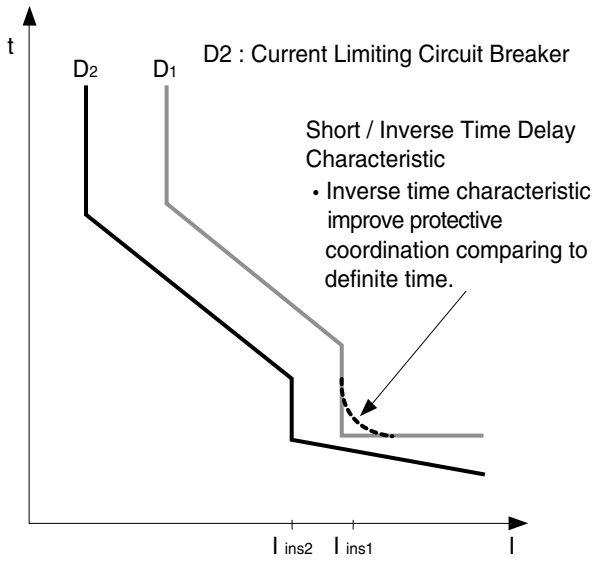
2. Selectivity Techniques

3. Time Selectivity

Time selectivity is achieved when upstream breaker has longer time delay than downstream breaker about the same accident current. The optimum arrangement of this system can be organized with upstream breaker's electronic trip unit which can perform short time delay setting. Upstream breaker should be able to perform time -delay function long enough for downstream breaker to eliminate the accident. Therefore upstream breaker can withstand thermal and magnetic stress for the duration of operation time by downstream breaker. Below picture 3, time selectivity concept is illustrated.



(a) Time Selectivity



(b) Pseudo-Time Selectivity

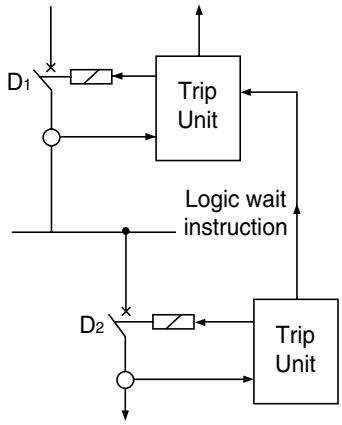
Picture 4. Time Selectivity

Picture 4(a) illustrates time discrimination in general, picture 4(b) illustrates pseudo-time discrimination that extend time discrimination by modifying its previous line from right angle to tilt between instantaneous and long time delay areas. In general, ACB is designed with pseudo-time discrimination, and MCCB is equipped with general time discrimination.

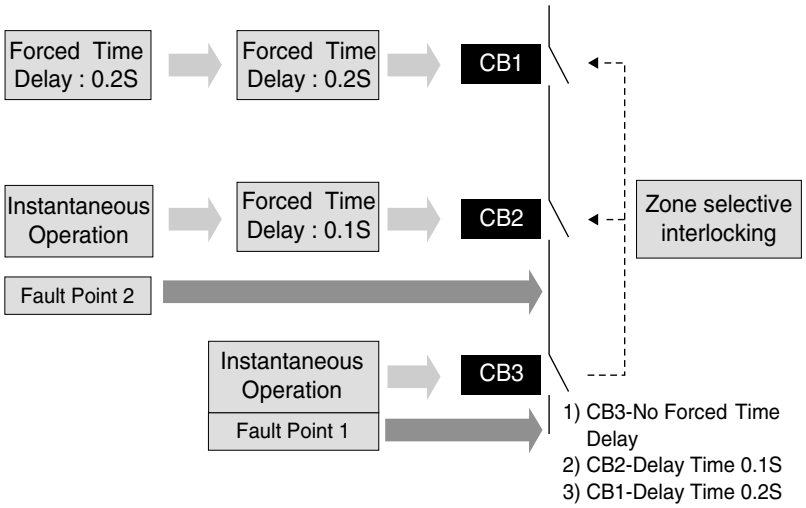
Using time discrimination to achieve selective protection between two breakers is limited to short time delay area explained in picture 1. Because most of breakers operate at similar operation speed under instantaneous area.

ZSI (Zone Selective Interlocking)

This ZSI technique allow breakers to exchange communication signals and to provide more precise discrimination at upstream trip unit level. For instance (see picture 6), ZSI technique is applied to D2 and D1, and hypothesize that both trip units detected the fault in downstream area. For this case, D2 is activated instantaneously and sends its delay signal (pre-arranged) to D1. D1 breaker operates its breaking function if the fault event is not eliminated after its delay time.



Picture 6. ZSI Operation Principle



Picture 7. ZSI Applied in Power Supply

To further explanations, another example is illustrated on picture 7 where three breakers are installed in series. Suppose each CB3, CB2, and CB1 breaker under picture 7 is predetermined its operating time as follows.
If fault occurred in downstream of CB2(fault point #2 from the picture), without ZSI technique the breaker will function after 0.1second (its original prearranged delay time) however with ZSI technique the breaker will recognize it as an accident. Because CB3 breaker can not monitor the fault current at fault point #2, and failed to send its ZSI signal to CB2. Therefore, CB2 breaker detects fault currents and from not receiving ZSI signals will perceive that this accident should be dealt at its level. For this case, CB2 operates instantaneously after sending its ZSI signals. For CB1 breaker, it operates after 0.2 seconds which is prearranged for its delay time after receiving ZSI signals.

In other words, a breaker with ZSI technique will operate under following these three cases.

1) Case 1 : Fault current was detected, however ZSI signal was not received ➞ The breaker is responsible for an instantaneous operation. If there is a breaker in upstream, send ZSI signals to the breaker, and operate instantaneously.
2) Case 2 : Fault current was detected, and received ZSI signals ➞ If there is a breaker tied with ZSI signal in upstream, send ZSI signal and operate at prearranged delay time.
3) Case 3 : Fault current was not detected. But ZSI signal was received when fault current did not reach its short time delay range. ➞ Even though there is a breaker tied with ZSI signal, it will not send ZSI signal. It operates after its prearranged delay time.

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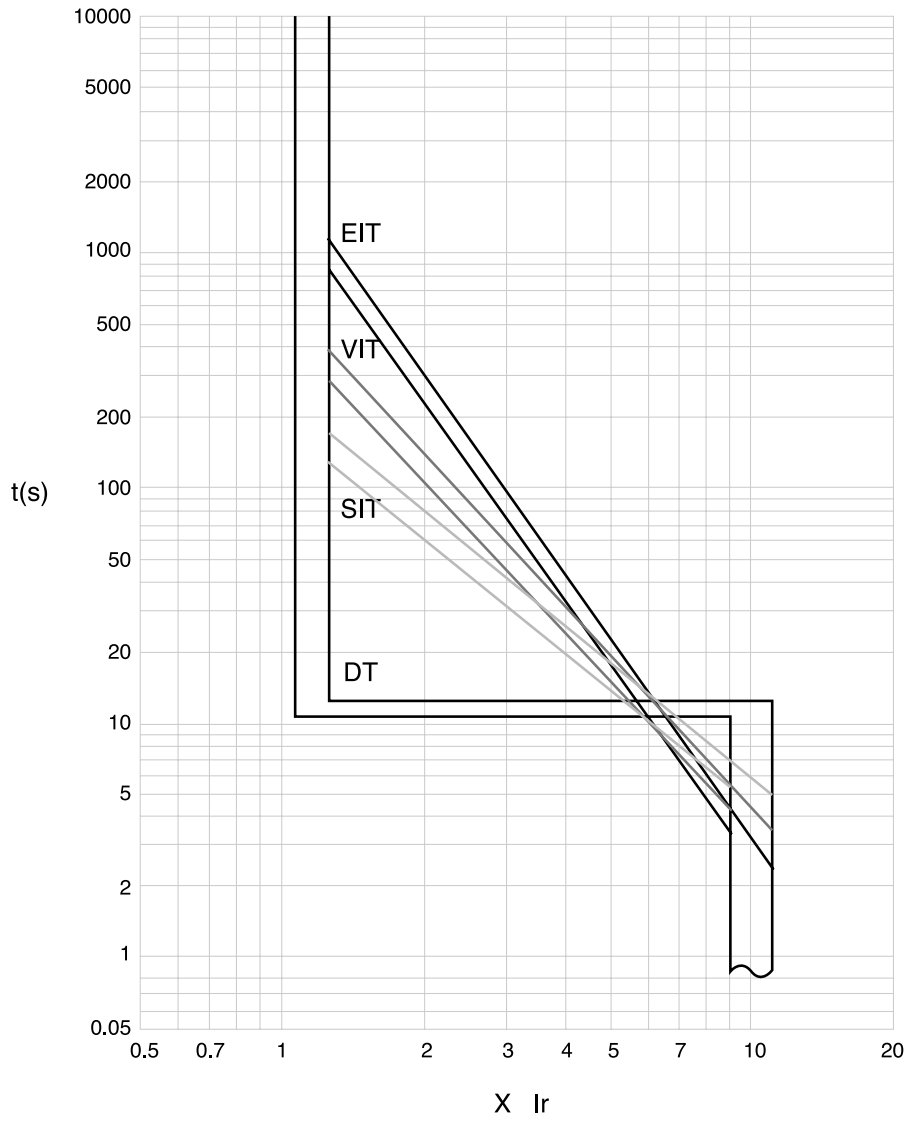
2. Selectivity Techniques

IDMTL (Inverse Definite Minimum Time Lag)

IDMTL (shown on picture 8) is a method to select a degree of slope under long time delay range.



Picture 8. Characteristics of IDMTL

IDMTL is used to improve breaker's discrimination ability under overload protecting area. Not only long time delay characteristic curve's trip threshold can be changed but also degree of slope can be adjusted during its time delay area. It is convenient to set up discrimination with high voltage protective devices (especially fuse) at steep slopes.

H

3. Discrimination Table

Main Breaker : Susol ACB / Branch Breaker : Susol MCCB

Rated Voltage : AC 220/240V

Below protective coordination table is based on ACB equipped with OCR under arrangement of short time delay trip current as 10 times of rated current.

Upstream Breaker / Branch Breaker		Product Type	Susol AH Series																							
			AH-D, W										AH-E, X											AH-G, Z		
			AH-06D			AH-08D			AH-10D	AH-13D	AH-16D	AH-20D	AH-06E		AH-08E	AH-10E	AH-13E	AH-16E	AH-20E	AH-25E	AH-32E	AH-40E	AH-40G	AH-50G	AH-63G
		Rated Current [A]	200	400	630	400	630	800	1,000	1,250	1,600	2,000	400	630	800	1,000	1,250	1,600	2,000	2,500	3,200	4,000	4,000	5,000	6,300
		Short Time Delay Trip Current (Max. 10In) Is [kA]	2	4	6.3	4	6.3	8	10	12.5	16	20	4	6.3	8	10	12.5	16	20	25	32	40	40	50	63
Model		Rated Current [A]	Ultimate Breaking Capacity Icu [kA]	85										100										150		
Susol MCCB	TD100N	100	85	-	4	9	4	9	17	29	50	T	T	4	9	17	29	50	T	T	T	T	T	T	T	T
	TD100H	100	100	-	4	9	4	9	17	29	50	85	T	4	9	17	29	50	85	T	T	T	T	T	T	T
	TD100L	100	200	-	4	9	4	9	17	29	50	85	180	4	9	17	29	50	85	180	T	T	T	T	T	T
	TD160N	160	85	-	4	9	4	9	17	29	50	T	T	4	9	17	29	50	T	T	T	T	T	T	T	T
	TD160H	160	100	-	4	9	4	9	17	29	50	85	T	4	9	17	29	50	85	T	T	T	T	T	T	T
	TD160L	160	200	-	4	9	4	9	17	29	50	85	180	4	9	17	29	50	85	180	T	T	T	T	T	T
	TS100N	100	100	-	4	7	4	7	12	20	35	60	T	4	7	12	20	35	60	T	T	T	T	T	T	T
	TS100H	100	120	-	4	7	4	7	12	20	35	60	100	4	7	12	20	35	60	100	T	T	T	T	T	T
	TS100L	100	200	-	4	7	4	7	12	20	35	60	100	4	7	12	20	35	60	100	T	T	T	T	T	T
	TS160N	160	100	-	4	7	4	7	12	20	35	60	T	4	7	12	20	35	60	T	T	T	T	T	T	T
	TS160H	160	120	-	4	7	4	7	12	20	35	60	100	4	7	12	20	35	60	100	T	T	T	T	T	T
	TS160L	160	200	-	4	7	4	7	12	20	35	60	100	4	7	12	20	35	60	100	T	T	T	T	T	T
	TS250N	250	100	-	4	7	4	7	12	20	35	60	T	4	7	12	20	35	60	T	T	T	T	T	T	T
	TS250H	250	120	-	4	7	4	7	12	20	35	60	100	4	7	12	20	35	60	100	T	T	T	T	T	T
	TS250L	250	200	-	4	7	4	7	12	20	35	60	100	4	7	12	20	35	60	100	T	T	T	T	T	T
	TS400N	400	100	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	T	T	T	T
	TS400H	400	120	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	T	T	T	T
	TS400L	400	200	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	120	120	T	T
	TS630N	630	100	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	T	T	T	T
	TS630H	500	120	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	T	T	T	T
		630		-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	T	T	T	T
	TS630L	500	200	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	120	120	T	T
		630		-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	30	50	120	120	T	T
	TS800N	700	100	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	50	50	T	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	50	50	T	T
	TS800H	700	120	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	50	50	T	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	50	50	T	T
	TS800L	700	200	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	50	50	120	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	50	50	120	T

Note) 1. On table, protective coordination is not available for areas where number is missing.
2. On table, marked number is breaking capacity limit (Unit : KA) for protective coordination.
3. On table, areas that is marked as T are capable of total discrimination up to its branch breaker's rated short breaking capacity.

H

3. Discrimination Table

Main Breaker : Susol ACB / Branch Breaker : Susol MCCB

Rated Voltage : AC 380/415V

Below protective coordination table is based on ACB equipped with OCR under arrangement of short time delay trip current as 10 times of rated current.

Upstream Breaker / Branch Breaker		Product Type	Susol AH Series																						
			AH-D, W										AH-E, X										AH-G, Z		
			AH-06D			AH-08D			AH-10D	AH-13D	AH-16D	AH-20D	AH-06E		AH-08E	AH-10E	AH-13E	AH-16E	AH-20E	AH-25E	AH-32E	AH-40E	AH-40G	AH-50G	AH-63G
		Rated Current [A]	200	400	630	400	630	800	1,000	1,250	1,600	2,000	400	630	800	1,000	1,250	1,600	2,000	2,500	3,200	4,000	4,000	5,000	6,300
		Short Time Delay Trip Current (Max. 10In) Is [kA]	2	4	6.3	4	6.3	8	10	12.5	16	20	4	6.3	8	10	12.5	16	20	25	32	40	40	50	63
Model		Rated Current [A]	Ultimate Breaking Capacity Icu [kA]	85									100										150		
Susol MCCB	TD100N	100	50	-	4	6.3	4	6.3	9	13.5	22	38	T	4	6.3	9	13.5	22	38	T	T	T	T	T	T	T
	TD100H	100	85	-	4	6.3	4	6.3	9	13.5	22	38	60	4	6.3	9	13.5	22	38	60	T	T	T	T	T	T
	TD100L	100	150	-	4	6.3	4	6.3	9	13.5	22	38	60	4	6.3	9	13.5	22	38	60	120	T	T	T	T	T
	TD160N	160	50	-	4	6.3	4	6.3	9	13.5	22	38	T	4	6.3	9	13.5	22	38	T	T	T	T	T	T	T
	TD160H	160	85	-	4	6.3	4	6.3	9	13.5	22	38	60	4	6.3	9	13.5	22	38	60	T	T	T	T	T	T
	TD160L	160	150	-	4	6.3	4	6.3	9	13.5	22	38	60	4	6.3	9	13.5	22	38	60	120	T	T	T	T	T
	TS100N	100	50	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	T	T	T	T	T	T
	TS100H	100	85	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	70	T	T	T	T	T
	TS100L	100	150	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	70	120	T	T	T	T
	TS160N	160	50	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	T	T	T	T	T	T
	TS160H	160	85	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	70	T	T	T	T	T
	TS160L	160	150	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	70	120	T	T	T	T
	TS250N	250	50	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	T	T	T	T	T	T
	TS250H	250	85	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	70	T	T	T	T	T
	TS250L	250	150	-	4	6.3	4	6.3	8	10	15	26	43	4	6.3	8	10	15	26	43	70	120	T	T	T	T
	TS400N	400	65	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	T	T	T	T
	TS400H	400	85	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	65	65	T	T
	TS400L	400	150	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	65	65	130	T
	TS630N	630	65	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	T	T	T	T
	TS630H	500	85	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	65	65	T	T
		630		-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	65	65	T	T
	TS630L	500	150	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	65	65	130	T
		630		-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	35	65	65	130	T
	TS800N	700	65	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	T	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	T	T
	TS800H	700	100	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	65	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	65	T
	TS800L	700	150	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	65	110
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	65	110

Note) 1. On table, protective coordination is not available for areas where number is missing.
2. On table, marked number is breaking capacity limit (Unit : KA) for protective coordination.
3. On table, areas that is marked as T are capable of total discrimination up to its branch breaker's rated short breaking capacity.

Main Breaker : Susol ACB / Branch Breaker : Susol MCCB

Rated Voltage : AC 480/500V

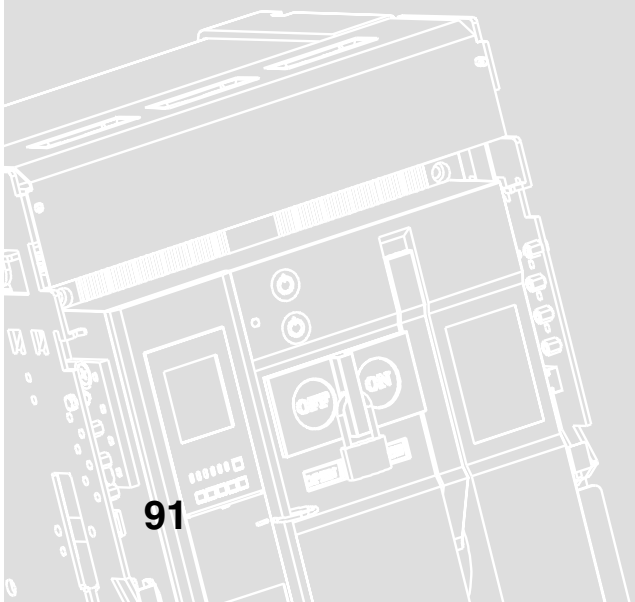
Below protective coordination table is based on ACB equipped with OCR under arrangement of short time delay trip current as 10 times of rated current.

Upstream Breaker / Branch Breaker			Product Type	Susol AH Series																						
				AH-D, W										AH-E, X										AH-G, Z		
				AH-06D			AH-08D			AH-10D	AH-13D	AH-16D	AH-20D	AH-06E		AH-08E	AH-10E	AH-13E	AH-16E	AH-20E	AH-25E	AH-32E	AH-40E	AH-40G	AH-50G	AH-63G
			Rated Current [A]	200	400	630	400	630	800	1,000	1,250	1,600	2,000	400	630	800	1,000	1,250	1,600	2,000	2,500	3,200	4,000	4,000	5,000	6,300
			Short Time Delay Trip Current (Max. 10In) Is [kA]	2	4	6.3	4	6.3	8	10	12.5	16	20	4	6.3	8	10	12.5	16	20	25	32	40	40	50	63
Model		Rated Current [A]	Ultimate Breaking Capacity Icu [kA]	85										100										150		
Susol MCCB	TD100N	100	30	-	4	6.3	4	6.3	8	10	17	T	T	4	6.3	8	10	17	T	T	T	T	T	T	T	T
	TD100H	100	50	-	4	6.3	4	6.3	8	10	17	30	T	4	6.3	8	10	17	30	T	T	T	T	T	T	T
	TD100L	100	65	-	4	6.3	4	6.3	8	10	17	30	55	4	6.3	8	10	17	30	55	T	T	T	T	T	T
	TD160N	160	30	-	4	6.3	4	6.3	8	10	17	T	T	4	6.3	8	10	17	T	T	T	T	T	T	T	T
	TD160H	160	50	-	4	6.3	4	6.3	8	10	17	30	T	4	6.3	8	10	17	30	T	T	T	T	T	T	T
	TD160L	160	65	-	4	6.3	4	6.3	8	10	17	30	55	4	6.3	8	10	17	30	55	T	T	T	T	T	T
	TS100N	100	42	-	4	6.3	4	6.3	8	10	14	25	T	4	6.3	8	10	14	25	T	T	T	T	T	T	T
	TS100H	100	65	-	4	6.3	4	6.3	8	10	14	25	42.5	4	6.3	8	10	14	25	42.5	T	T	T	T	T	T
	TS100L	100	85	-	4	6.3	4	6.3	8	10	14	25	42.5	4	6.3	8	10	14	25	42.5	70	T	T	T	T	T
	TS160N	160	42	-	4	6.3	4	6.3	8	10	14	25	T	4	6.3	8	10	14	25	T	T	T	T	T	T	T
	TS160H	160	65	-	4	6.3	4	6.3	8	10	14	25	42.5	4	6.3	8	10	14	25	42.5	T	T	T	T	T	T
	TS160L	160	85	-	4	6.3	4	6.3	8	10	14	25	42.5	4	6.3	8	10	14	25	42.5	70	T	T	T	T	T
	TS250N	250	42	-	4	6.3	4	6.3	8	10	14	25	T	4	6.3	8	10	14	25	T	T	T	T	T	T	T
	TS250H	250	65	-	4	6.3	4	6.3	8	10	14	25	42.5	4	6.3	8	10	14	25	42.5	T	T	T	T	T	T
	TS250L	250	85	-	4	6.3	4	6.3	8	10	14	25	42.5	4	6.3	8	10	14	25	42.5	70	T	T	T	T	T
	TS400N	400	42	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	T	T	T	T
	TS400H	400	65	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	52.5	52.5	T	T
	TS400L	400	85	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	52.5	52.5	T	T
	TS630N	630	42	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	T	T	T	T
	TS630H	500	65	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	52.5	52.5	T	T
		630		-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	52.5	52.5	T	T
	TS630L	500	85	-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	52.5	52.5	T	T
		630		-	-	-	-	-	8	10	12.5	16	20	-	-	8	10	12.5	16	20	25	32	52.5	52.5	T	T
	TS800N	700	42	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	T	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	T	T
	TS800H	700	85	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	55	T
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	55	T
	TS800L	700	100	-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	55	90
		800		-	-	-	-	-	-	10	12.5	16	20	-	-	-	10	12.5	16	20	25	32	40	40	55	90

Note) 1. On table, protective coordination is not available for areas where number is missing.
2. On table, marked number is breaking capacity limit (Unit : KA) for protective coordination.
3. On table, areas that is marked as T are capable of total discrimination up to its branch breaker's rated short breaking capacity.

H

I. Accessories



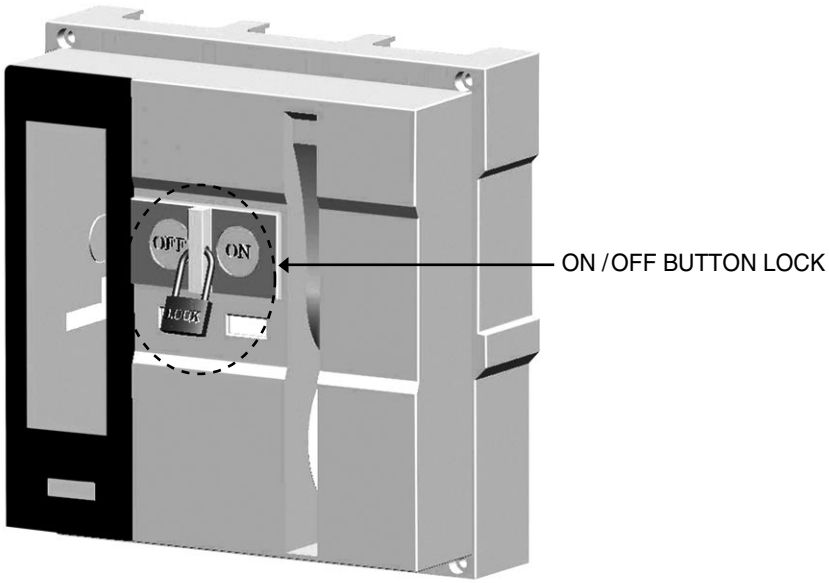
1. Main Body Mounting

ON / OFF Button Lock

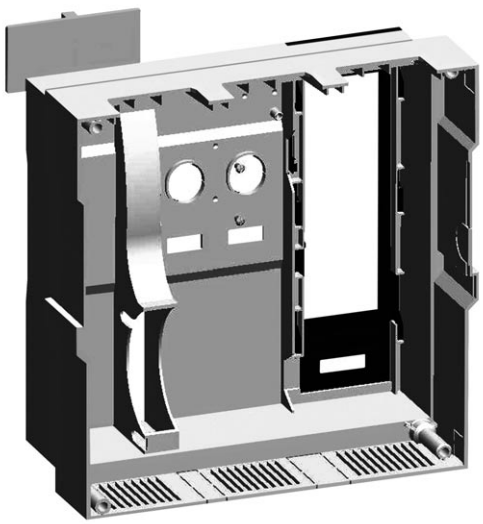
To prevent the manual operation of closing / Trip button by mistake

1. Installation Method

1) Install it to the correct place of Front cover.



2) Install ON / OFF BUTTON LOCK by using two bolt screws to pass through the holes on inside Front cover as shown in figure above.

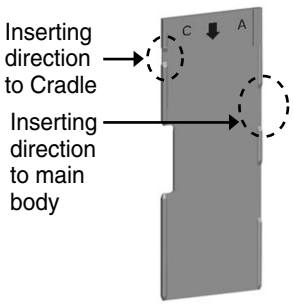


1. Main Body Mounting

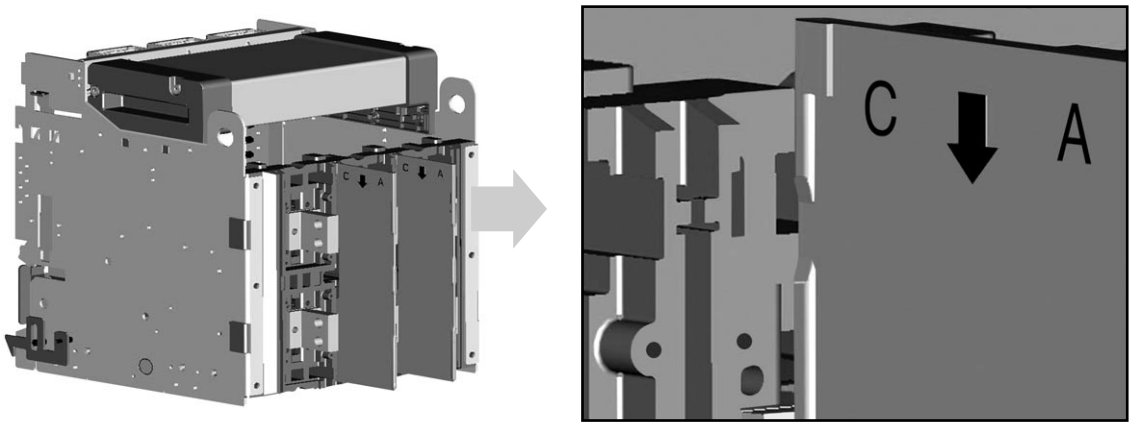
Insulating Barrier Between Poles / Phases

1. Externals

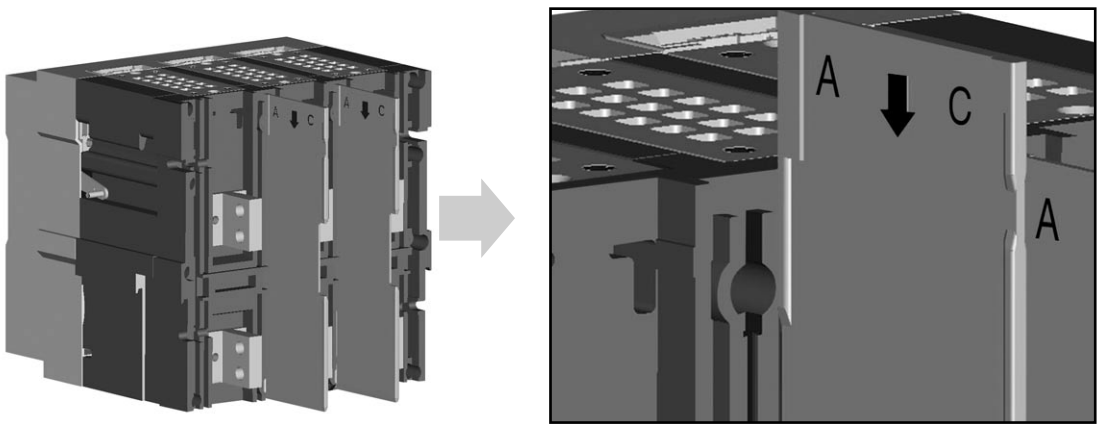
- Prevent the arc which may arise and result in short-circuit between phases in advance
- The installation methods are divided into Fixed type and Draw-out type. (∗ Common use for all types)
- As “C” stands for “CRADLE”, install the insulating barrier in the direction of “C” in case of Draw-out type.
- As “A” stands for ACB main frame, install the insulating barrier in the direction of “A” in case of Fixed type.
- The red dotted line on the figures shown below indicates the assembling parts of insulating barrier.



2. Installation Method



Draw-Out Type



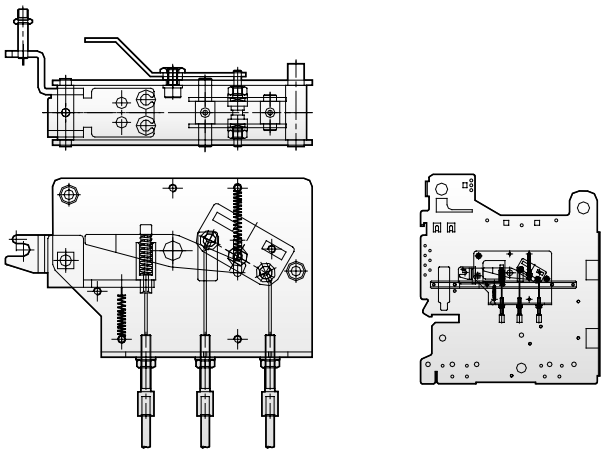
Fixed Type

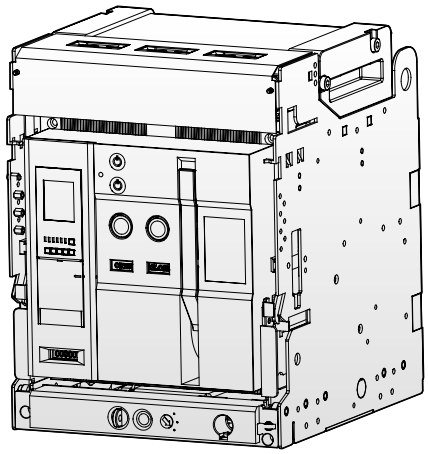
2. Cradle Mounting

Mechanical Interlock

It interlocks two or three circuit breakers mechanically by controlling closing and trip operation mutually. It is used for distribution panel or protecting device and has two types, Bar type (Interlocking of two ACBs) and Wire type (Interlocking of three ACBs)

1. Externals





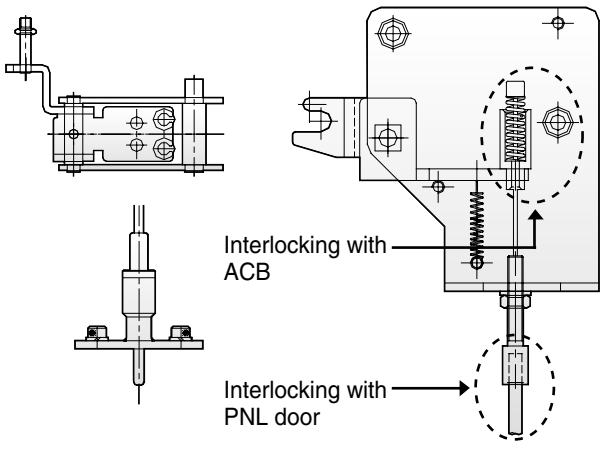
2. Installation Method

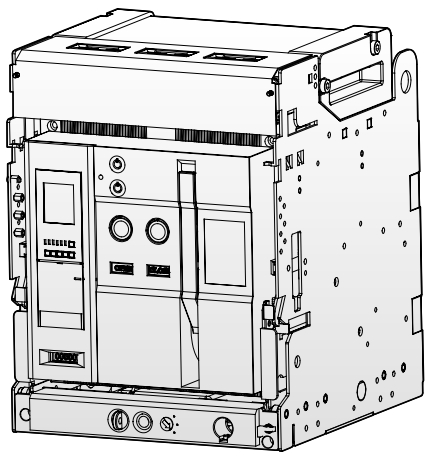
Install on the right plate of cradle by bolting.

Door Interlock : DI

It is a safety device which does not allow the panel door to open when a circuit breaker is in the “ON” position.

1. Externals





2. Installation Method

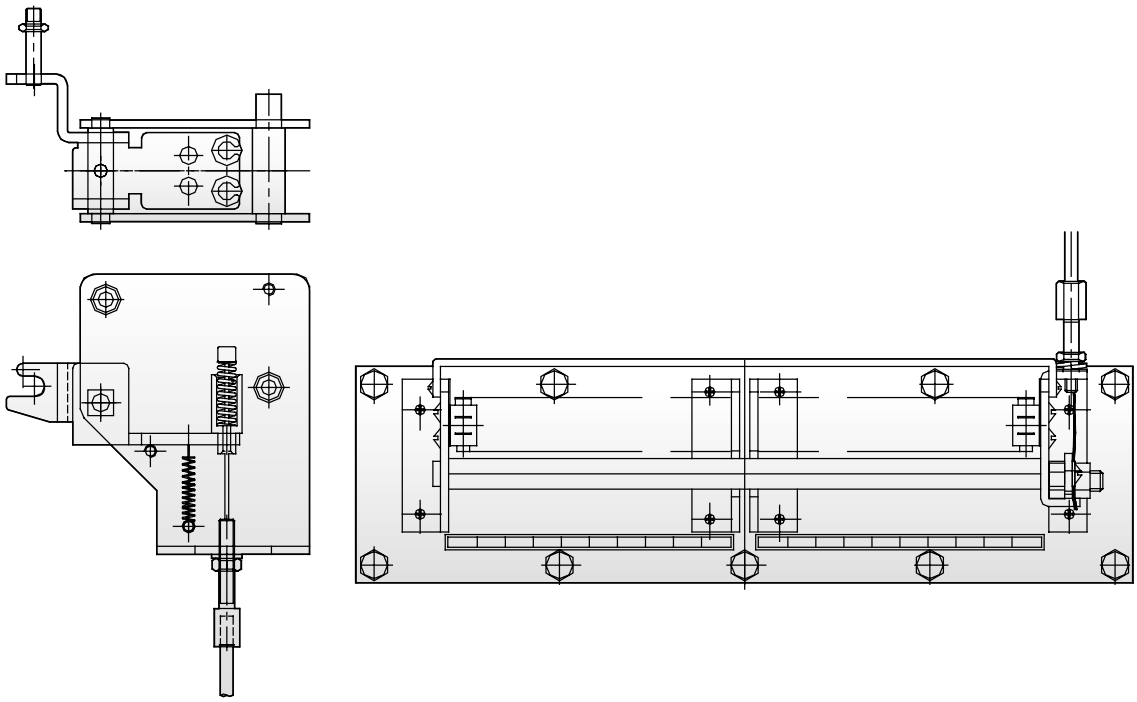
Install on the right plate of cradle by bolting and install the another one on the panel door.

2. Cradle Mounting

MOC (Mechanical Operated Cell Switch, MOC)

It is the contacts (10a10b) which indicate the ON / OFF condition of ACB by operating mechanically only when ACB is in “CONNECTED” position and two types are available, Standard type and High capacity type. The contact capacity is as same as aux. contacts listed on page of D1-26.

1. Externals



2. Installation Method

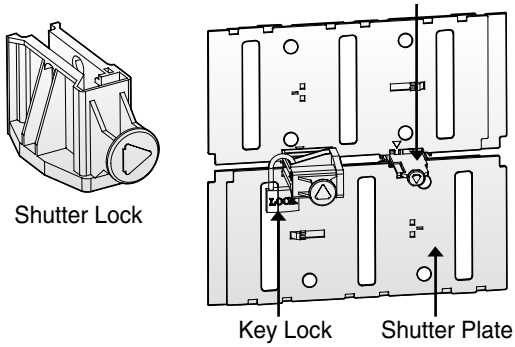
It can be assembled on the panel with relevant bolts.

Safety Shutter Lock

1. Externals

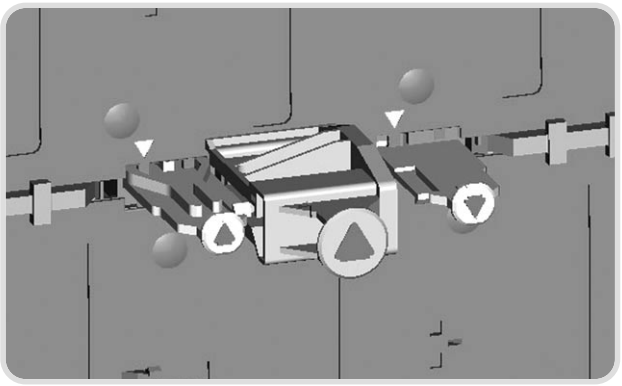
It is a locking device which prevents safety shutter from being opened when it is closed.

- As “C” stands for “CRADLE”, install the insulating barrier in the direction of “C” in case of Draw-out type.
- As “A” stands for ACB main frame, install the insulating barrier in the direction of “A” in case of Fixed type.

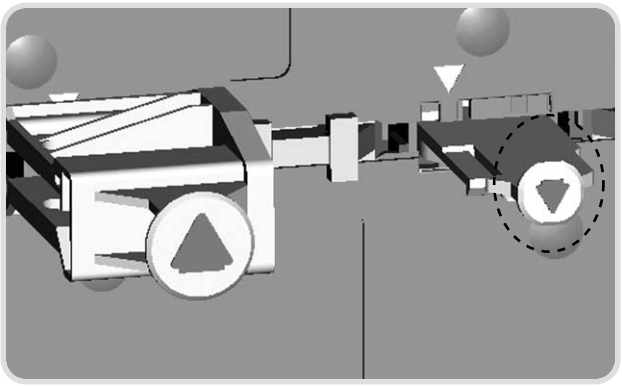


2. Installation Method

1) The figures below show the Safety shutter connected with Sutter lock. The arrow printed on Guide shutter and Shutter lock should be upwards.

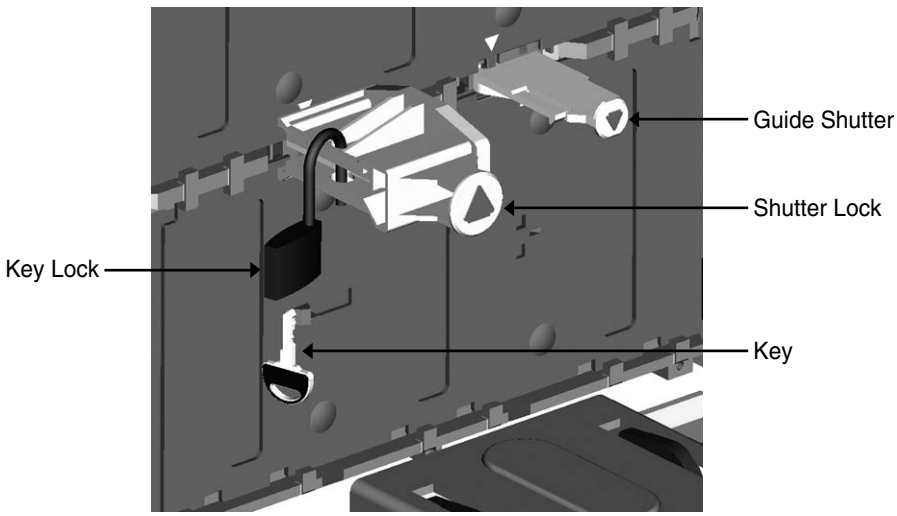


Mounting direction of Shutter lock



Guide shutter

2) Lock after setting up Key lock through Shutter lock as shown in figure to make Guide shutter not pushed. Apply same installation method to opposite side.



I

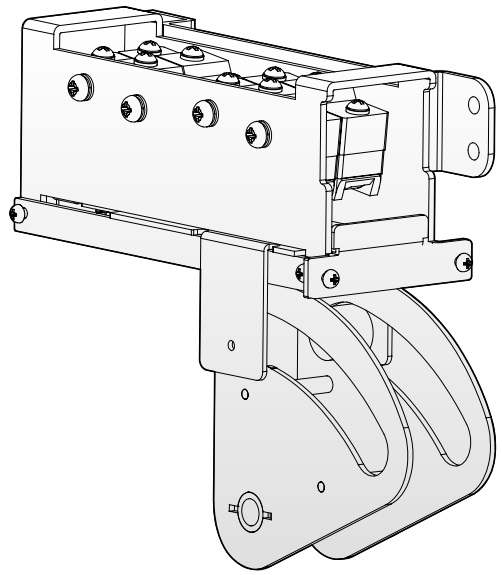
2. Cradle Mounting

Cell Switch, C

It is a conctat which indicates the present position of ACB (CONNECTED, TEST, DISCONNECTED)
(∗ Common use for all types)

- Contact configuration
  4C : 1 Disconnected 1 Test 2 Connected
  8C : 2 Disconnected 2 Test 4 Connected (4CX2EA)
  ※ Contact configuration can be changeable if necessary.

1. Externals

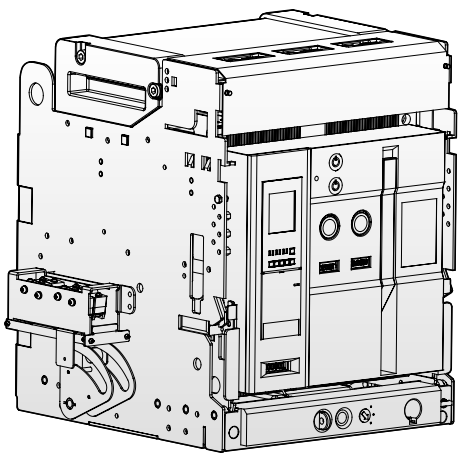


2. Operating Characteristics

ACB Position			DISCONNECTED		CONNECTED
Draw-in and Draw-out Position			DISCONNECTED	TEST	CONNECTED
Contact Operation	CL-C (CONNECTED)		OFF		ON
	CL-T (TEST)		OFF	ON	
	CL-D (DISCONNECTED)		ON	OFF	
Contact Capacity	Voltage(V)		Resistive load		Inductive load
	AC	460	5		2.5
		250	10		10
		125			
	DC	250	3		1.5
		125	10		6
		30	10		10
Contact Number			4C		

3. Installation Method

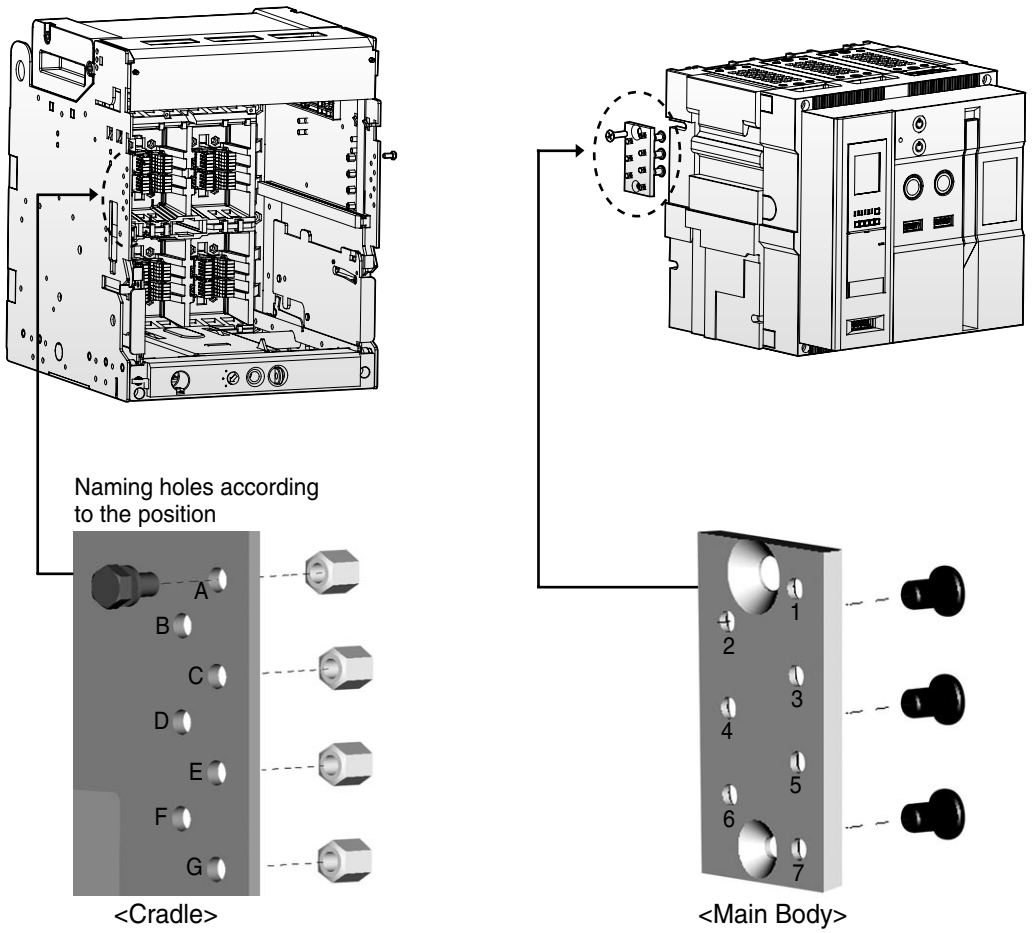
Install Cell switch on the right plate as shown in figure as it interlocks with Main shaft on cradle.



Miss Insertion Prevent Device (MIP)

- If the ratings of ACB does not match with cradle, it mechanically prevents ACB from being inserted into cradle of ACB.
- Classification upon ratings

1. Externals and Operating Characteristics



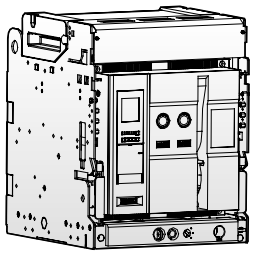
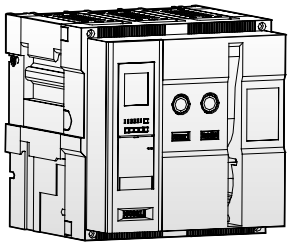
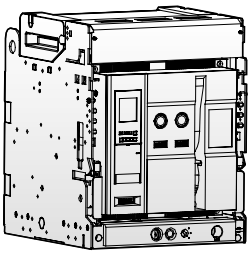
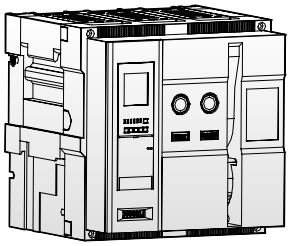
<Cradle> <Main Body>

2. Installation Method

- Install MIP on the left plate of cradle by bolting as shown in figure.
- Install MIP which is mounted to main frame on the rear base of left side by tightening two bolts.

2. Cradle Mounting

3. The List of Combination

			
Cradle	**Main Body**	**Cradle**	**Main Body**
ABCD	567	BCDE	167
ABCE	467	BCDF	157
ABCF	457	BCDG	147
ABCG	456	BCEF	146
ABDE	367	BCEG	137
ABDF	357	BDEF	136
ABDG	356	BDEG	135
ABEF	347	BDFG	134
ABEG	346	CEDF	127
ABFG	345	CEDG	126
ACDE	267	CEFG	124
ACDF	257	DEFG	123
ACDG	256		
ACEF	247		
ACEG	246		
ACFG	245		
ADEF	237		
ADEG	236		
ADFG	235		
AEFG	234		

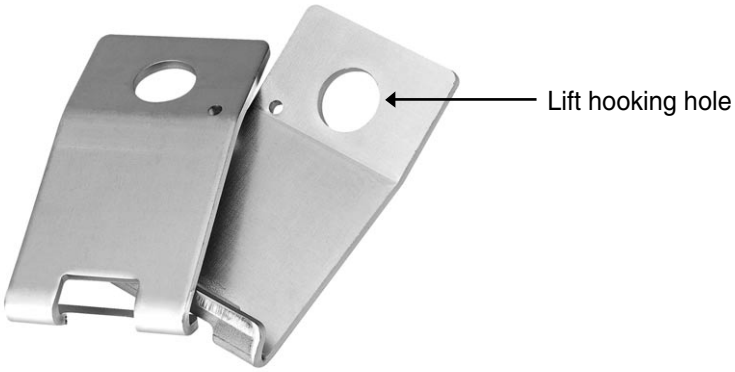
I

3. External Mounting

Lift Hooking

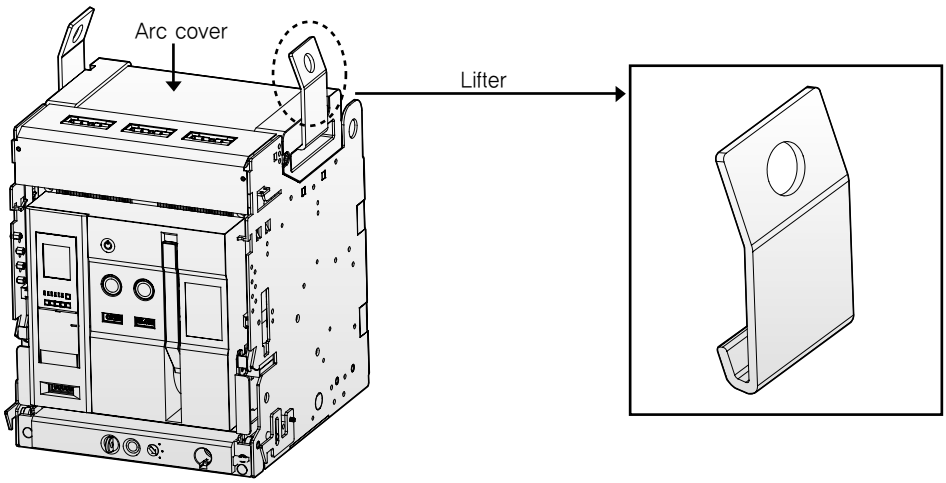
It is a device for easy transport of ACB.

1. Externals



2. Installation Method

Hook Lifter to the both sides of Arc cover and insert the Lift hooking through holes of Lifter to lift up ACB.



ATS Controller with ACBs

The mechanical interlock has two types, Bar Type, Wire Type and ATS Controller is required additionally to achieve the function of electrical interlock. In order to consist of ATS with ACBs, Motor charging closing mode, Voltage trip coil, Closing coil, Aux. contact, charge complete contact are needed basically.

1. The Ratings of ATS Controller

The operating voltage of ATS Controller and a circuit breaker should be corresponding together as the operating voltage of ATS Controller operates the motor of a circuit breaker.

3. External Mounting

Model Type	ATSC-110	ATSC-110-C	ATSC-220	ATSC-220-C
Rated Voltage	AC110V		AC220V	
Possible Voltage Range	AC 93.5(±5%) ~ 126.5V(±5%)		AC 187(±5%) ~ 235V(±5%)	
Frequency	50Hz / 60Hz			
Power Consumption (apparent power)	15.4W			
4-Location Switch (Stop, N, R, Auto)	■	■	■	■
Test Function	■	■	■	■
Generator Control Function	■	■	■	■
NRS Function	■	■	■	■
N Power Source Setting (phase-to-phase)	■	■	■	■
Time Setting(t1~t6)	■	■	■	■
Fault Function (OCR/Circuit Breaker Trouble)	■	■	■	■
Output Contact (Auto, Load Burden)	■	■	■	■
Communication Function (RS-485)	■	■	■	■

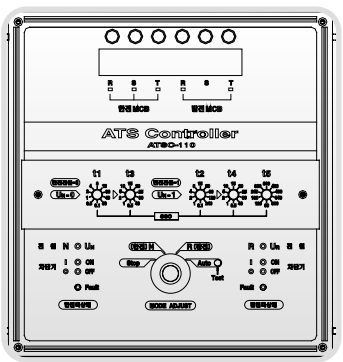
T1 : The delayed time from when UN (power supply of electric company) is tripped to when Generator start-up signal contact is closed.
(t1 : 0.1, 0.5, 1, 2, 4, 8, 15, 30, 40, 50secs)

T2 : The delayed time from when UN is closed to when ACB2 is tripped.
(t2 : 0.1, 1, 2, 4, 8, 15, 30, 60, 120, 240secs)

T3 : The delayed time from when ACB1 is tripped to when ACB2 is closed.
(t3 : 0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40secs)

T4 : The delayed time from when ACB2 is tripped to when ACB1 is closed.
(t4 : 0.5, 1, 2, 5, 10, 15, 20, 25, 30, 40secs)

T5 : The delayed time when ACB1 is closed to when Generator start-up Signal contact is opened. (t5 : 60, 120, 180, 240, 300, 360, 420, 480, 540, 600secs)



Stop-mode : This mode is for compulsory trip of ACB1(electric power company) or ACB2 (power station) when UN (power supply of electric power company) or UR (power supply of power station) is available
* UN or UR should be kept in ON position

N-mode : This mode is for compulsory closing of ACB1 when UN is available.
* It does not matter to ON or OFF position of UR and if converting to N-mode while using UR, Generator Start-up signal contact is opened.

R-mode : This mode is for compulsory closing of ACB2 during the use of UR in case UN is available or not.

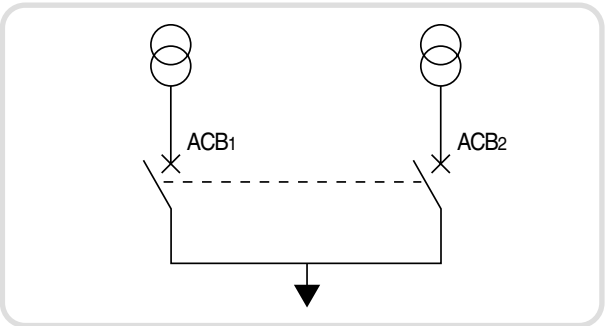
Auto-mode : This mode is for transferring a circuit breaker automatically to available power supply of UN or UR. In short, it trips the circuit breaker where power supply is not available and it close the circuit breaker where power supply is available.

2. In Case of 2 ACBs with ATS Controller

If one of ACB is closed, another is not closed mechanically or electrically due to interlocking system.

Operating Status

ACB_1	ACB_2
OFF	OFF
ON	OFF
OFF	ON

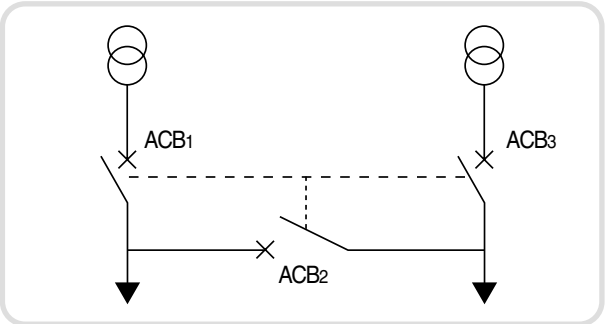


3. In Case of 3 ACBs with ATS Controller

If two ACBs among three of them are closed, the other is not closed mechanically or electrically due to interlocking system.

Operating Status

ACB_1	ACB_2	ACB_3
OFF	OFF	OFF
ON	OFF	OFF
ON	ON	OFF
OFF	ON	ON
OFF	OFF	ON
ON	OFF	ON



4. BAR Type

ACB_1	**ACB_2**	**ACB_3**
2000AF	2000AF	2000AF
4000AF	4000AF	4000AF
3Pole	3Pole	3Pole
4Pole	4Pole	4Pole

5. WIRE Type

Interlocking is available regardless of Ampere Frame and number of poles. The standard length of wire is 2m.

3. External Mounting

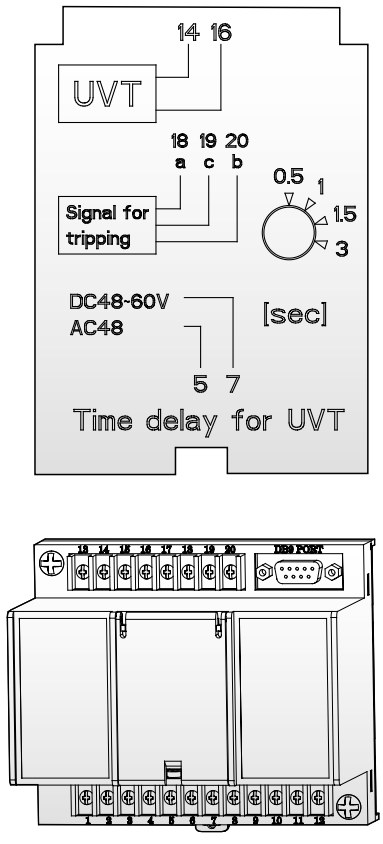
UVT Time Delay Controller

It is a device which makes ACB tripped automatically to prevent the accident on load side due to under voltage or power breakdown. There are two types, Instantaneous type and time delay type.

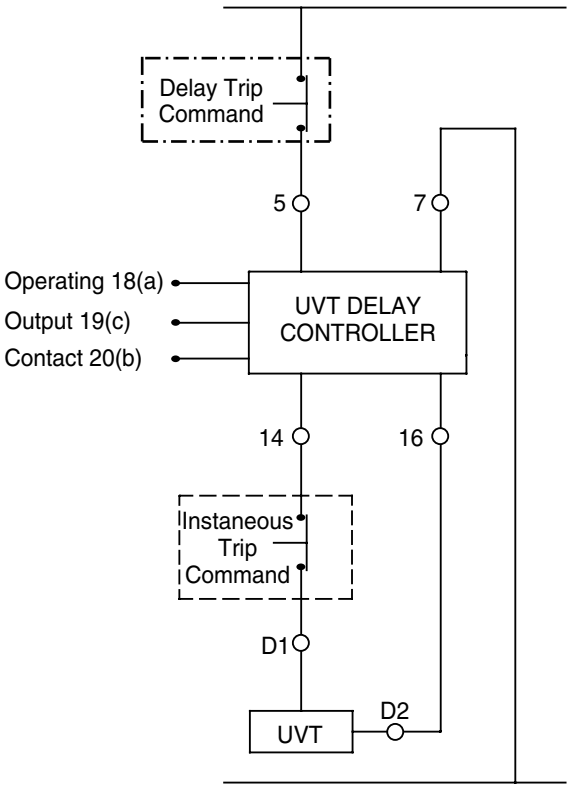
Rated Voltage[Vn]		Operating Voltage Range[V]		Power Consumption[VA or W]		Trip Time [S]
DC[V]	AC[V]	Pick-up	Drop-out	Inrush	Steady-state	
48~60	48	0.65 ~ 0.85 Vn	0.4 ~ 0.65 Vn	200	5	0.5, 1, 1.5, 3
100~130	100~130					
200~250	200~250					
-	380~480					

Note) Operating voltage range is the min. rated standard for each rated voltage (Vh).

1. Externals

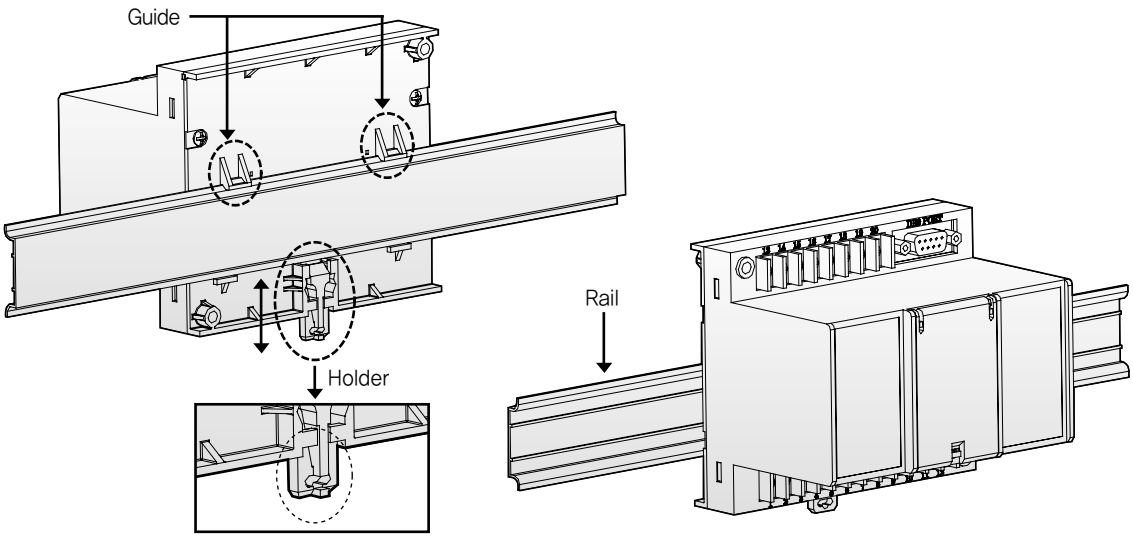


2. Wring Diagram

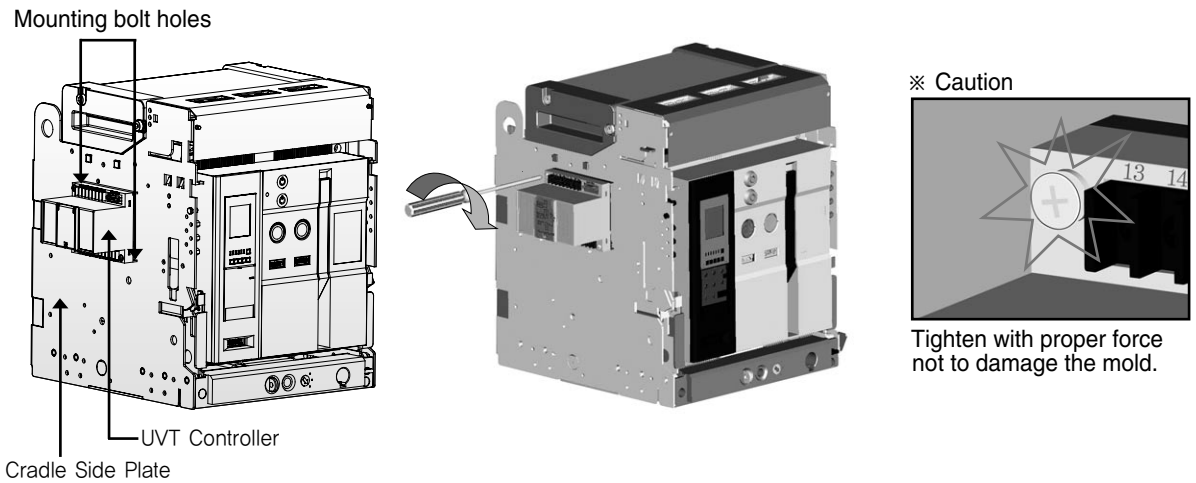


2. Installation Method

1) Tighten one screw for upper left side and another for lower right side of UVT Controller.



2) Tighten bolt through hole on LEFT PLATE of Cradle.

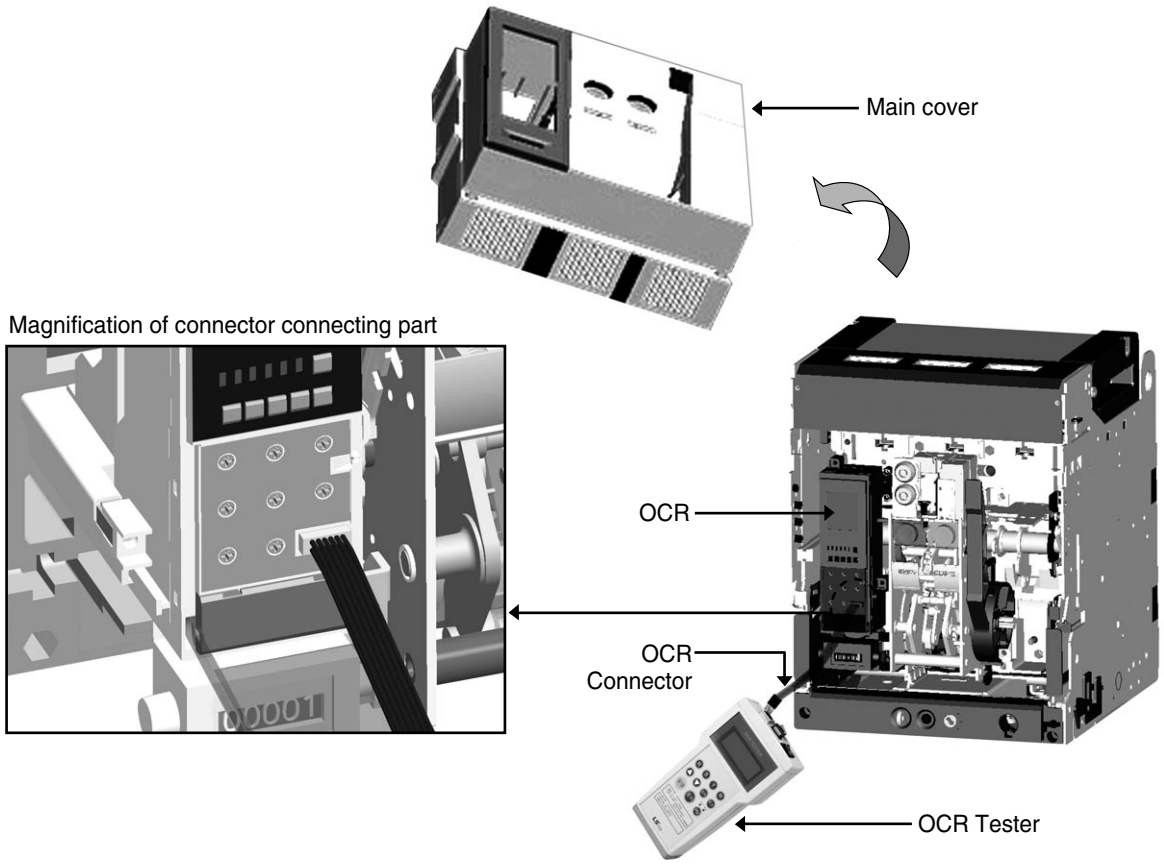


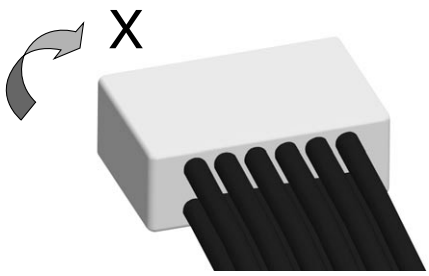
3. External Mounting

OCR Tester

It is an exclusive testing device which can test the function of OCR.

- Portable Test Kit
- Full-function Test kit →Able to check the operating time of long / short time delay setting and phase current.



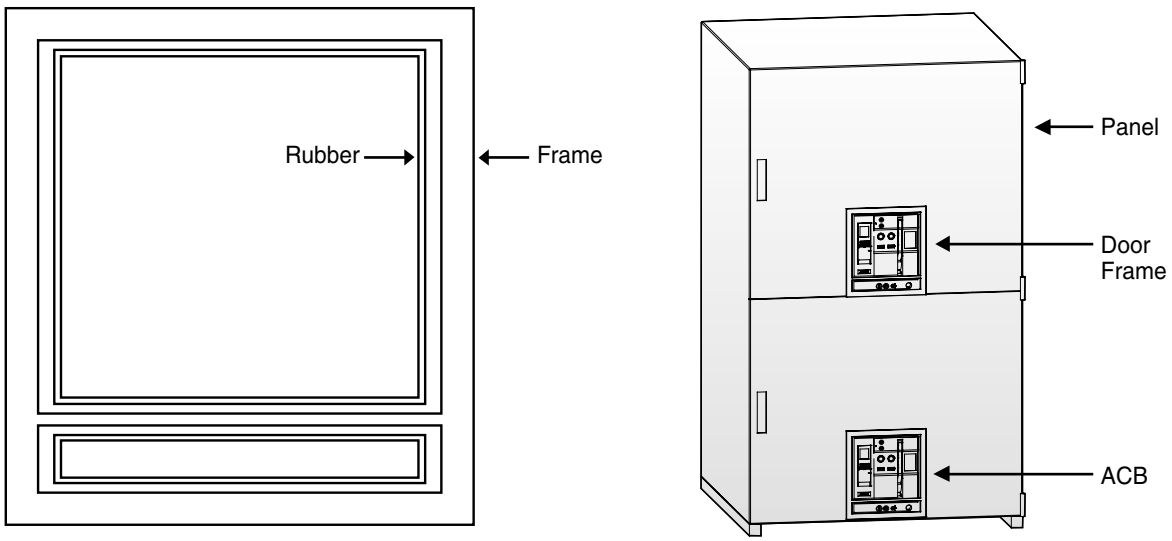


※ Caution
Connector should be connected with the correct direction specified.

Door Frame

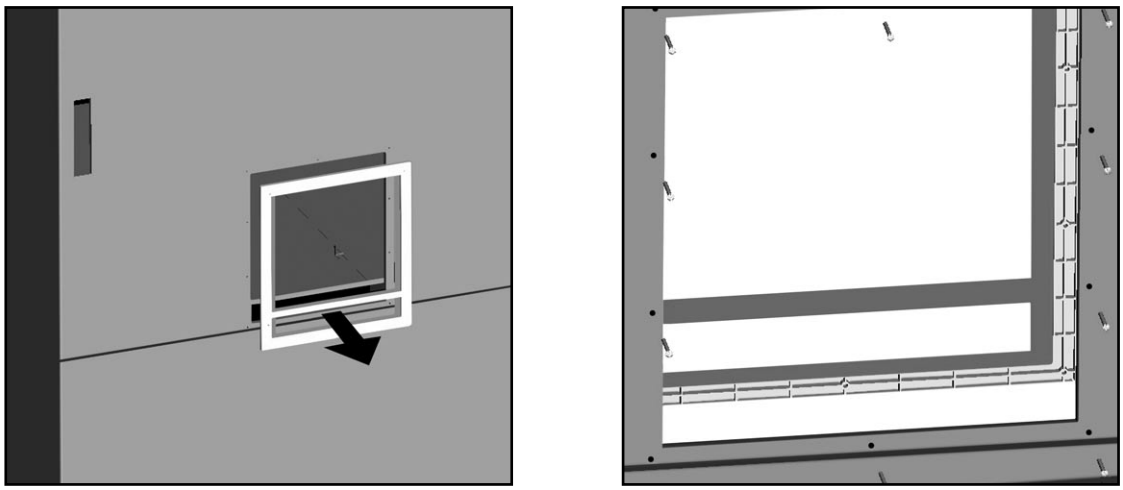
It is used as an external guide when structuring the protrude type of panel and it improves the appearance of ACB by attaching it to the panel door.

1. Externals



2. Installation Method

Insert Door frame to the panel cut-out on panel door and tighten it with 10pcs of M5 bolts.



3. External Mounting

Dust Cover

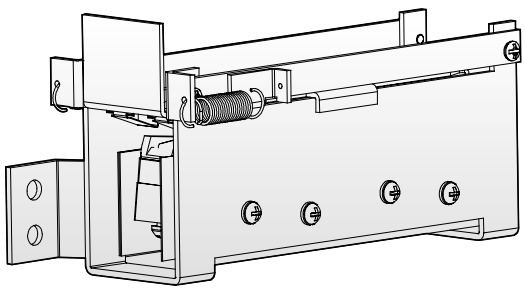
1. Externals

- Attach it to Door frame
- It protects the product against the dust (IP5X) which may cause faulty operation and mounted to protrude type of panel.
- It is transparency to show users the front side of ACB and Cover can be closed even if ACB is drawn out to TEST position.

Shorting b-Contact

1. Externals

- It is the contact which keeps the external control circuit in normal condition by Aux. contact which disconnects "shorting b-contact" when ACB is moved from CONNECTED position to TEST position. The number of "shorting b-contact" corresponds to the number of "Axb" (4b).



2. Contact Condition (Link between Axb and Shorting "b" Contact)

ACB Location \ ACB Condition		CLOSE	OPEN
Shorting b Contact	CONNECTED location	OFF	OFF
	TEST location	ON	ON
Auxiliary Contact (Axb)	CONNECTED location	OFF	ON
	TEST location	OFF	ON

Condenser Trip Device (CTD)

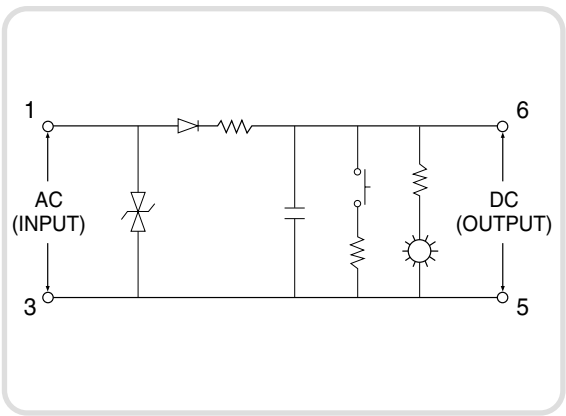
1. Externals and Ratings

• It gets a circuit breaker tripped electrically within regular time when control power supply is broken down and is used with Shunt coil, SHT.
In case there is no DC power, It can be used as the rectifier which supplies DC power to a circuit breaker by rectifying AC power.

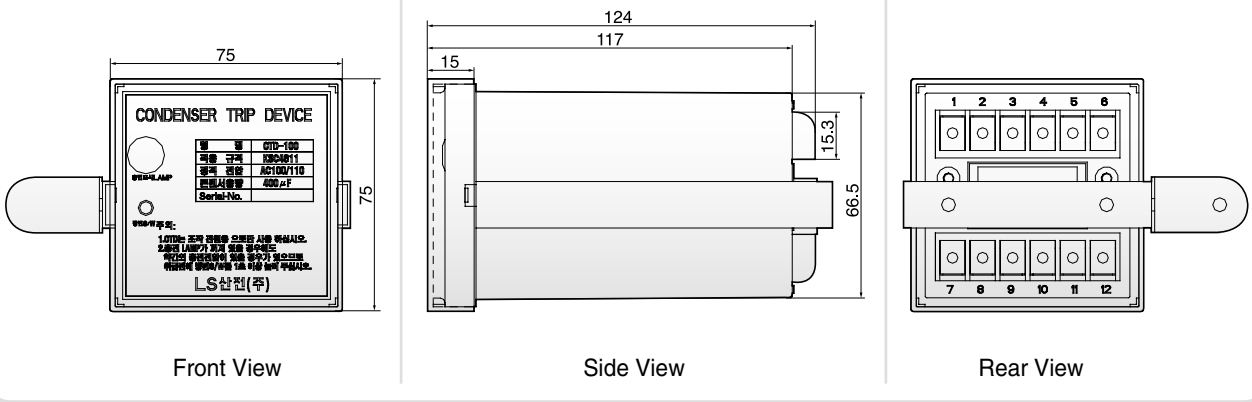
2. Ratings

Ratings	Specification	
Type name	CTD-100	CTD-200
Rated input voltage (V)	AC 100/110	AC 200/220
Frequency (Hz)	50/60	50/60
Rated charge voltage (V)	140/145	280/310
Charging time	Within 5S	Within 5S
Trip possible time	Over 3 MIN	Over 2 MIN
Range of Input voltage (%)	85~110	85~111
Condenser capacity	400μF	160μF

3. Circuit Diagram



4. External Dimension



Front View | Side View | Rear View

I

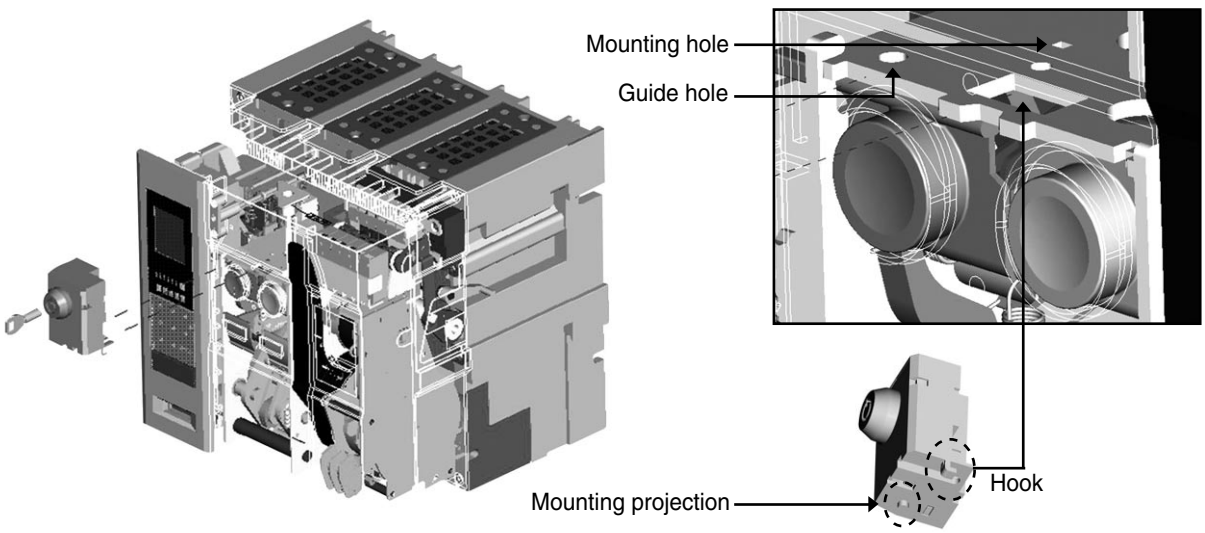
4. Optional Accessories

Key Lock : K1

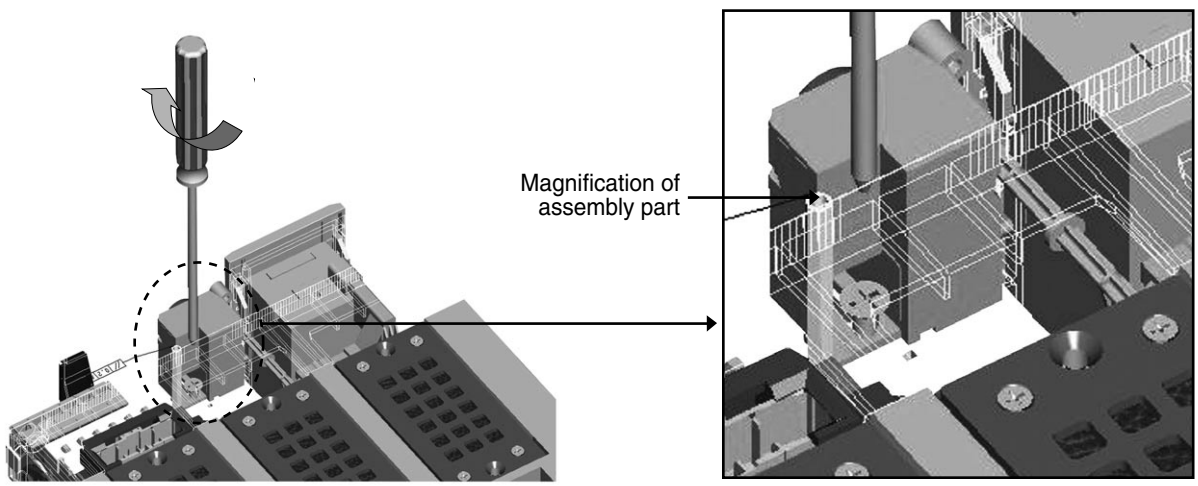
- It is locking device which prevents a certain circuit breaker from being operated by user's discretion when two or more circuit breakers are used at the same time.
- K1: Preventing mechanical closing

1. Installation Method

1) Mount Key lock to the upper plate of mechanism by using the mounting projection and hook placed on the bottom of Key lock as shown in fig. below.

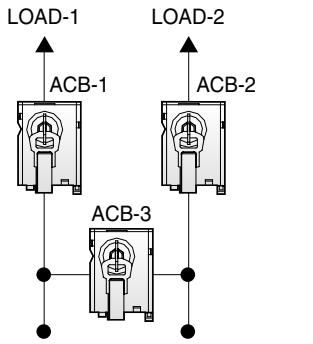


2) Finish the installation by tightening the corresponding screws.



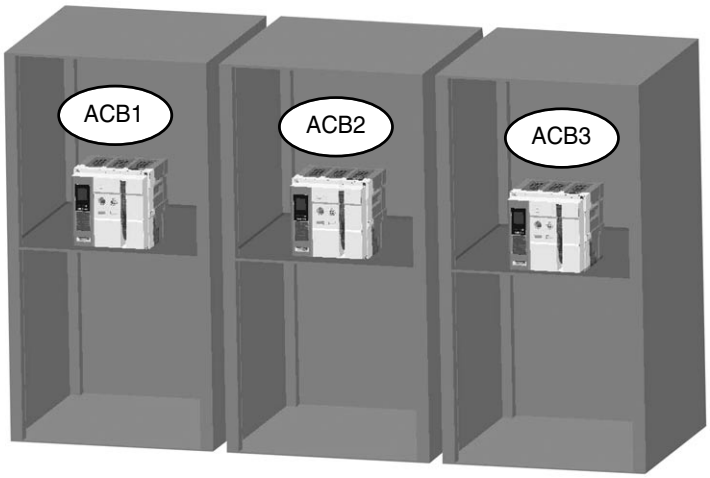
Key Interlock : K2

• 3 circuit breakers can be arranged for the continuous power supply to the load side and be interlocked mutually by using Key Lock embedded in each circuit breaker.



○ RELEASE
● LOCK

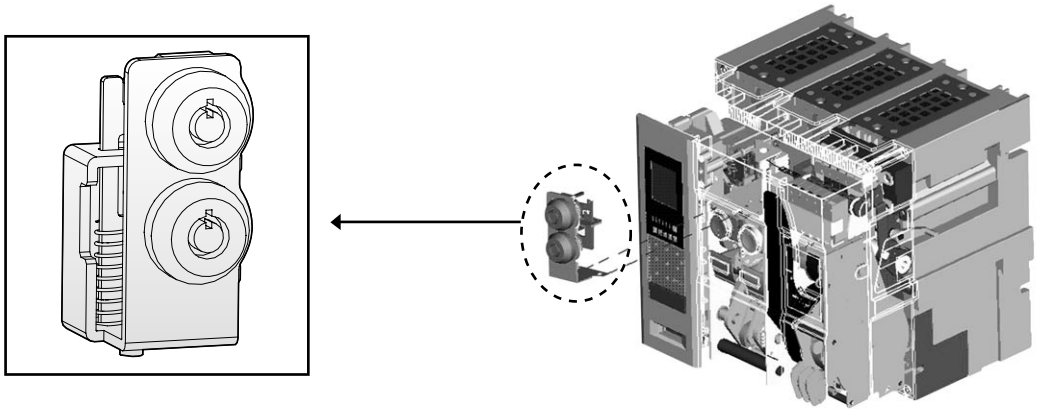
ACB-1	ACB-2	ACB-3	Status
●	●	●	LOAD 1, 2-OFF
●	○	○	LOAD 1-OFF / LOAD 2-ON
○	●	●	LOAD 1-ON / LOAD 2-OFF
○	○	●	LOAD 1, 2-ON
●	●	○	LOAD 1, 2-OFF
●	○	●	LOAD 1-OFF / LOAD 2-ON
○	●	●	LOAD 1-ON / LOAD 2-OFF



In case of extended ACB compartment

Key Interlock Double

• Only when two Key Interlocks are released at the same time, circuit breakers operate.
Installation method is same as K1.

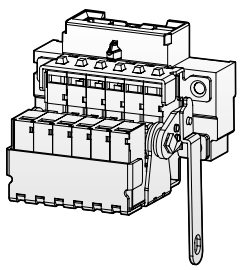
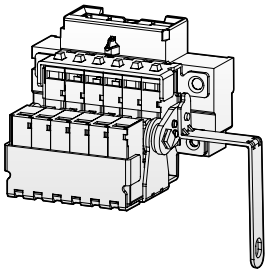
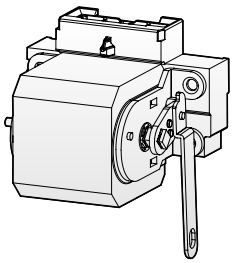
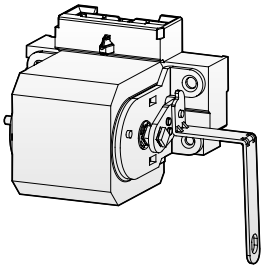


4. Optional Accessories

Auxiliary contact (AX)

It is to monitor ON/OFF position of ACB from remote place.

1. Standard Classification

Low Capacity		High Capacity	
2000, 5000AF	4000, 6300AF	2000, 5000AF	4000, 6300AF
			

■ **Ratings**

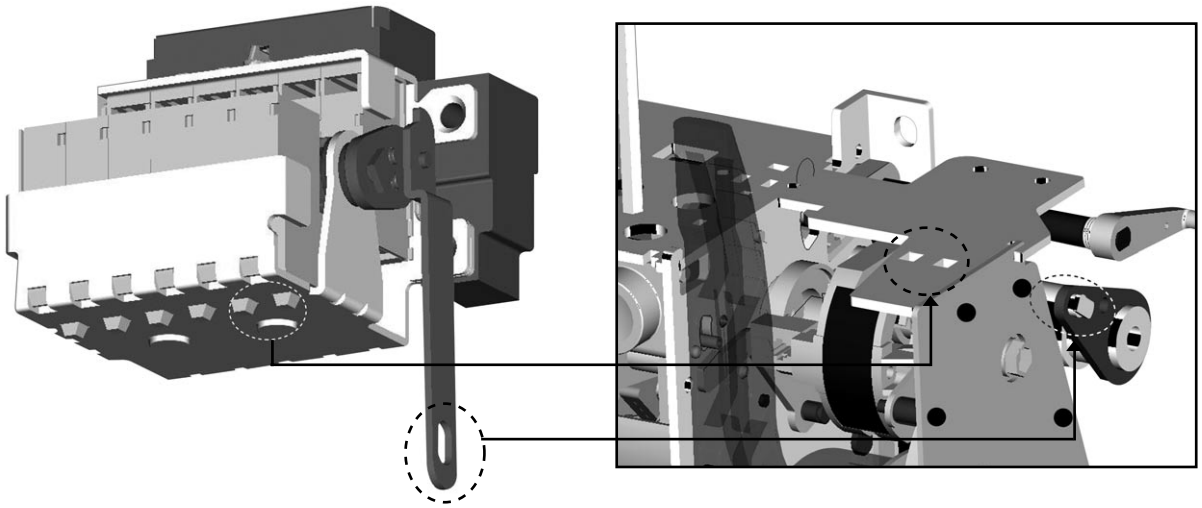
Classification			Standard		High Capacity		Remark
			Resistive Load	Inductive Load	Resistive Load	Inductive Load	
Contact Capacity	AC	490V	5A	6A	5A	2.5A	
		250V	10A	6A	10A	10A	
		125V	10A	6A	10A	10A	
	DC	250V	0.3A	0.3A	3A	1.5A	
		125V	0.6A	0.6A	10A	6A	
		30V	10A	6A	10A	10A	
No. of Contact that can be used		AX	3a3b		-		Standard Charging Type
		BX	5a5b		-		
		HX	-		5a5b		
		AC	3a3b		-		Rapid Auto-reclosing Charging Type
		BC	5a5b		-		
		CC	6a6b		-		
		HC	-		5a5b		
		JC	-		6a6b		
Supply Method			Standard		Option		

■ **Contact Operation**

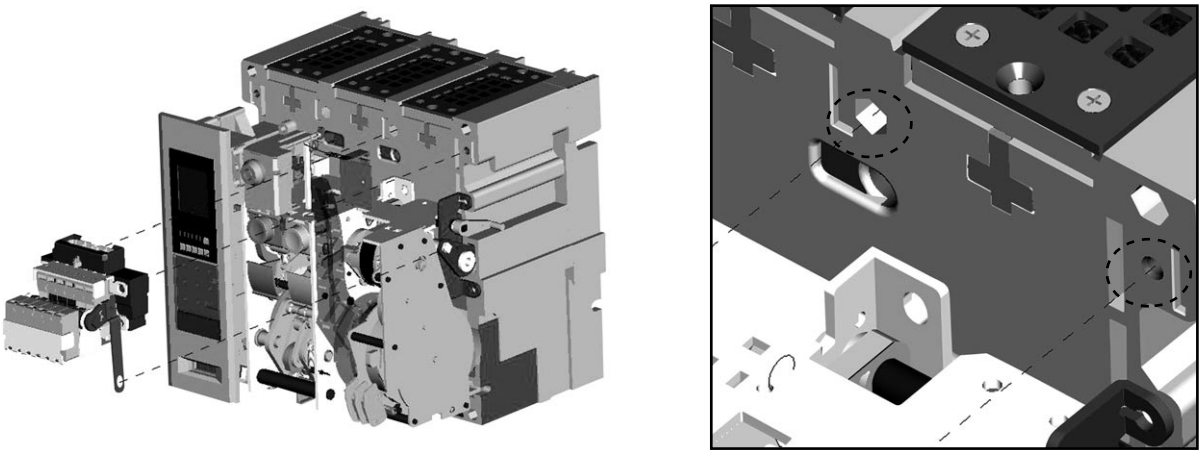
AUX.Contact & Charging Types							
AX	AC	BX	BC	HX	HC	CC	JC
Low Capacity OFF Charge 3a3b	Low Capacity ON Charge 3a3b	Low Capacity OFF Charge 5a5b	Low Capacity ON Charge 5a5b	High Capacity OFF Charge 5a5b	High Capacity ON Charge 5a5b	Low Capacity ON Charge 6a6b	High Capacity ON Charge 6a6b

2. Installation Method

1) Put the projections on the bottom of aux. switch into the holes on UPPER PLATE of mechanism and then assemble Main shaft link and Aux. switch link.



2) Install ON/OFF BUTTON LOCK to the holes of Front base by tightening 2 bolts as shown in figure below.



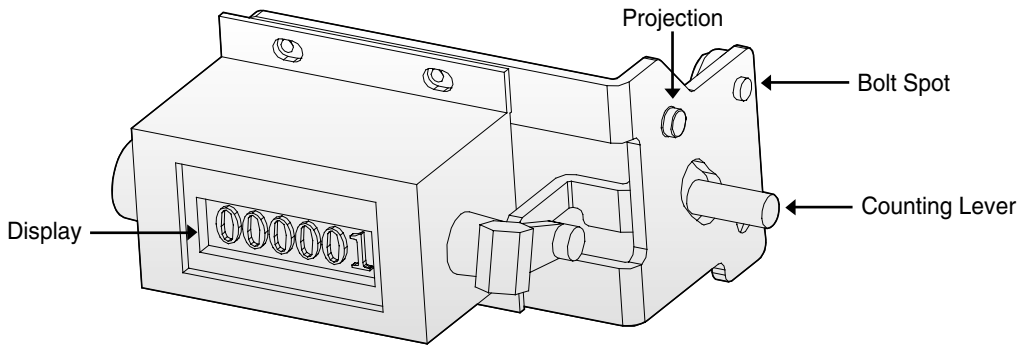
3) Installation method is same for low/high capacity of Aux. contact.

4. Optional Accessories

Counter

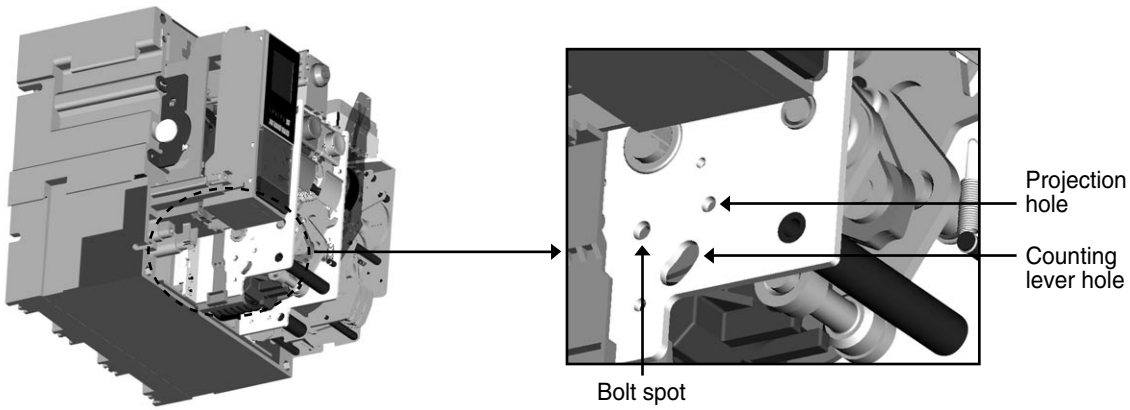
• It displays the total number of ON/OFF operation of ACB.

1. Externals

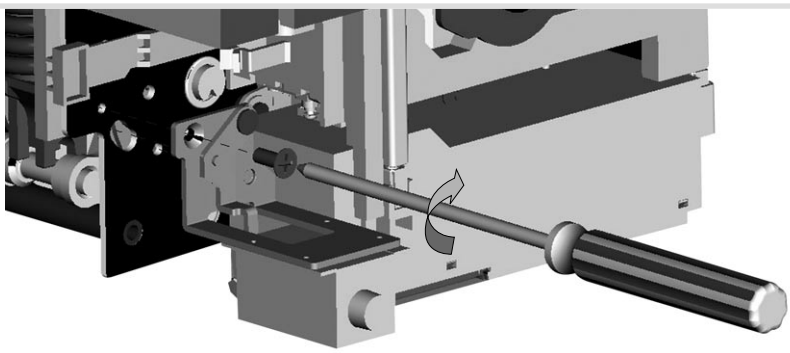


2. Installation Method

1) Operate Charge Handle two times up/downward. → For easy assembly



2) Insert the projections of counter to the bottom part of SIDE PLATE of mechanism and put counting lever into counting lever hole.

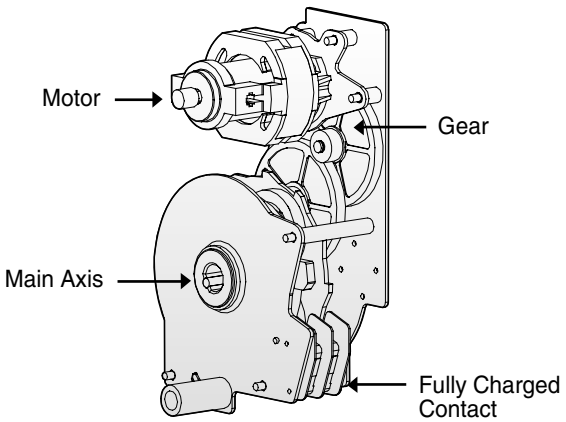


3) Tighten the screw.

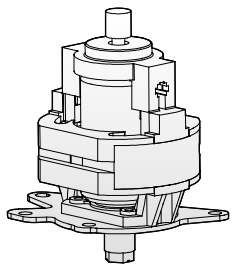
Charging Motor

1. Externals

- Charge the closing spring of a circuit breaker by the external power source. Operating voltage range is in the range of 85%~110% Vn (IEC 60947).
- **Common use for all types**

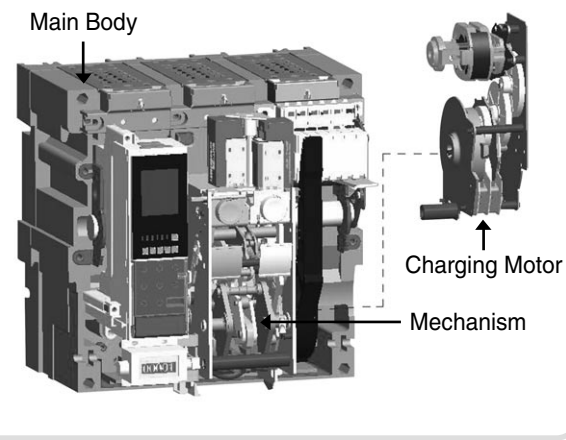


2. The Classification of Motor

Motor	Input voltage(Vn)	DC24/30V	DC48/60V	AC/DC100/130V	AC/DC200/250V	AC380V	AC440/480V
	Load current (max.)	5A	3A	1A	0.5A	0.3A	0.3A
	Starting current (max.)	5 times of load current					
	Load (rpm)	15000 ~ 19000 rpm					
	Charging Time (sec.)	Time $\leq$ 5 sec					
	Dielectric strength	2kV/min					
	Using temperature range	-20˚ ~ 60˚					
	Using humidity range	Max. RH 80% (No dew condensation)					
	Endurance	15,000 cycle (Load connection, 2 times/min, Operating time : 5 sec per a operation)					
	Fully Charged Contact	10A at 250VAC					

3. Installation Method

1) Connect the manual handle axis of mechanism in main body with the main axis of charging motor.



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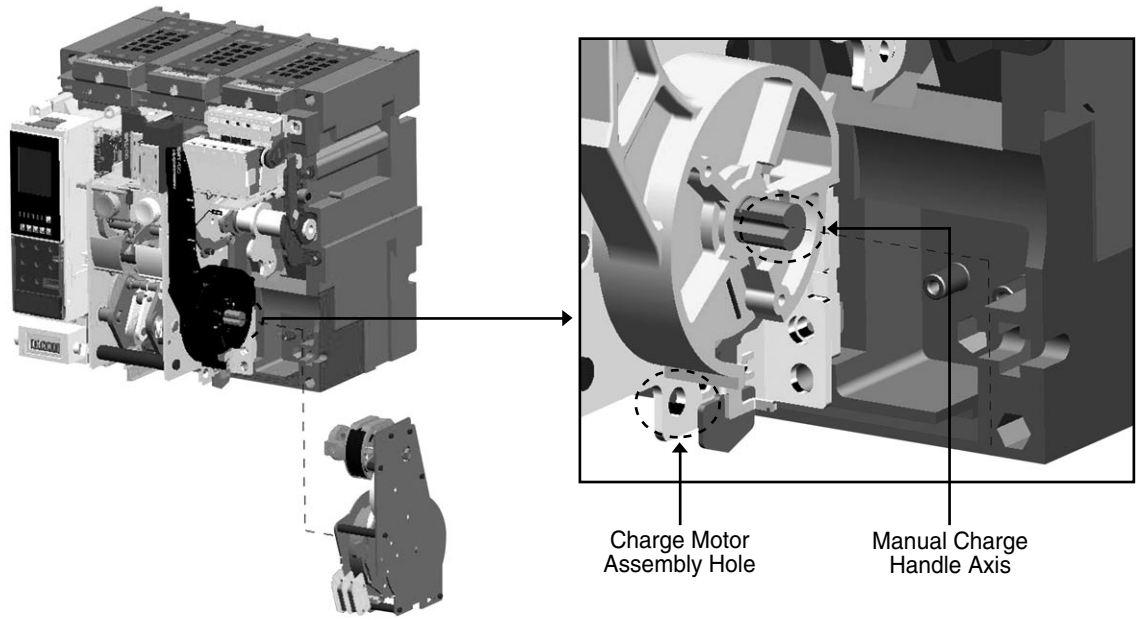
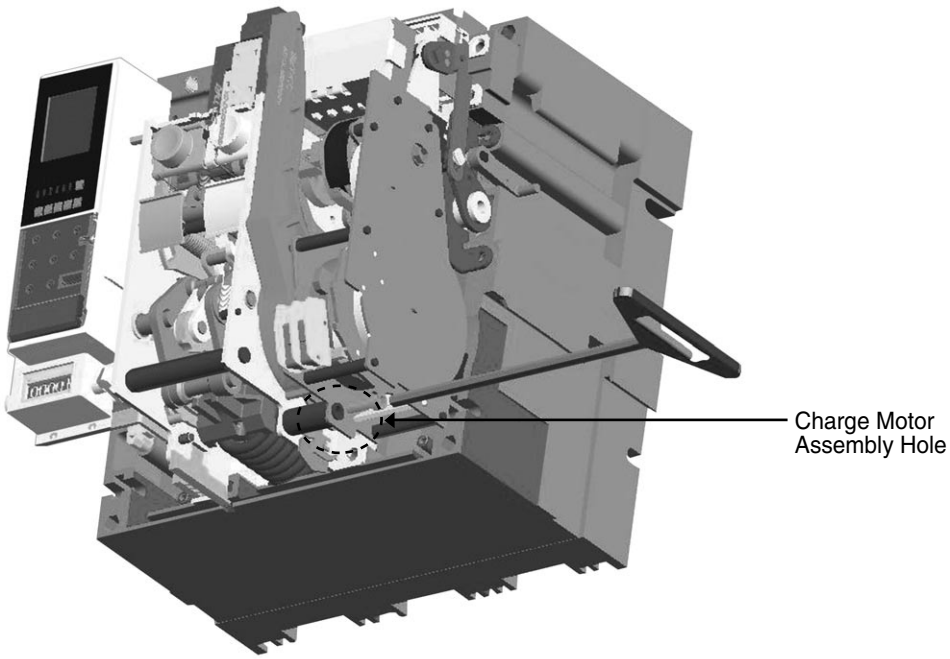
4. Optional Accessories

2) Connect manual charge handle axis of mechanism in main body and main axis of charge motor.



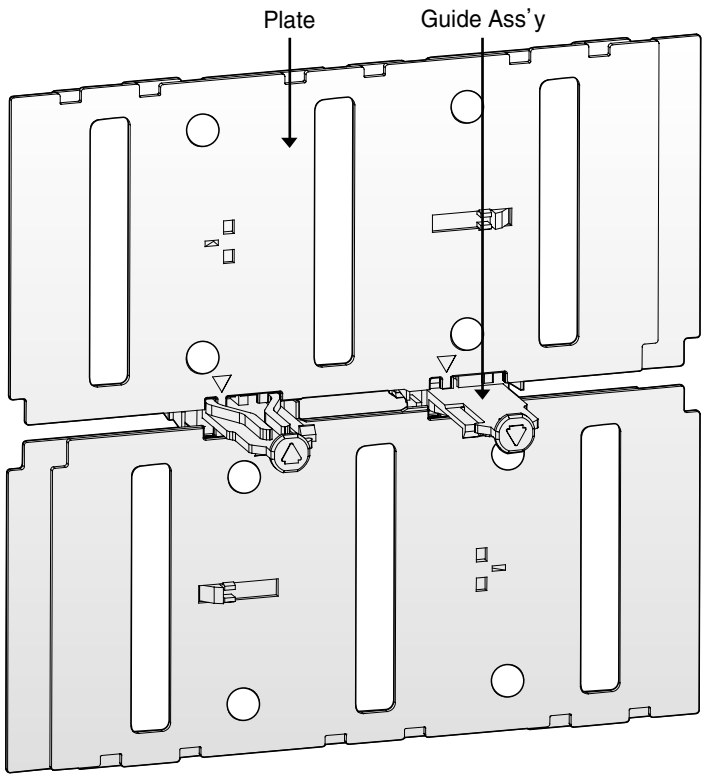
3) Tighten with M6 bolt after fitting the bottom of charge motor into the bottom of mechanism.



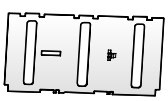
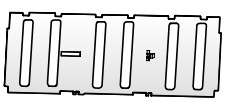
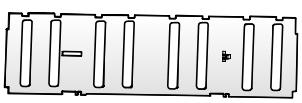
Safety Shutter

1. Externals

- It is the automatic safety device which prevents the connectors of main circuit from being contacted with outside when drawing out ACB and Shutter is only opened during draw-in operation.



- There are 4 types of Safety Shutter and they are divided as shown in figure below.

The Types of Safety Shutter Plate			
2000, 5000AF/3P	**2000, 5000AF/4P**	**4000, 6300AF/3P**	**4000, 6300AF/4P**
			
Installation Numbers : 4ea(2000, 4000AF) / 8ea(5000,6300AF)			

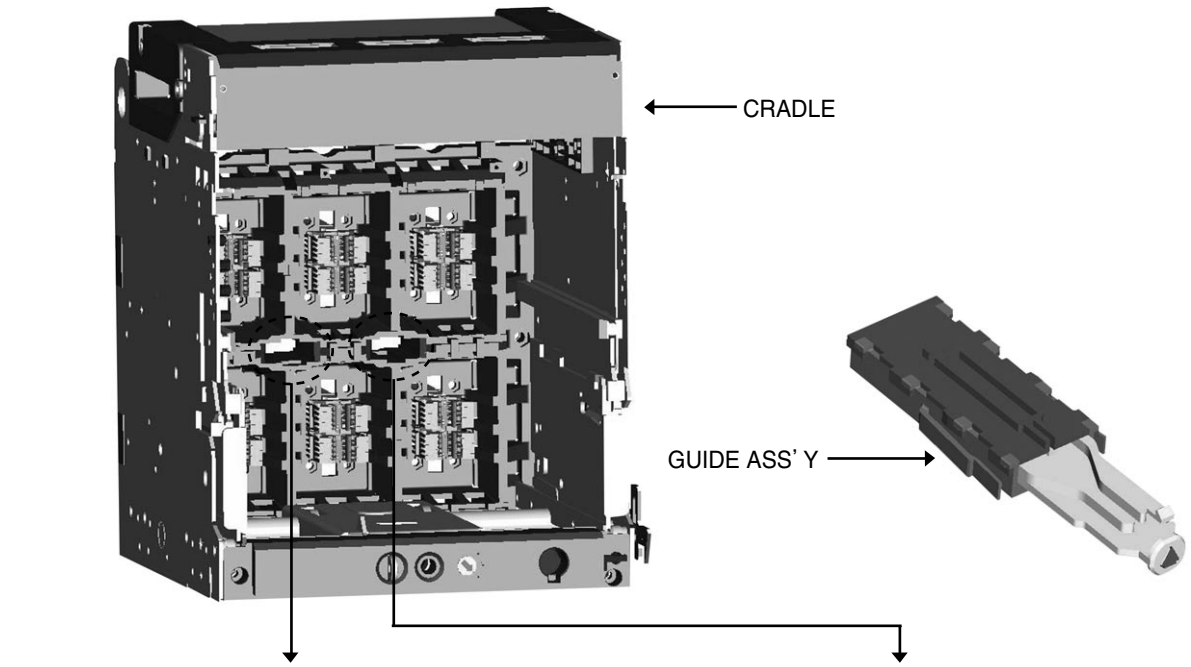
4. Optional Accessories

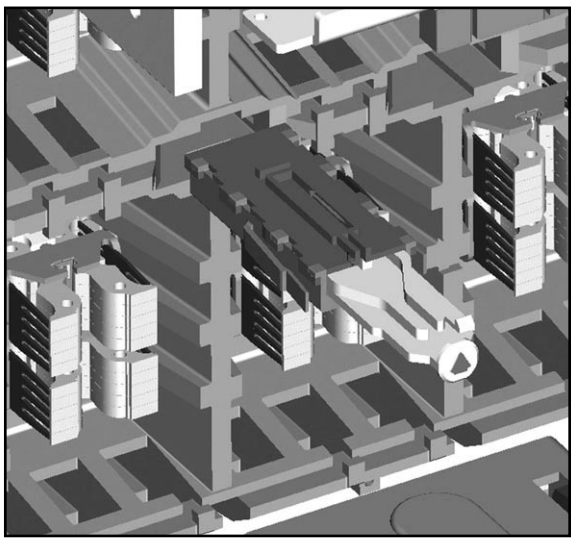
2. Installation Method

1) It is mounted into cradle and easily attachable. Insert 2 GUIDE ASS'Y into the hole on BASE ASS'Y of cradle first as shown in figure below.

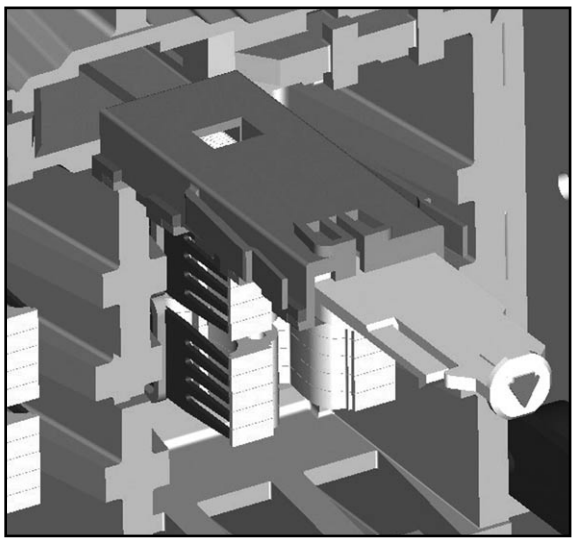
Note 1. It can be installed only when putting it into the knob with its own particular direction.

Note 2. Two of GUIDE ASS' Y has the exactly opposite direction for insertion.



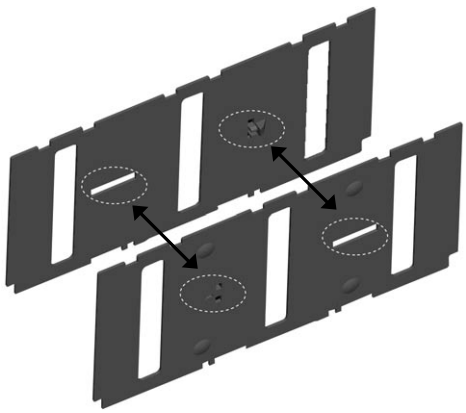


No.1. GUIDE ASS' Y

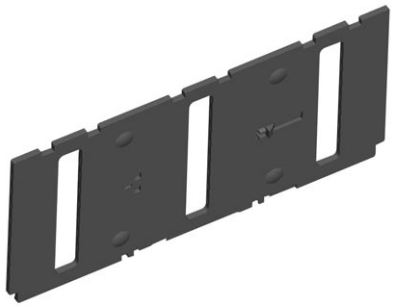


No.2. GUIDE ASS' Y

2) Arrange two shutter plates facing each other in the assembly process.



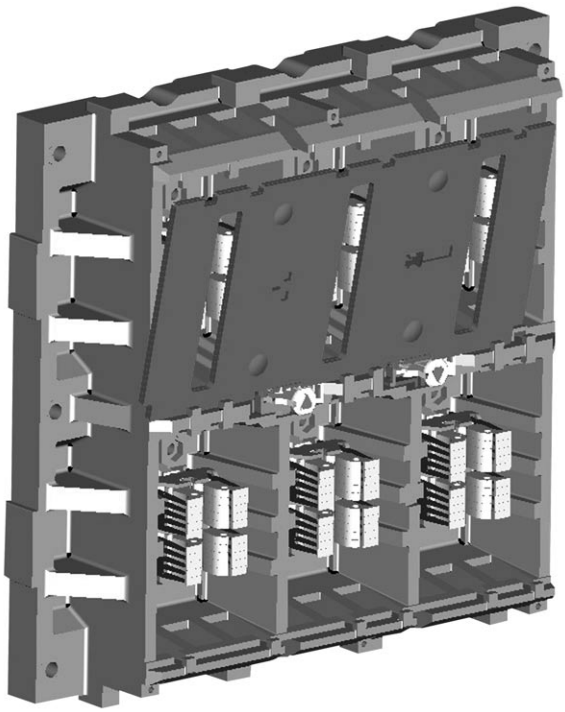
Before Assembly

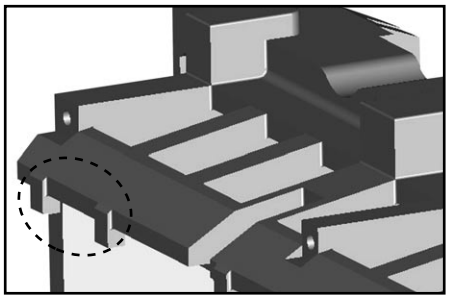


After Assembly

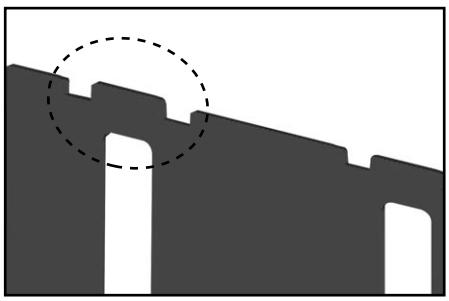
3) Place Shutter plate at an angle as shown in figure below after pushing GUIDE ASS' Y completely. Insert the bottom of Shutter plate first and then put the projections of BASE into the assembly hole of Shutter.

4) Move Shutter plate toward right side.





Projections for Assembling Shutter of BASE

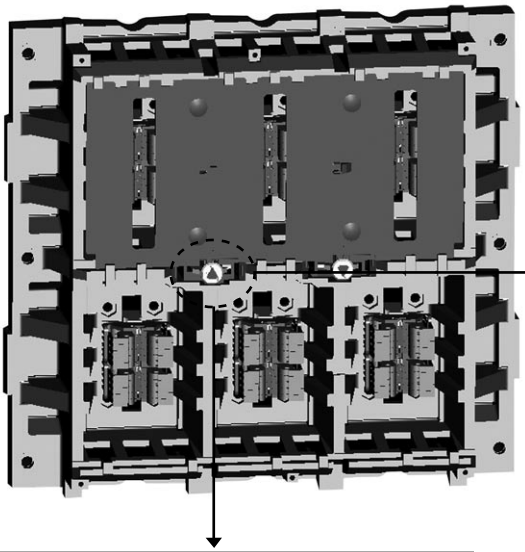


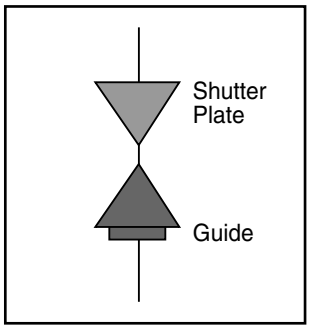
Shutter Plate Assembly Groove

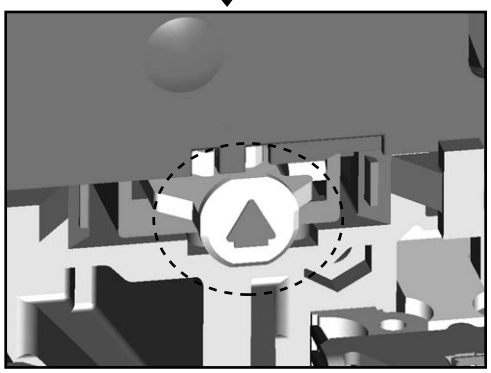
4. Optional Accessories

5) Fit the projections of Shutter plate and the hole of guide for the operation of Shutter plate and then release the Guide pushed.

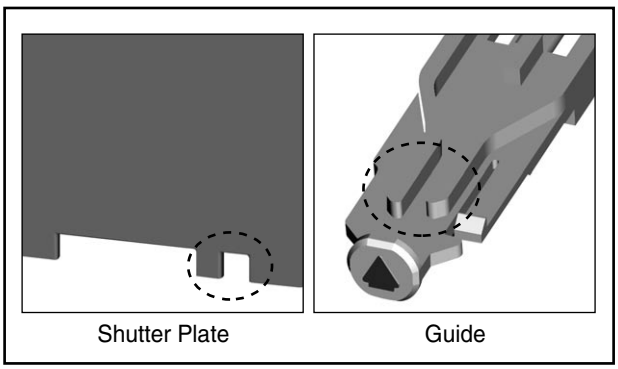
Projections and groove for operating Shutter plate



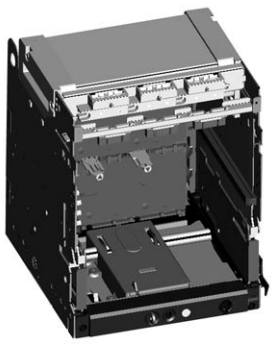




Place a projection matching with its groove, or position two triangle labels to be on the same line.



6) The following shows the finished installation of safety shutter to cradle. However, apply the same procedure for installation of safety shutter for bottom.

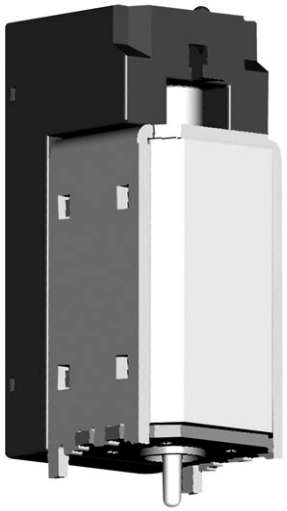


When finishing installing Safety Shutter as shown in figure, it automatically closes conducting part not to be exposure to outside.

Under Voltage Trip Device, UVT

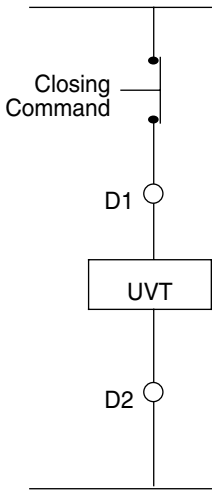
- It trips a circuit breaker automatically when its supply/control voltage drops under specified value and it is mounted to internal circuit breaker. In case of using it with time delay type, connect it with UVT time delay controller as It is the **instantaneous type**.
- Refer to "C. Electrical trip device" for the rated voltage and characteristics of UVT and the wire specification.

1. Externals and Wiring Diagram



Externals

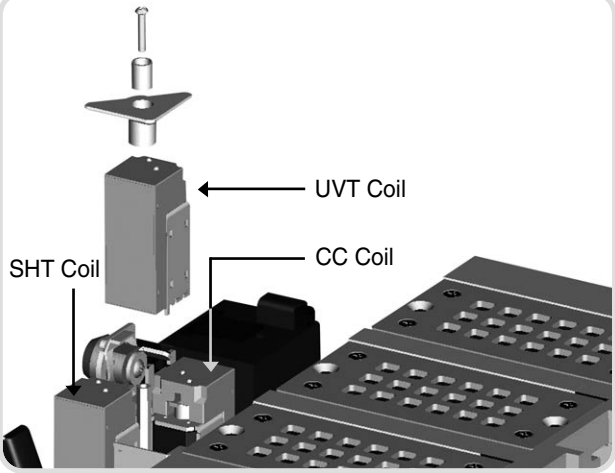
2. Installation Method



Wiring Diagram

2. Installation Method

Install UVT coil with M4, L16 into the holes on Upper plate of Mechanism corresponding to the correct place of UVT which is in the middle of CC coil and SHT coil as shown in left figure.



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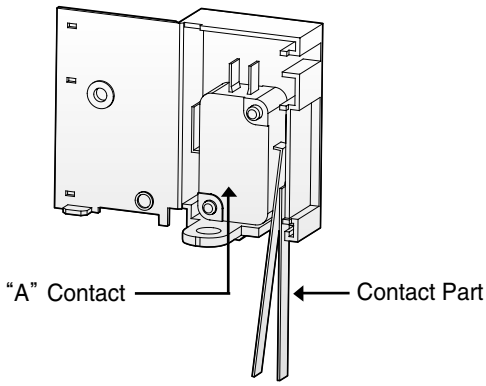
4. Optional Accessories

Ready-to-Close Contact

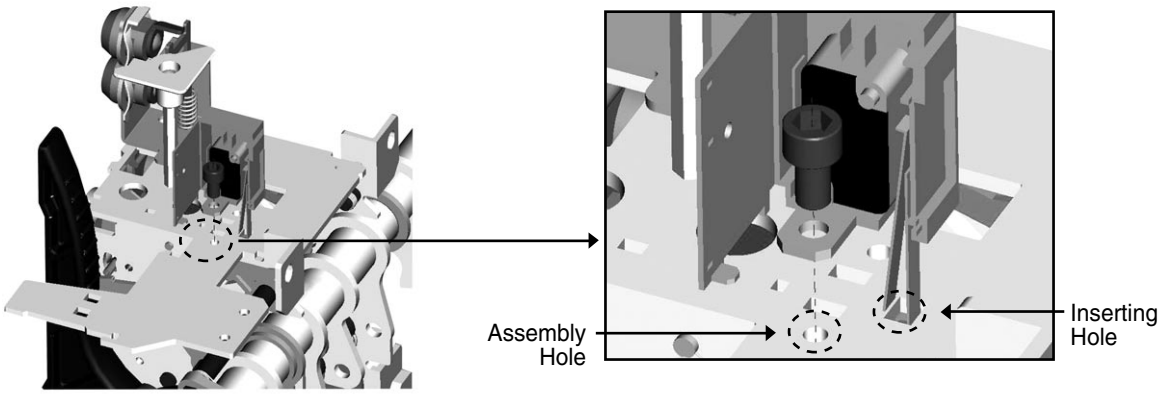
1. Externals

- It interlocks with the mechanism of circuit breaker and indicates the status that the circuit breaker is ready to do closing operation.
- When mechanism is in OFF position or in CHARGE. Contact is output with "ON" and it indicates that mechanism can be closed.

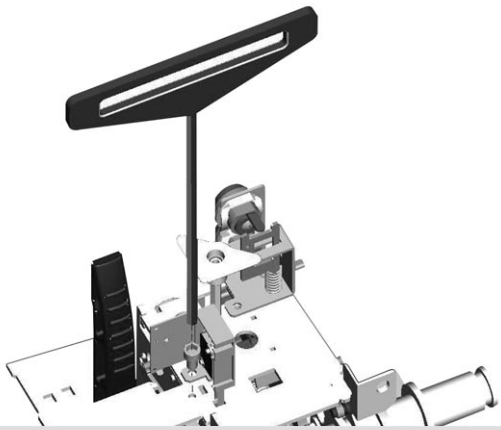


2. Installation Method

1) Put ready-to-close contact into the inserting/assembly hole of mechanism.



2) Tighten with M4 bolt by using wrench.

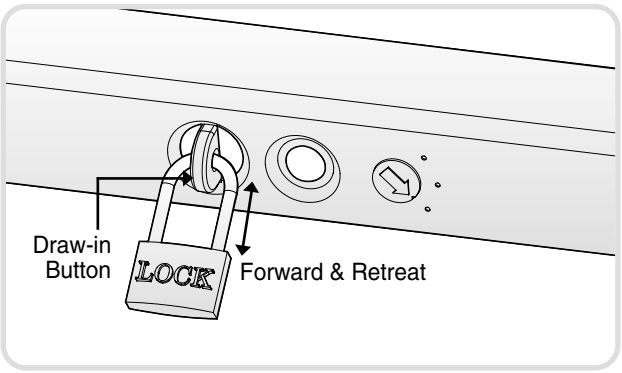


Pad Lock / Position Lock

1. Externals

ACB can be positioned in CONNECTED, TEST, DISCONNECTED. If main body of ACB is placed in 3 positions, It is locked and stopped when drawing in/out as operating handle does not operate.

1) If Lock operates, Draw-in/out button pops out as shown in fig.
2) Release Lock by pushing Draw-in/out button to continue Draw-in/out operation.
3) If fastening the lock as the figure on right side, the main body of ACB can not be drawn in/out from cradle.
4) Separate purchase for a lock.

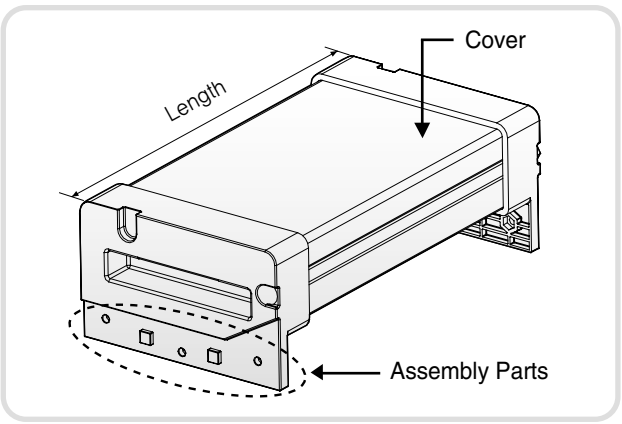


Arc Cover (Component for Zero arc space)

1. Externals and Specification

• Arc which may arise while breaking faulty current is extinguished first by arc box in main body of circuit breaker and then completely extinguished by Zero arc space. 8 types upon the length of Cover

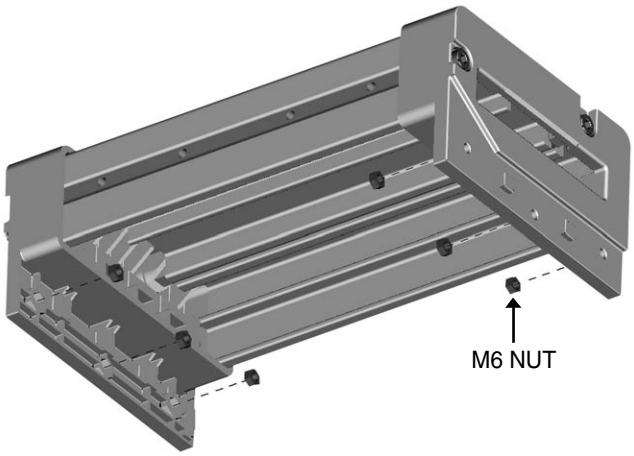
Frame	Cover Length
2000AF 3P	281.4
2000AF 4P	366.4
4000AF 3P	359.4
4000AF 4P	474.4
5000AF 3P	576.4
5000AF 4P	746.4
6300AF 3P	732.4
6300AF 4P	962.4



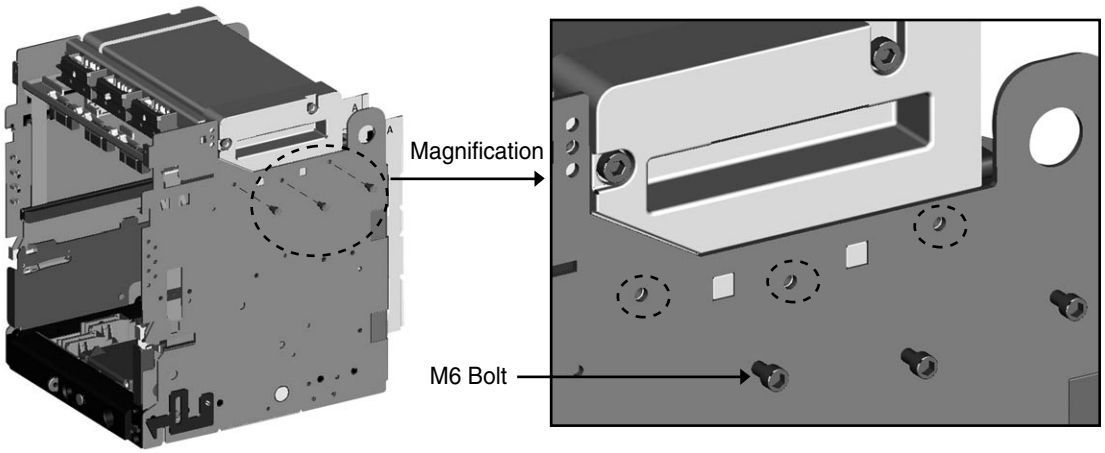
4. Optional Accessories

2. Installation Method

1) Put the 6pcs of M6 Nut into both Arc Covers.



2) Put 6pcs of M6 Bolt into holes of Arc cover and both Side plates and then tighten them.

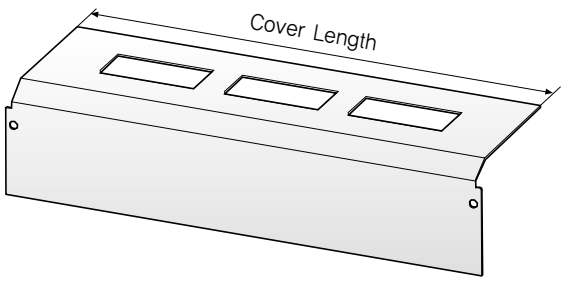


Control terminal block COVER

- It protects a circuit breaker from control terminals and foreign objects and name plate which describes the control terminal PIN is attached on to help user with easy operation.
- 8 types based on Cover Length

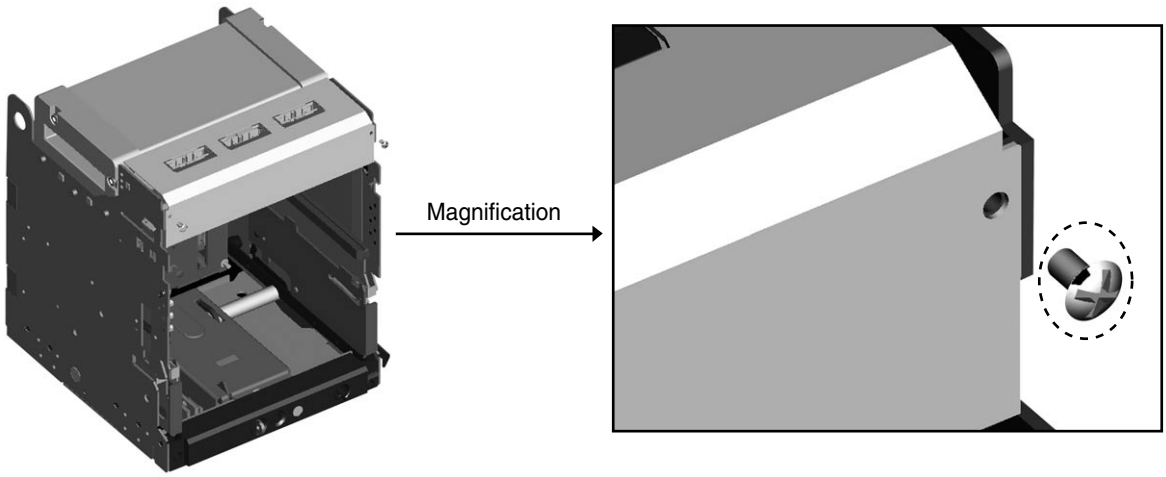
1. Externals and Frame sizes

Frame	Cover Length
2000AF 3P	334
2000AF 4P	419
4000AF 3P	412
4000AF 4P	527
5000AF 3P	629
5000AF 4P	799
6300AF 3P	785
6300AF 4P	1015



2. Installation Method

Tighten two M6 round-head screws to the holes of both control terminals.

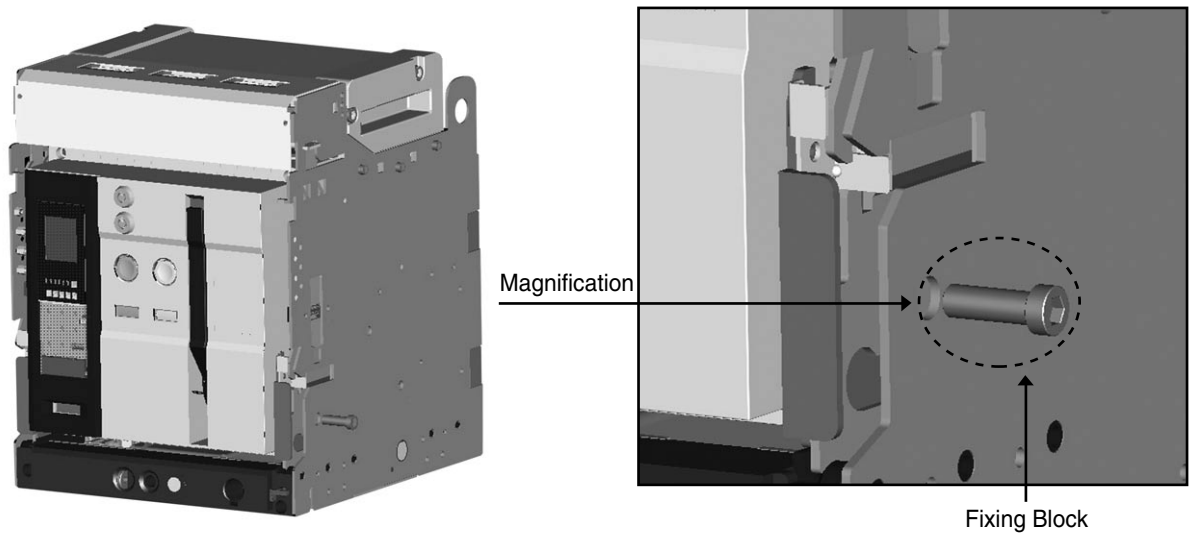


4. Optional Accessories

Fixing Block

1. Externals

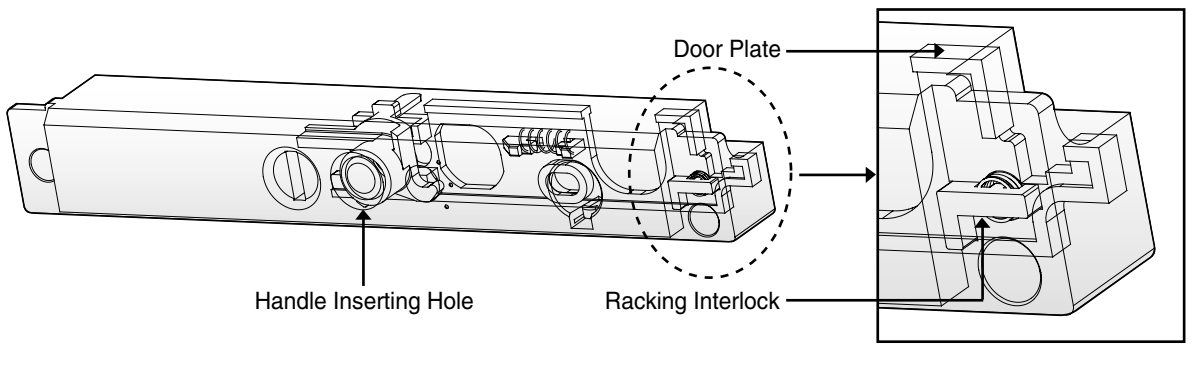
It interlocks the main body of circuit breaker and cradle mechanically to fix the former in connected position. Therefore, all draw-in/outs are not available.



Racking Interlock

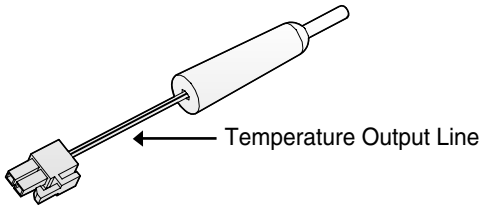
- Draw in/out handle will not be inserted when panel door is opened. Thus. Panel handle can be inserted only when panel door is closed.
- Door plate should be moved left side to get handle inserted. When opening panel door, Racking interlock will pop out by spring and Door plate can not be moved to left side as it is stuck to Racking interlock. Therefore, handle can not be inserted.

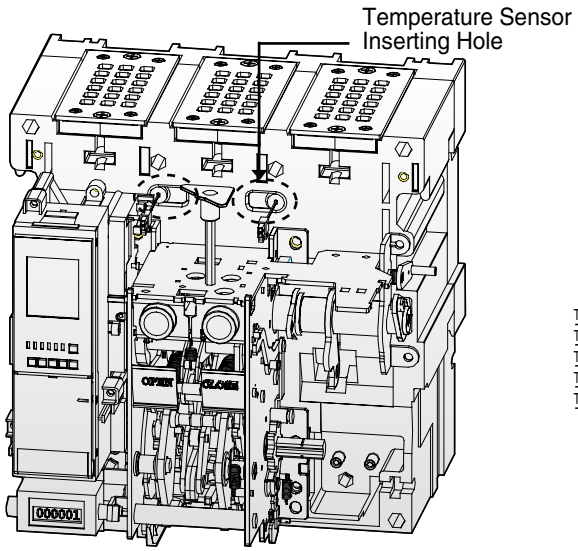
1. Externals and Structure

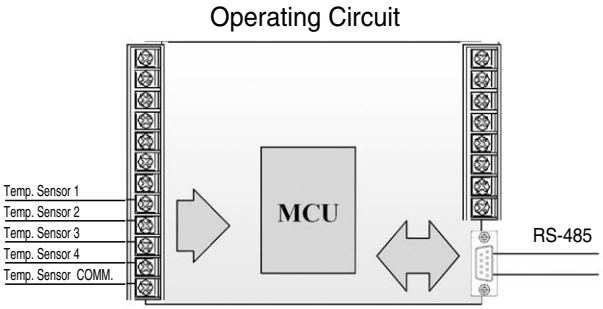


Temperature Measuring Sensor

- It alarms users through OCR when the temperature of circuit breaker is over specified value
- It interlocks with the extra module for sensing the temperature.
- The output line of sensor is connected to control terminal block and temperature measuring sensor is also connected to it.

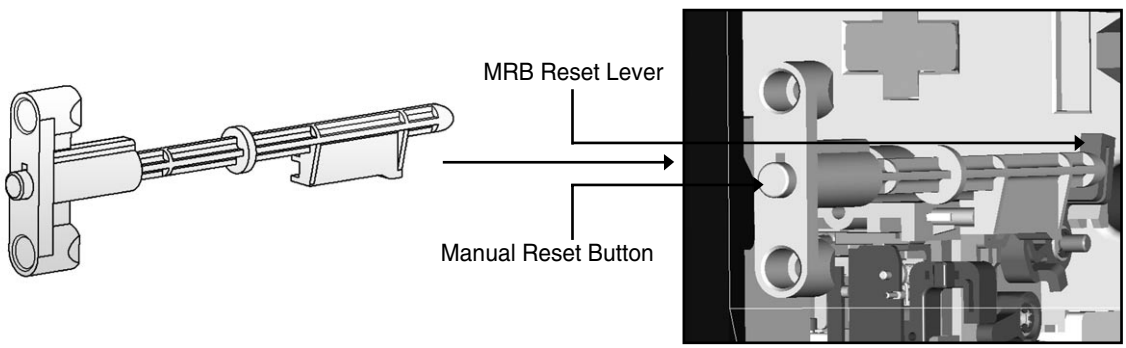






MRB (Manual Reset Button)

- When a circuit breaker tripped by faulty current, a mechanical trip indicator (MRB, Manual Reset Button) pops out from the main cover and the switch(AL)which sends control signal electrically is conducted to output the information occurred from faulty circuit breaker.
- MRB can be operated only by OCR but not by OFF operation of circuit breaker.
  To re-close a circuit breaker after a trip, press MRB to reset it for closing.



4. Optional Accessories

SLOW Closing Lever

It is the Jig which makes it possible to check the contacting status between arc contact and main contact visually by slowing down the operating speed of them when closing under fully charged condition.

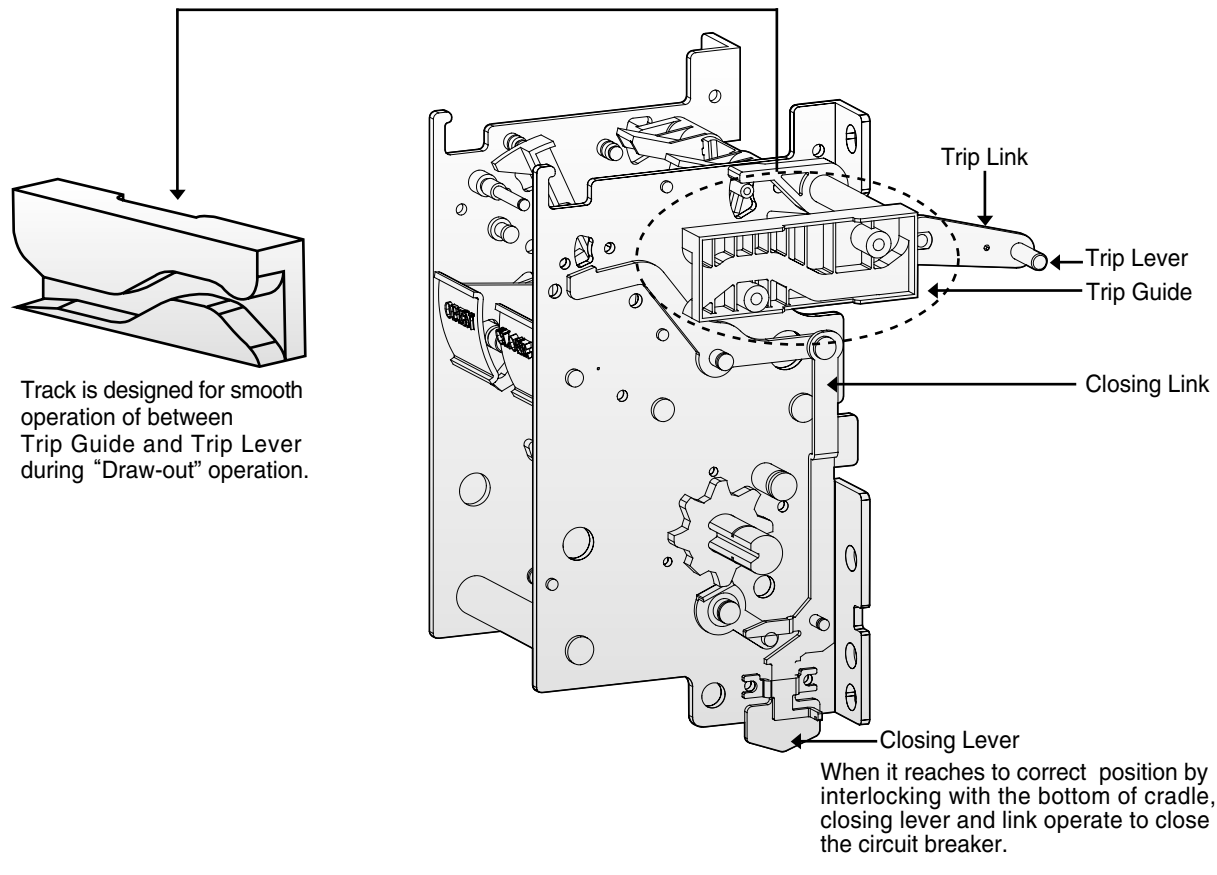
Automatic Spring Release (Energy Release)

- If a circuit breaker is put into service and mechanism is in "charged" or "closed" position, safety device is required during draw-in/out operation to ensure the safety in advance.

  1.CASE : when drawing out under "charged" position of circuit breaker
  →Closing and Trip operation occurred in series

  2.CASE : when drawing out under "closed" position of circuit breaker
  →Trip operation

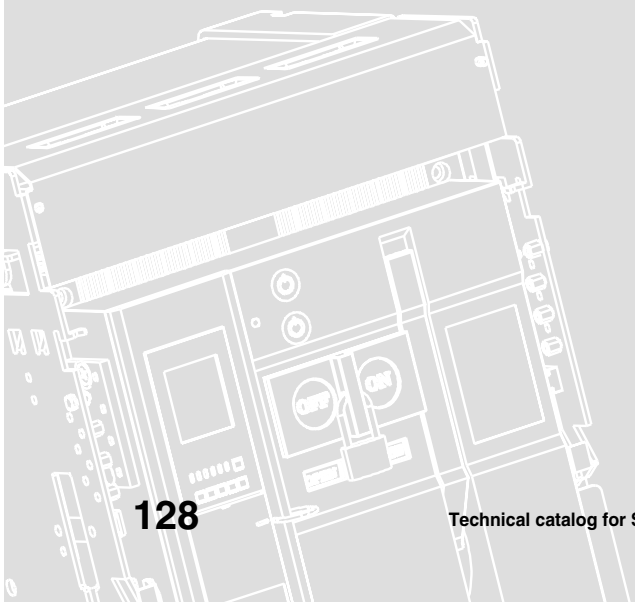
1. Externals and Structure



2. Installation Method

- Trip Guide is mounted to right internal side plate of cradle by tightening bolts.
- Closing and Trip Link is mounted to right external side of mechanism.

J. Handling and Maintenance



1. Transporting and Storage

This breaker and cradle are designed to move easily by overhead lifting devices such as hoisters. You can use lifting hooks which is optional to move them without difficulty. All the carrying devices should be suited to the product's permissible weight which is presented in Table.1. In case of using forklift, refer to figure.1.

[Based on kgf, IEC]

Type	2,000AF				4,000AF				5,000AF		6,300AF	
	1,600A		2,000A		3,000A		4,000A [Fork-Type]					
	3P	4P	3P	4P	3P	4P	3P	4P	3P	4P	3P	4P
Fixed Type	34	44	38	47	44	55	63	100	76	94	103	130
Draw-out Type	63	74	70	85	87	103	104	147	145	173	186	230
Cradle	29	32	33	40	44	50	58	70	78	90	102	124
Draw-in/Out Load [kgf.cm]	60/35	70/45	70/45	80/50	105/54	110/55	125/58	135/60	160/65	170/70	190/75	195/85

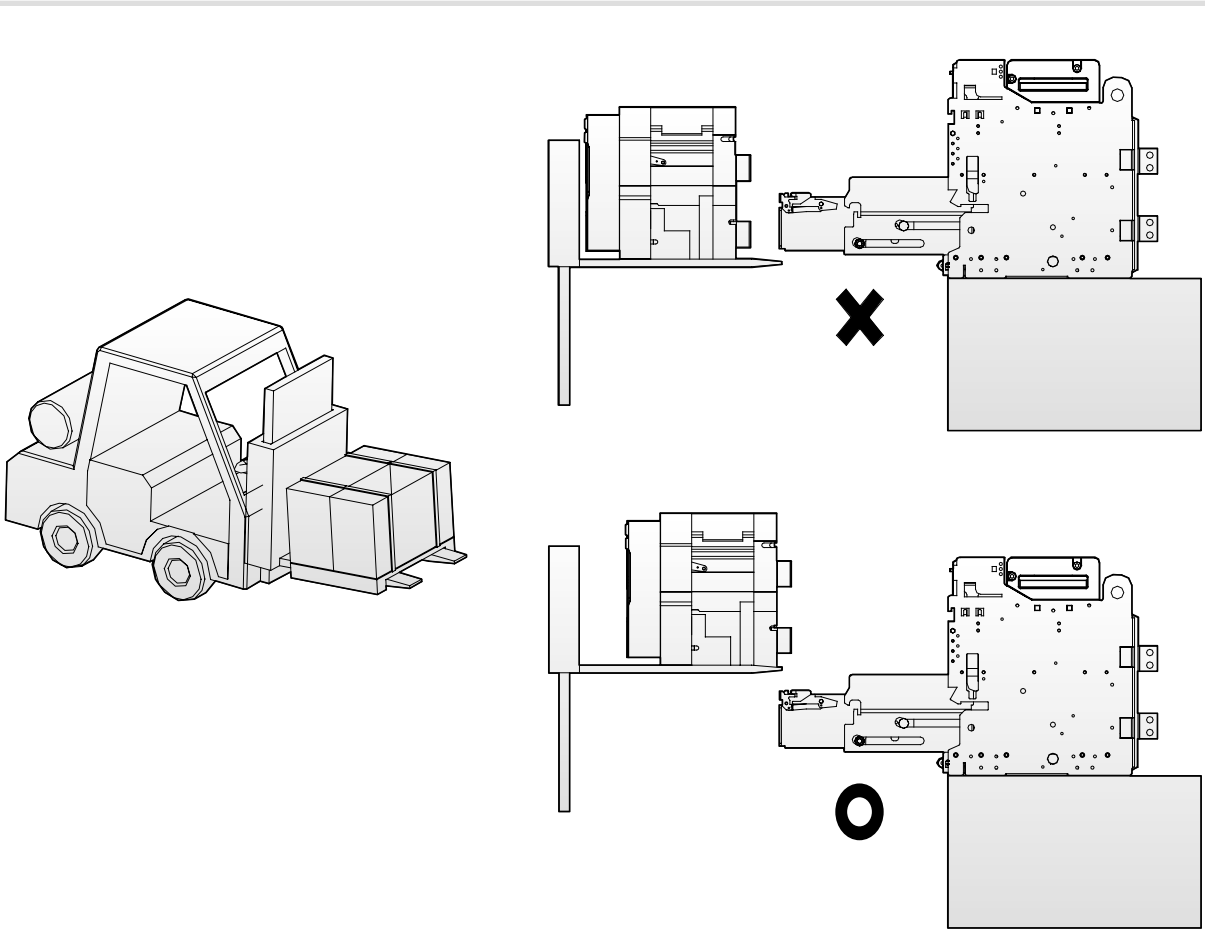


Fig 1. Lifting by forklift

- When lifting products with forklift, be careful with the bottom plane not to be beyond the rear side of products. (Refer to fig.1)

Precaution of Transporting

1.To lift the breaker (Fixed type), use the lifting hooks on the sides of the breaker, and lift with rope or something similar.

2. When placing the breaker on the ground, be careful not to drop or to impact the breaker.

3. When the draw-out breaker is lifted with the cradle, lift it in the connected position.

4. Never slide the breaker when handling.

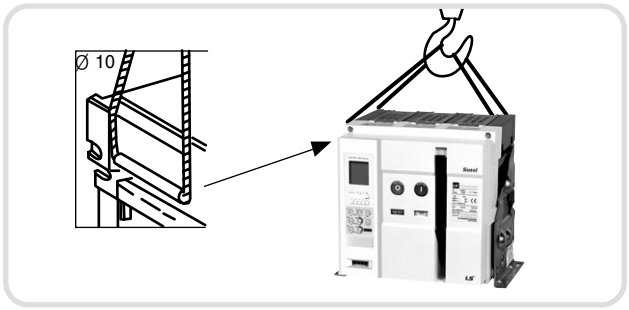


Fig. 2. Transporting method of Fixed type

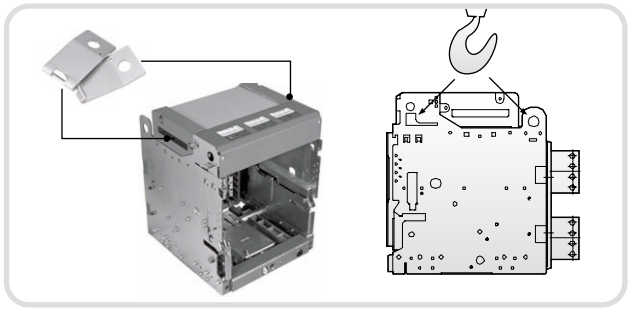


Fig. 3. Transporting method of Draw-out type

Precaution of Storage

When storing a circuit breaker for a long term,

1. Keep the breaker at OFF position with the charging spring discharged.

2. Store the draw-out type breaker on the flat place after the TEST position inserted.

Storage Method

1. Store the breaker in a dust free and dry environment.

2. Keep the breaker in OFF position with the charging spring discharged.

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.

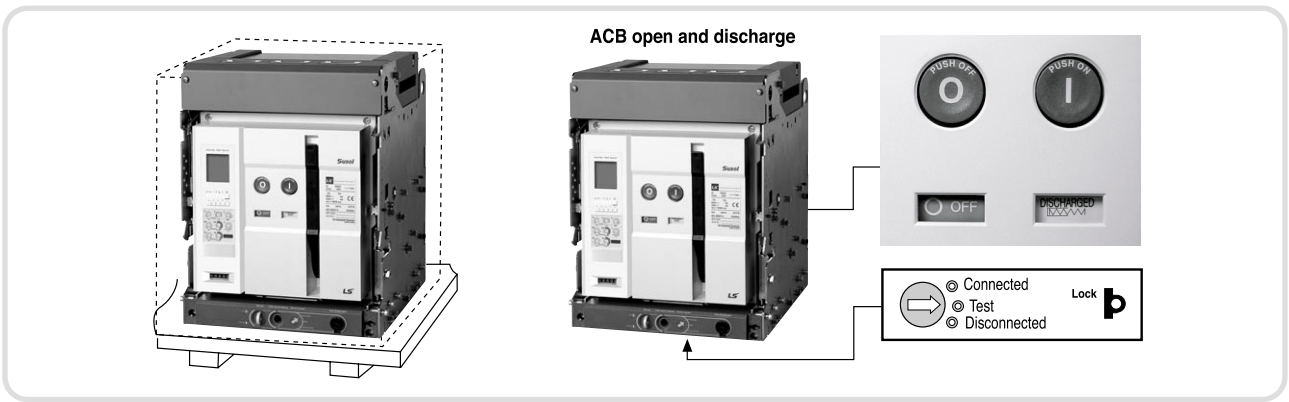


Fig. 4. Storage method

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2. Check Points Before Inspection

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 ACB 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. In case of Draw-out type, pull out the product until guideline comes to TESTED position from cradle. (Basic inspection is available under TEST position.)
5. In case of detailed inspection, remove the product form cradle securely and put it to the even stand.
6. Inspect product.

3. Inspection and Maintenance

The purpose of inspection for ACB is to prevent the accidents in advance and maintain the performance of it by changing timely the consumable and deteriorative parts. Please make sure the following guideline specified the method for inspection and cycles before using of the equipment.

1. Maintenance cycle upon using condition

Using Condition	Environments	Specific Examples	Inspection Cycle	Replacement Cycle
General environment for a use	Location with clean & dry air	Electrical rooms with dust proof & air-conditioner	Once every 2 years	Within approx. 10 years
	Indoor location with little dust Location without corrosive gases	Distribution panel or individual electrical room without dust proof & air conditioner		
Special environment for a use	Location with salinity, high temperature gases such as sulphur dioxide and hydrogen sulphide	Geothermal power plants, waste water treatment plants, steel mills, paper factories, pulp factories, etc.	Once every 1 year	Within approx. 7 years
	Locations with harmful or corrosive gases where humans cannot stay for a long time	Chemical factories, quarries, mining areas, etc.	Once every half a year	Within approx. 5 years

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3. Inspection and Maintenance

2. Inspection method after trip operation of circuit breaker

1) Figure out what cause the trip operation.
   - Do not perform the closing operation before figuring out the cause of trip and removing it completely.
   - The relevant cause will be indicated with LED of OCR in advance and be reported to the circuit breaker by output signal of SDE contact.
   - There can be various possible causes for trip operation of circuit breaker. The trip operation can be done due to the basic function test of facilities or the warning for accident.

2) If short-circuit occurred, check the condition of circuit breaker with the following inspection items suggested below. (All power source should be disconnected from circuit breakers for the inspection.)
   - Check Arc chamber. (Refer to C. Inspection method of Arc chamber.)
   - Check contacts. (Refer to D. Inspection method of Moving contact condition)
   - Check connection parts are well connected. (ex. Bolt tightened parts, Busbar connected parts, etc,.)
   - Check Cluster. (Refer to fig. 9.)

3) Re-close after removing the causes for trip operation by checking all inspection items listed above.

3. Inspection method of Arc chamber

1) Remove the mounting screws of the arc chamber.
2) Separate the arc chamber by lifting it up using two screw drivers as shown in fig. 7 below.
3) Check the condition of the disassembled arc chamber.
   - Check if there are any damage on Grid ass' y of arc chamber or parts and replace them if necessary.

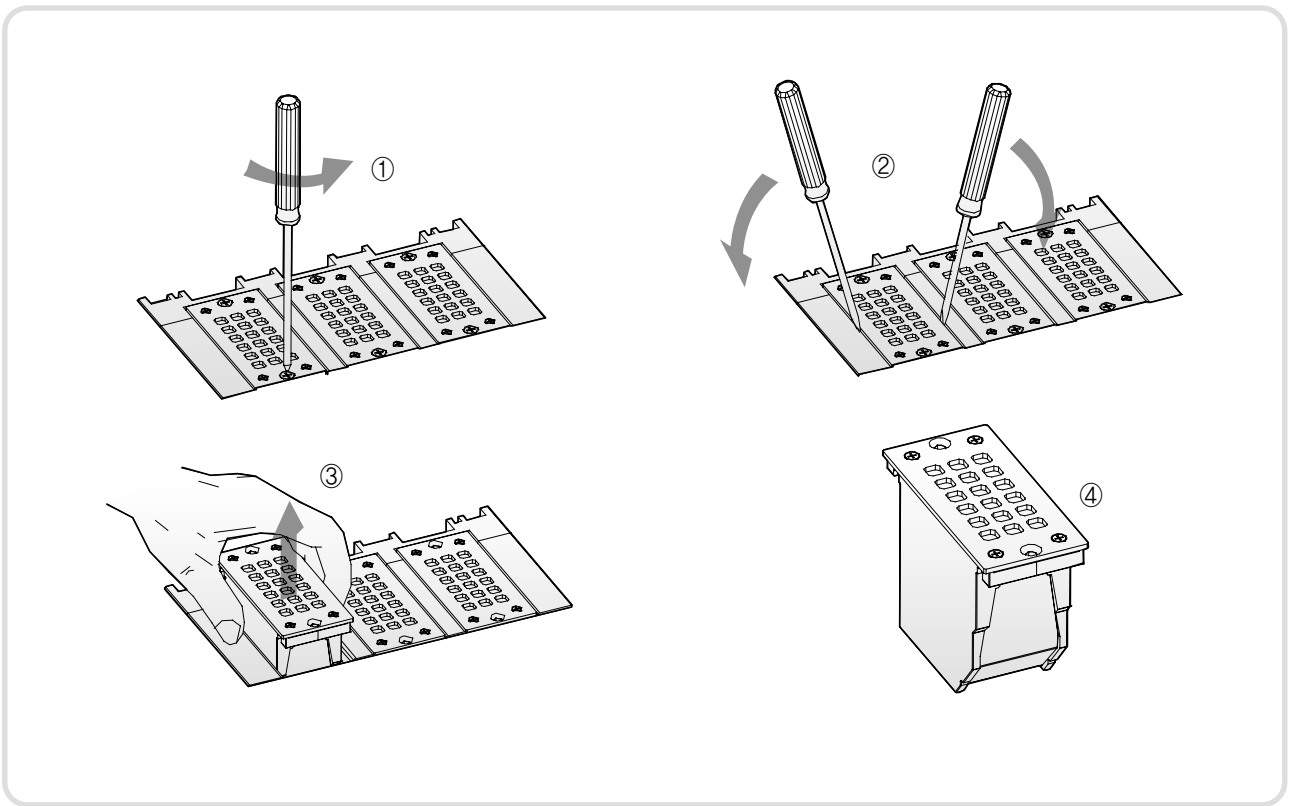


Fig. 7. Separate procedure of Arc chamber

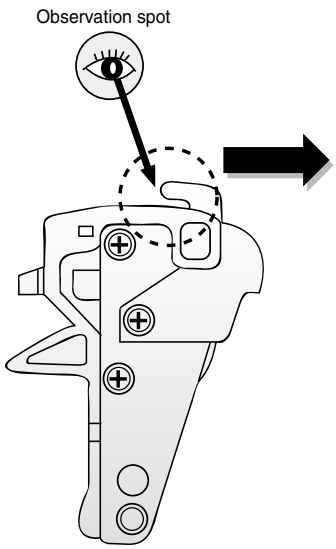
3. Inspection and Maintenance

4. Inspection method for moving contact condition

The degree of damage of contact can be checked upon following inspection method periodically.

1) Separate arc chamber.

2) Close the circuit breaker and compare the condition of the moving contact with the below figure to decide whether it is to be replaced or not.



	New Product	Replacement Needed
630~ 4000A	Standard Line	Standard Line
5000~ 6300A	Standard Line	Standard Line

Fig 8. The standard figure for contact replacement

5. Inspection method for Cluster

1) Inspect the external appearance and check for following possible damages.
   - Check for discolored parts
   - Check for worn-off coating
   - Check for damages on the plate spring
   - Check for assembly condition of cluster
   - Check for other possible damages on the cluster

2) Inspect the contact part of the cluster and terminal block and check the followings.
   - Check if there is enough conducting grease on the contacting part.
   - Check if conducting grease has hardened.
   - Check for other possible problems on the contacting part.

3) Remove the cluster by hand and replace it with a new one when damage of the cluster is confirmed. (refer to fig. 9)

4) If grease on the contacting part has been hardened or foreign body has got into the parts, remove it clean and apply new grease.

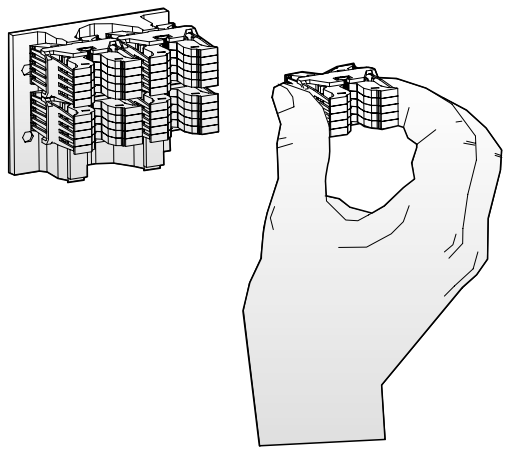


Fig 9. Mounting and separation of Cluster

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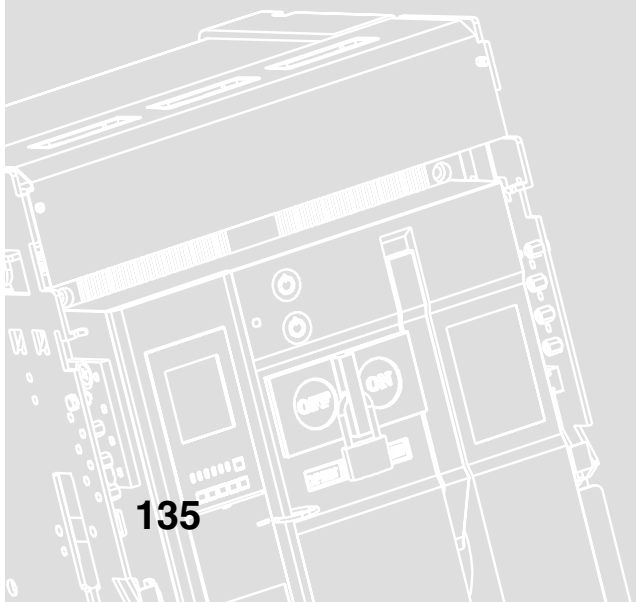
4. Defects and Troubleshooting Guideline

Troubleshooting Guideline

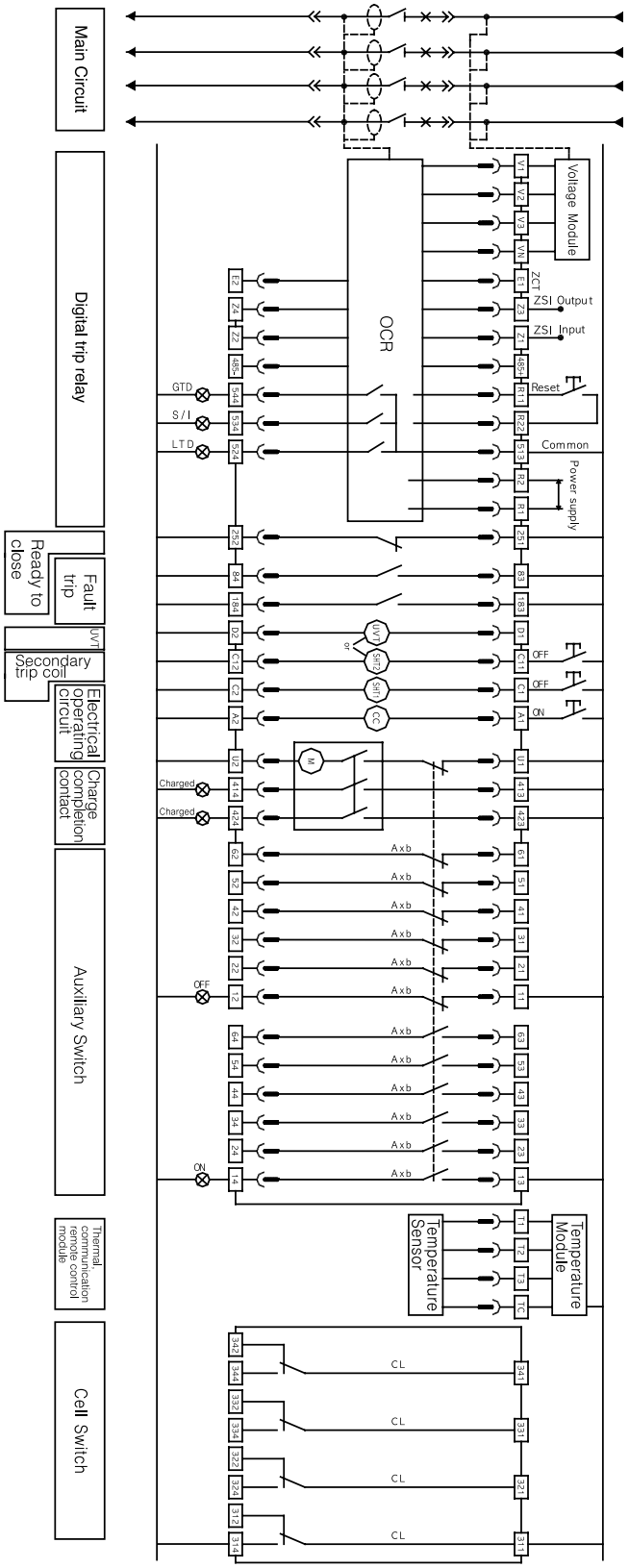
Types of Defect	Cause	Countermeasure
The breaker is opened but fault Trip Reset button does mot come out.	1. Voltage does not exist or UVT is damaged.	1. Check voltage. Replace damaged UVT.
	2. Voltage disturbance occurred to the trip device	2. Check voltage supply part.
The breaker is opened simultaneously with the closing operation and the fault trip Reset button comes out.	1. In state of short-circuit	1. Remove cause : Check condition of breaker before re-closing.
	2. Excess current is too high at closing operation.	2. Revise network or change setting of trip device.
OPEN operation is doe manually but not from remote.	1. Voltage supply from the trip device is too low. V〈0.7Vn	1. Check voltage supply.(0.7~1.1Vn)
	2. Defect on UVT circuit.	2. Replace UVT.
OPEN operation does not work manually.	1. Damage on the mechanism	1. Contact AS center
	2. Deposition of main circuit.	2. Contact AS center
Breaker does not close neither manually nor remotely.	1. Closing operation at state of short-circuit.	1. Remove cause : Check condition or breaker.
	2. Fault Trip Reset button does not reset.	2. Reset Fault Trip Reset button
	3. Unstable draw-in/out state of the product.	3. Check product's draw-in/out stage.
	4. Anti-pumping function	4. Re-operate after removing power of the closing coil.
	5. Closing spring of breaker is not charged.	5. Check power supply of the charging motor. Check if manual charging works. Contact AS center or replace charging motor if necessary.
	6. Power supply problem of the closing coil.	6. Remove power supply of the closing coil. Apply power again after checking the breaker's closing availability. Contact AS center if manual charging is unavailable.
	7. Power supply problem of the trip coil.	7. Remove power supply of the trip coil.
	8. Insufficient power supply of the UVT or defect.	8. Apply voltage(V〉0.85Vn) to the auxiliary switch and try closing operation using the closing coil.
	9. Locked state of the breaker under open position	9. Check if the closing error state is normal.
	10. Incase breaker is interlocked.	10. Release interlock.
Closes manually but does not close from remote.	1. Inappropriate voltage supply of the closing coil.	1. Check voltage supply of the closing coil.(0.85~1.1Vn)
	2. Defect of the closing coil,s open circuit.	2. Replace closing coil.
Dose not charge electrically.	Wrong voltage supply to spring charging motor.	1. Check voltage supply. 2. Check the circuit of charging motor. 3. Try reset operation and if there is a problem or defect. Contact local AS center and replace charging motor.
Crank handle for draw-in/out does not get inserted.	1. No opening of the crank insertion by pressing Open button	1. Insert while pressing Open button
	2. Under Padlock or interlock	2. Remove padlock or interlock.
	3. Not putting the product into the cradle securely.	3. Rush product into cradle securely.
Breaker does not get drawn out.	1. Crank handle is inserted.	1. Remove crank handle.
	2. Breaker is not in Disconnected position	2. Draw out to the Disconnected position completely.
	3. Under Padlock or interlock	3. Remove padlock or interlock.
Breaker is not drawn in completely. (It is not in the connected position)	1. The cradle and main frame of the breaker do not fit	1. Check if cradle fits with main frame.
	2. Inappropriate position of the cluster.	2. Move cluster to the right position.
	3. Safety shutter is under interlock.	3. Remove interlock.

K. Control Circuit and Dimension



1. Control Circuit

This diagram is based on “CONNECTED” position of a circuit breaker and Opening, Motor charging, Releasing of locking plate should be normal condition.



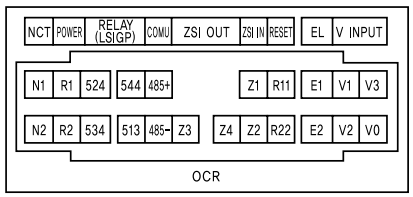
Control Circuit and Dimension

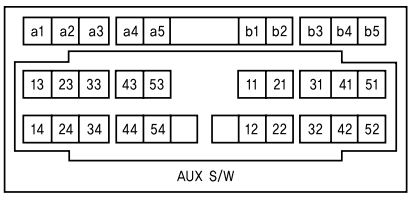
1. Control Circuit

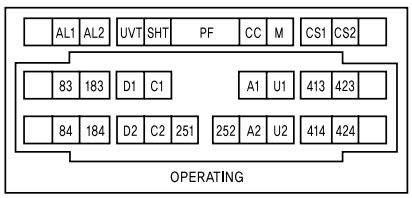
13 14 ~ 63 64	Auxiliary switch “a”
11 12 ~ 61 62	Auxiliary switch “b”
413 414	Charged signal
423 424	Charged signal communication
U1 U2	Motor charging
A1 A2	Closing Coil
C1 C2	Shunt Trip
C11 C12	2nd Shunt Trip
D1 D2	Voltage input terminal of UVT
83 84	Alarm1 “a”
183 184	Alarm2 “a”
251 252	Ready to close switch
R1 R2	Control Power
513 ~ 544	Alarm Contact
R11 R22	Alarm Reset (trip cause LED, Alarm contact)
Z1 Z2	ZSI Input
Z3 Z4	ZSI Output
E1 E2	ZCT
VN ~ V3	Voltage module
TC ~ T3	Temperature module

AX	Auxiliary switch
LTD	Long time delay trip indicator
S/I	
GTD	Ground fault trip indicator
CL	Cell switch
M	Motor
CC	Closing coil
SHT1	Shunt tripping device 1
SHT2	Shunt tripping device 2
UVT	UVT Coil

※Option : RCS, AL, SHT2, UVT, Charged contact, Aux, S/W

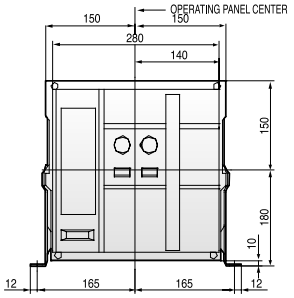
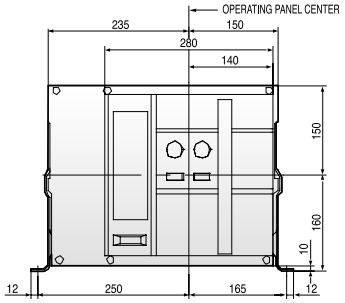
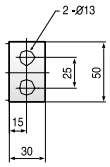
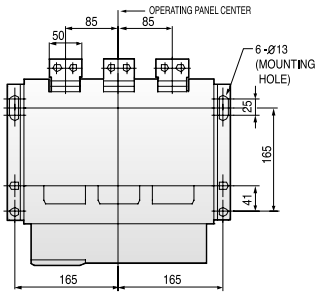
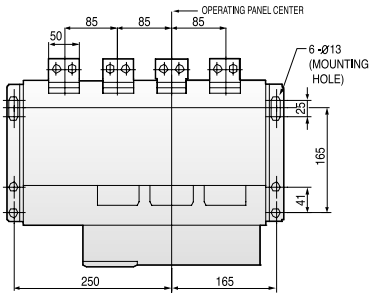
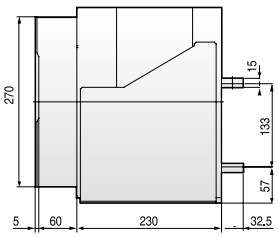
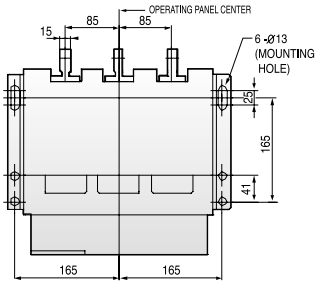
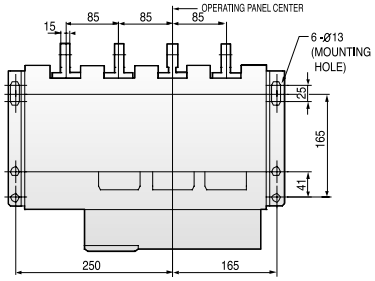
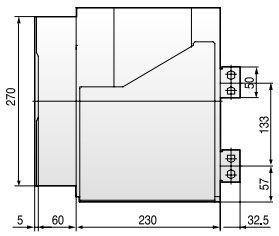
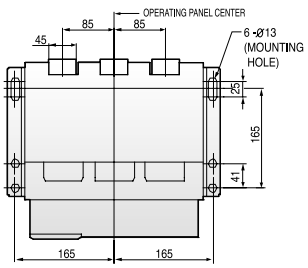
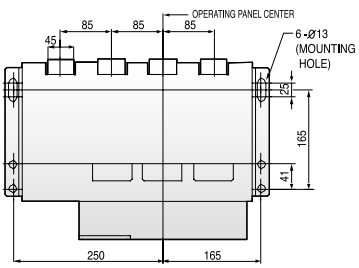
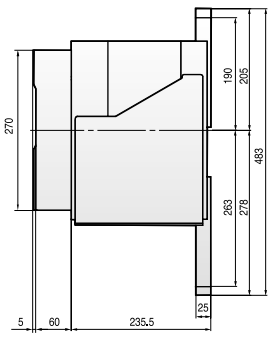






2. External Dimension

Fixed Type 2000AF (630A~1600A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		
■ Front Connection Type(3P Plan View)	■ Front Connection Type(4P Plan View)	■ Front Connection Type(Side View)
		

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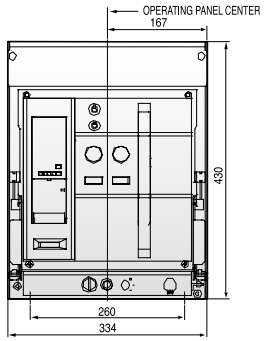
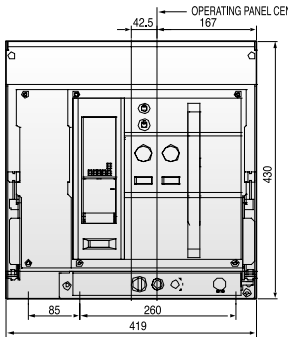
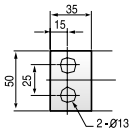
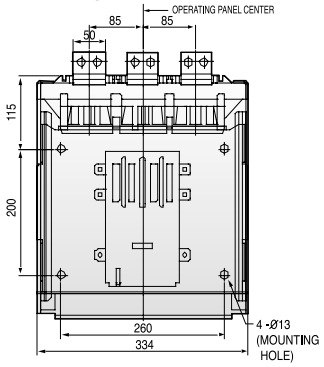
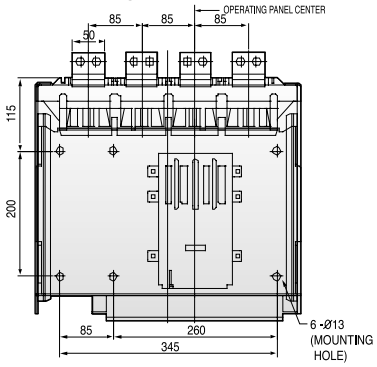
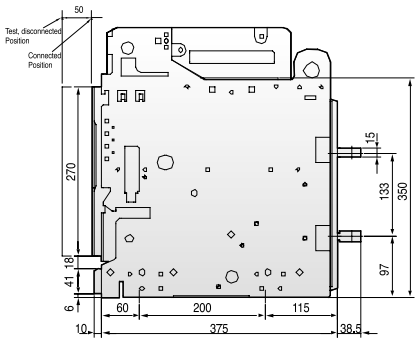
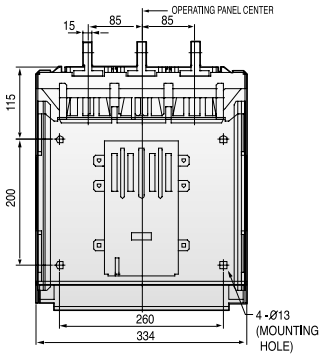
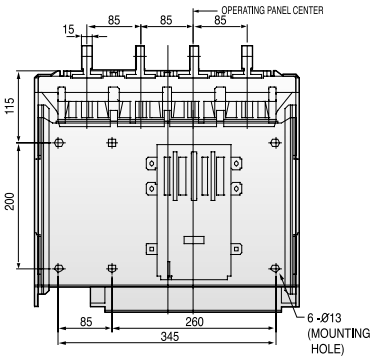
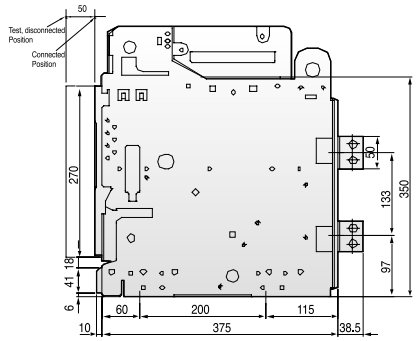
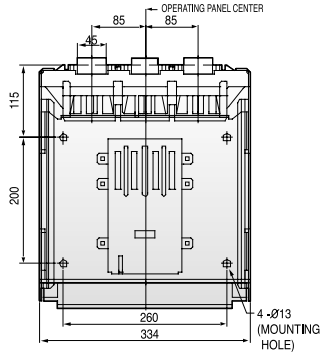
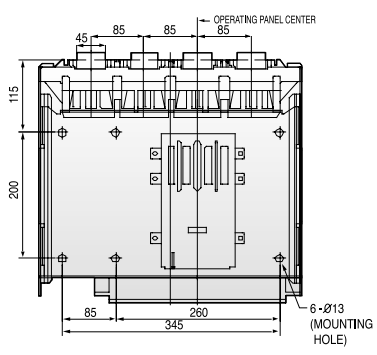
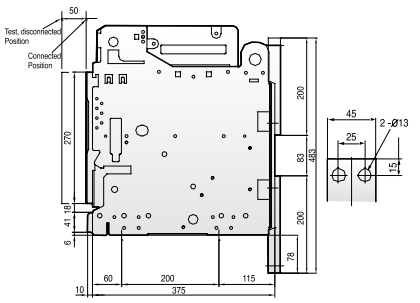
2. External Dimension

Draw-out Type 2000AF (630A~1600A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		
■ Front Connection Type(3P Plan View)	■ Front Connection Type(4P Plan View)	■ Front Connection Type(Side View)
		

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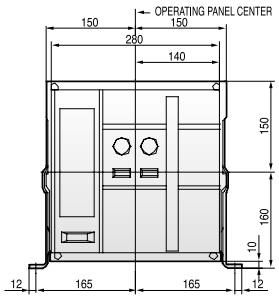
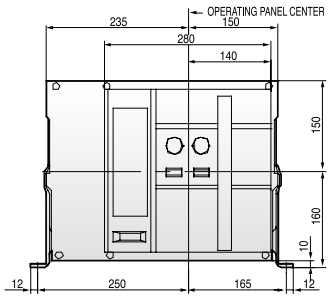
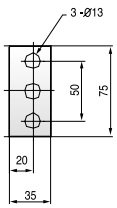
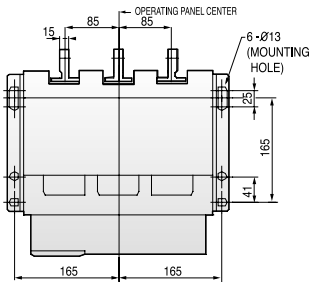
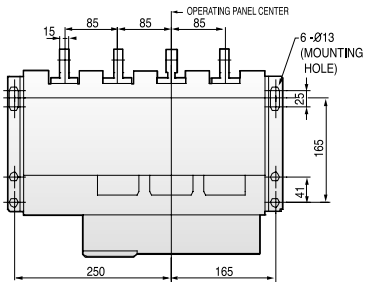
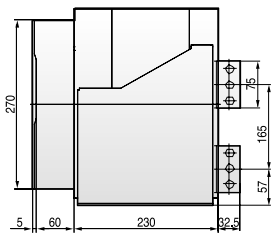
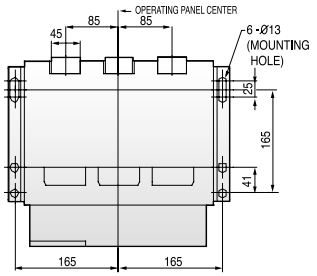
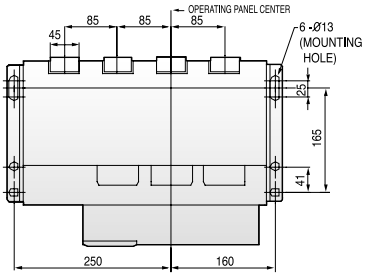
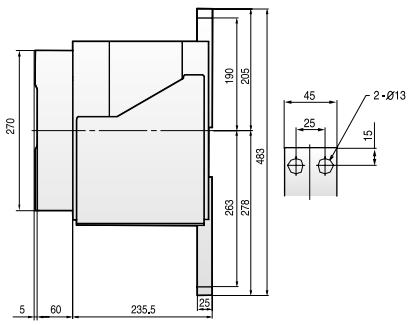
Fixed Type 2000AF (2000A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Front Connection Type(3P Plan View)	■ Front Connection Type(4P Plan View)	■ Front Connection Type(Side View)
		

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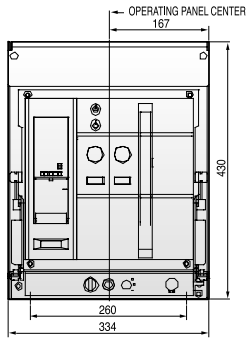
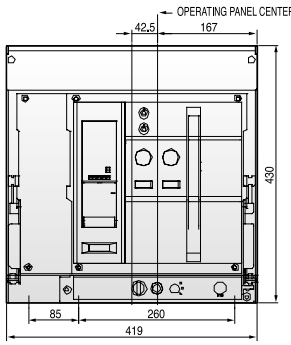
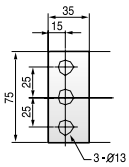
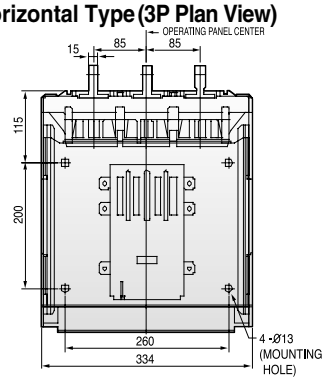
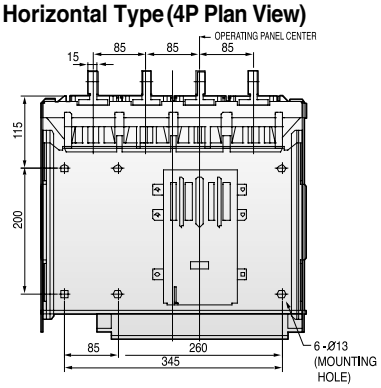
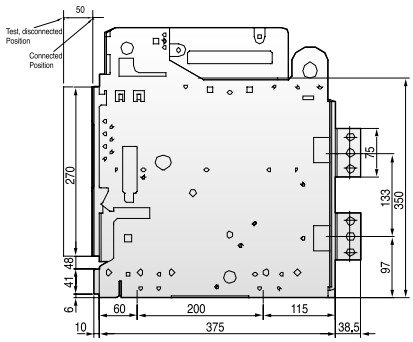
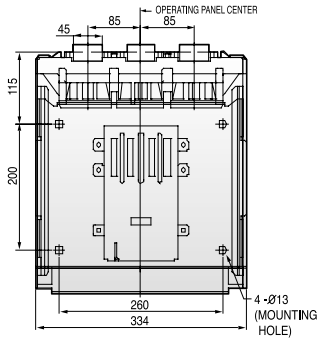
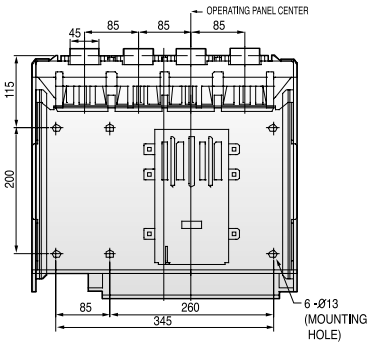
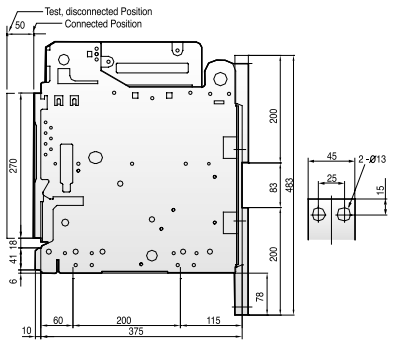
2. External Dimension

Draw-out type 2000AF (2000A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Front Connection Type(3P Plan View)	■ Front Connection Type(4P Plan View)	■ Front Connection Type(Side View)
		

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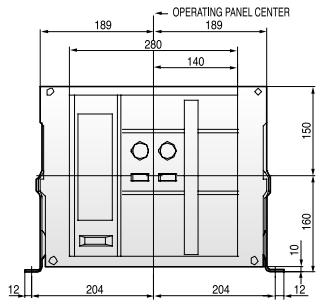
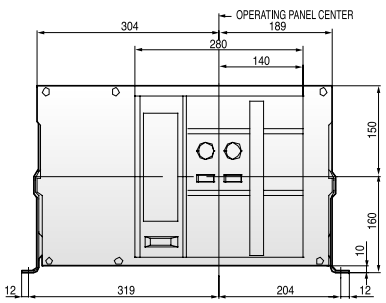
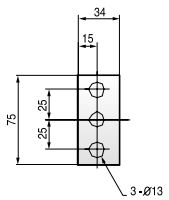
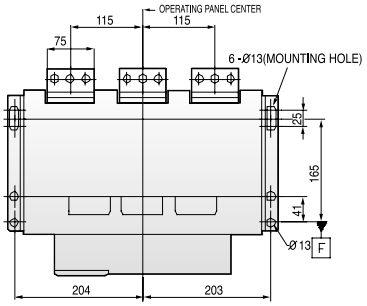
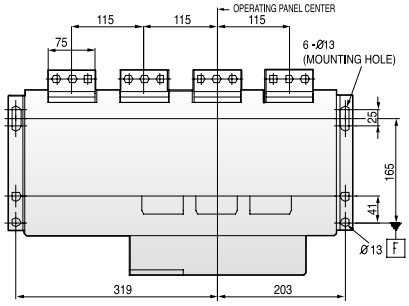
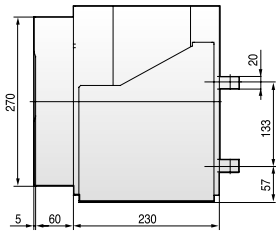
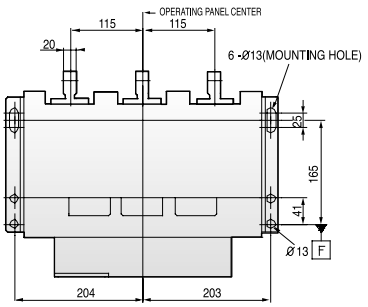
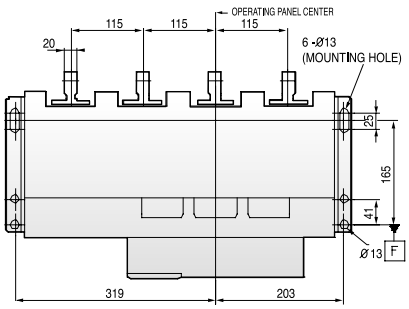
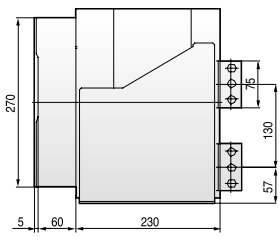
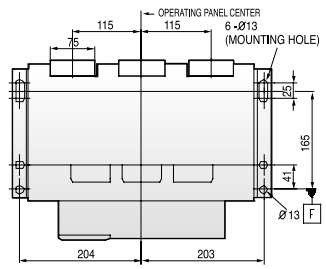
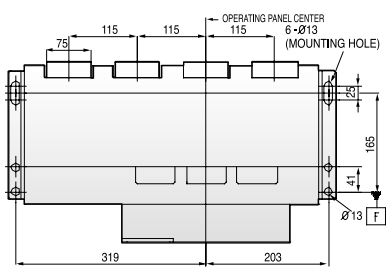
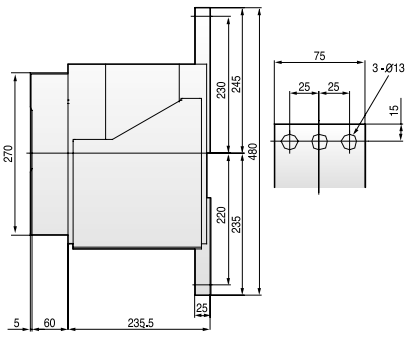
Fixed Type 4000AF (630A~3200A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		
■ Front Connection Type(3P Plan View)	■ Front Connection Type(4P Plan View)	■ Front Connection Type(Side View)
		

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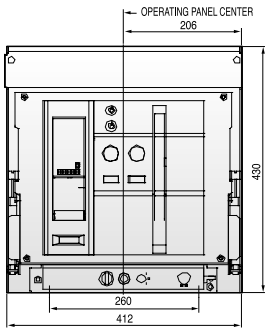
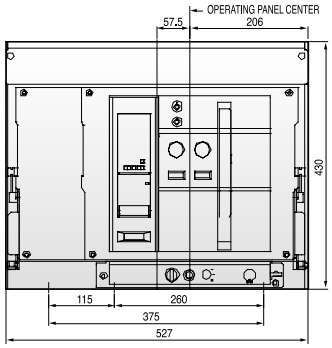
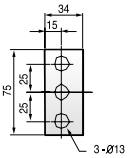
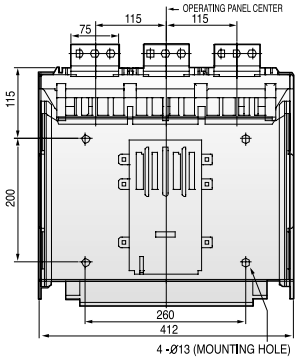
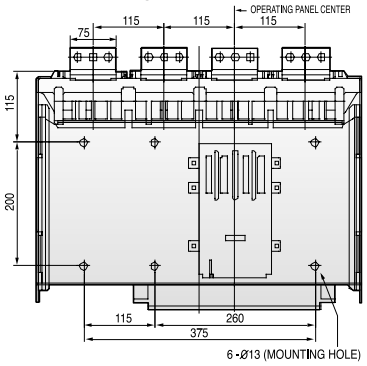
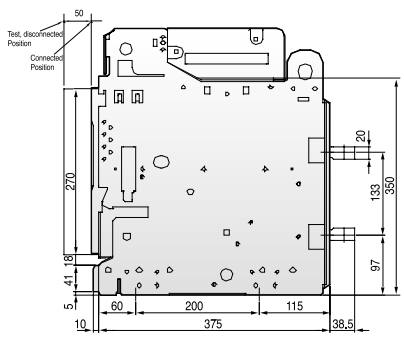
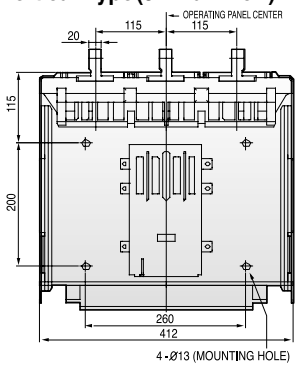
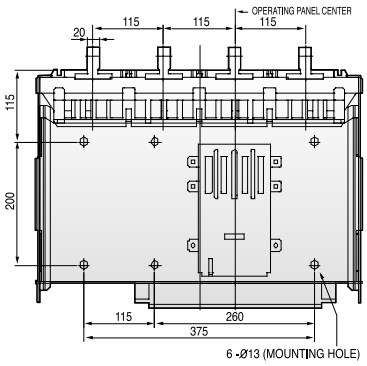
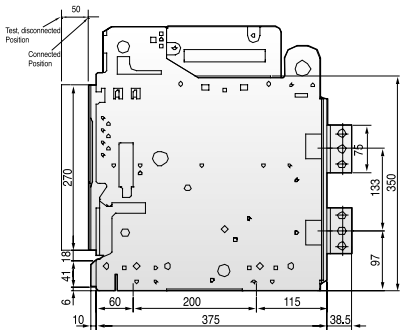
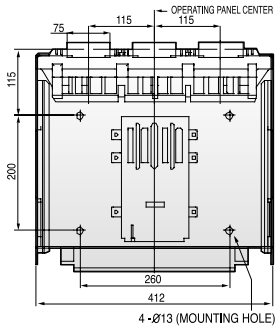
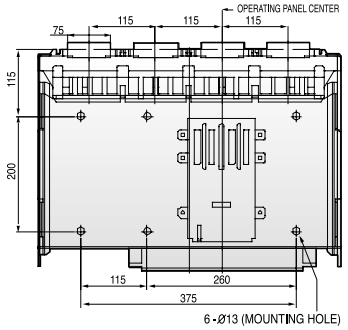
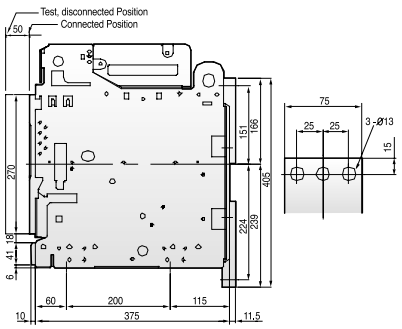
2. External Dimension

Draw-out Type 4000AF (630A~3200A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		
■ Front Connection Type(3P Plan View)	■ Front Connection Type(4P Plan View)	■ Front Connection Type(Side View)
		

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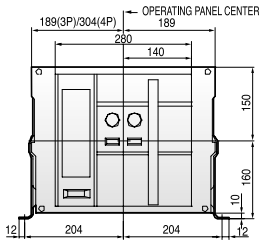
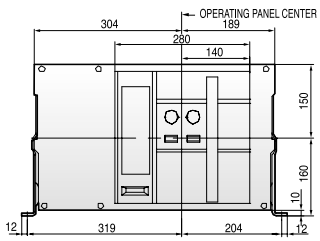
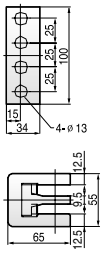
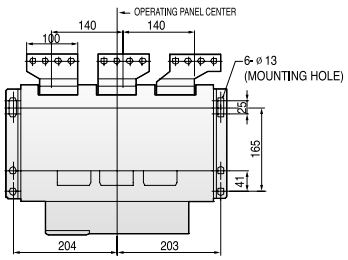
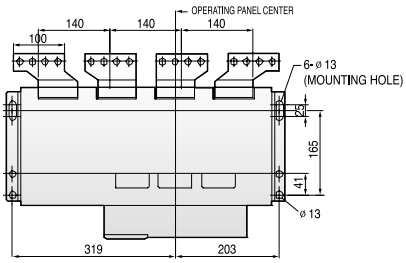
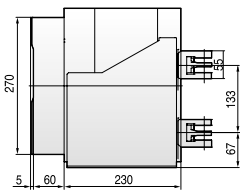
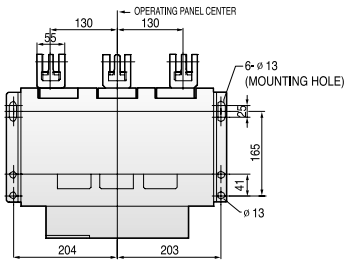
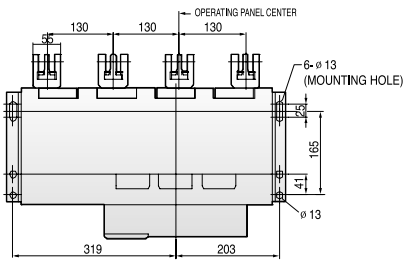
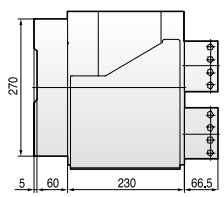
Fixed Type 4000AF (4000A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		

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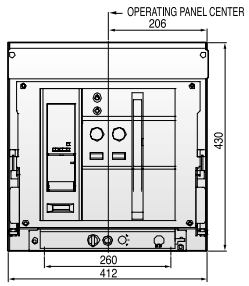
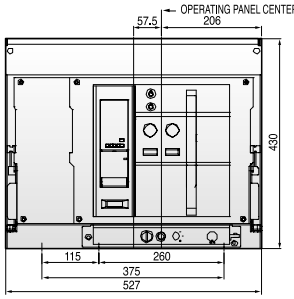
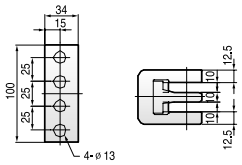
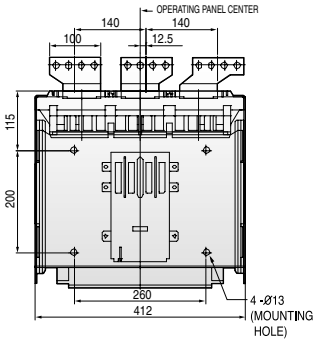
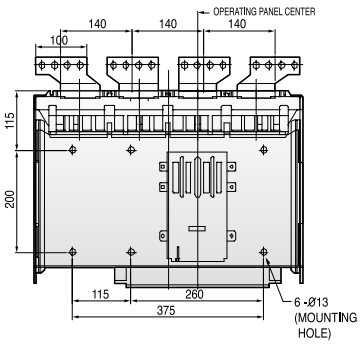
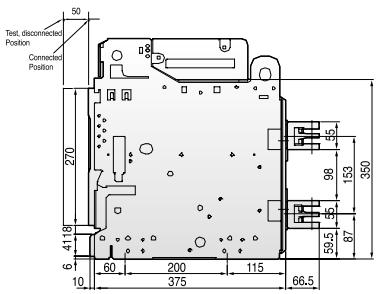
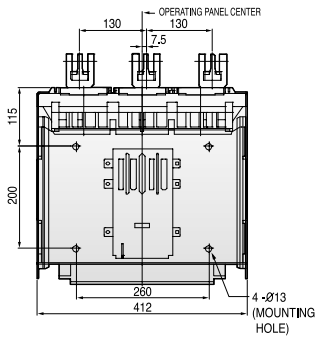
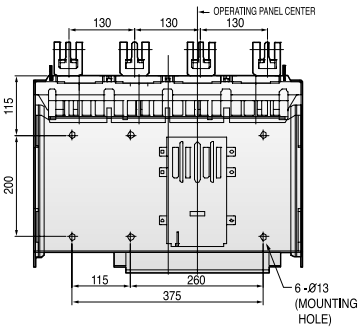
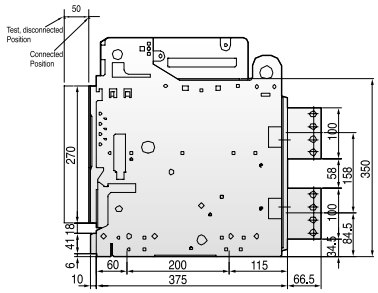
2. External Dimension

Draw-out Type 4000AF (4000A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		

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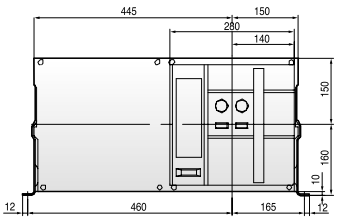
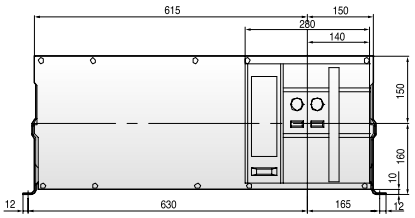
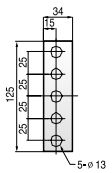
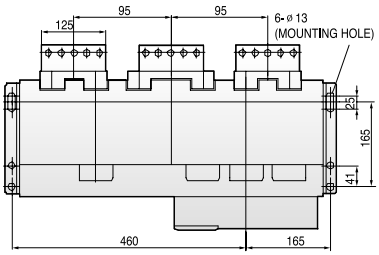
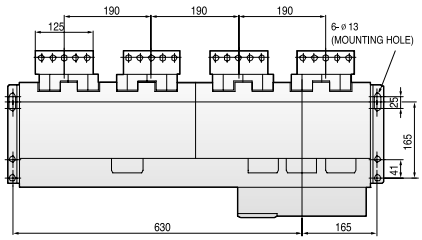
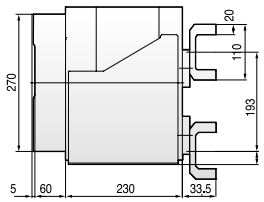
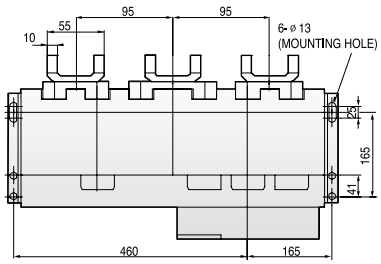
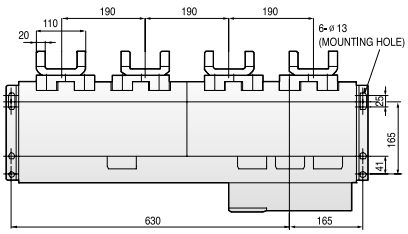
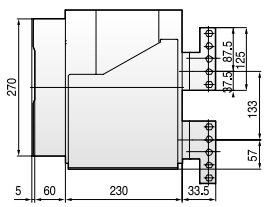
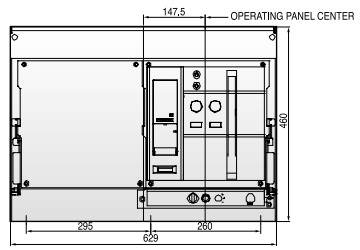
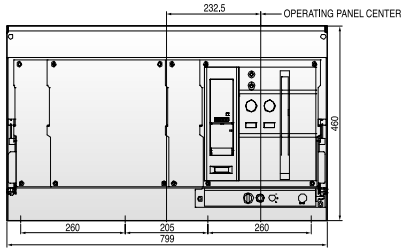
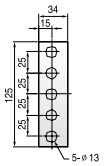
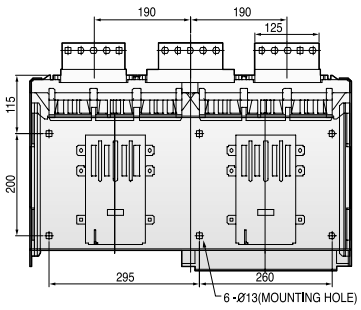
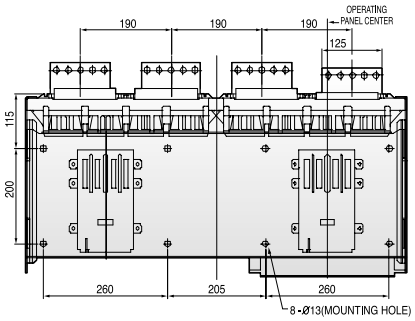
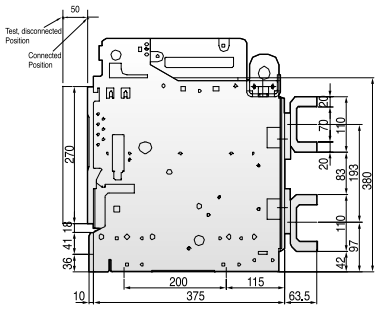
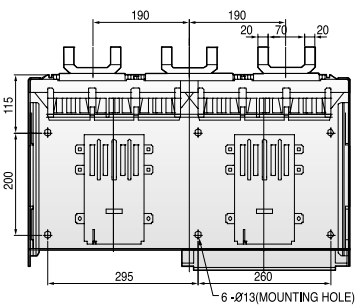
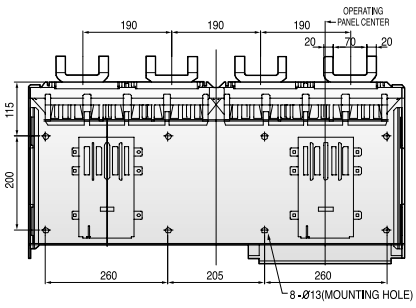
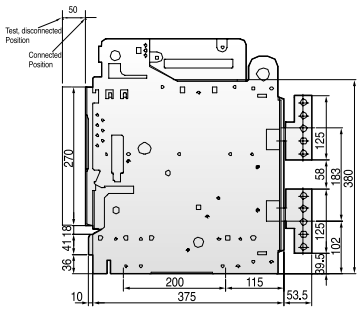
Fixed Type 5000AF

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		

2. External Dimension

Draw-out Type 5000AF

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		

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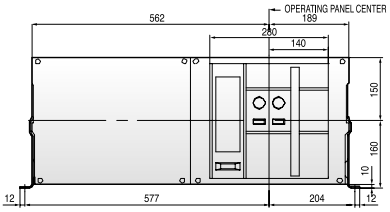
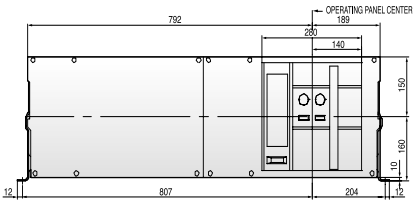
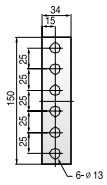
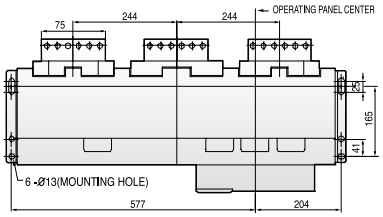
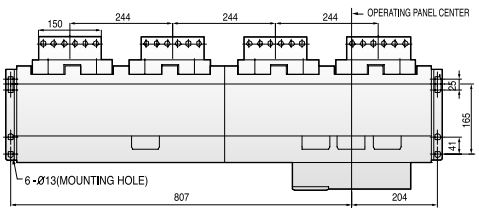
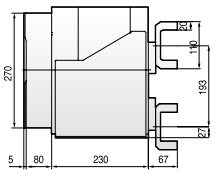
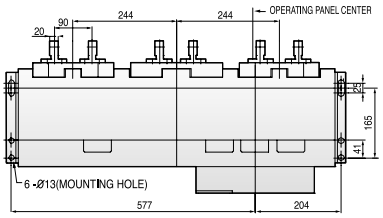
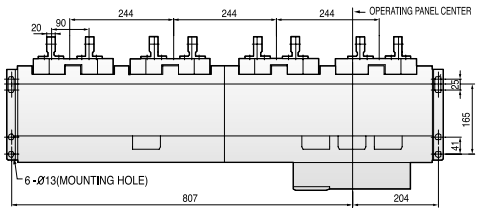
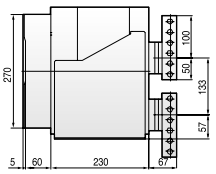
Fixed Type 6300AF (4000~6300A)

Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		

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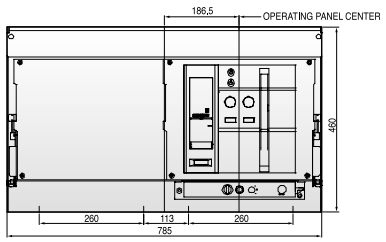
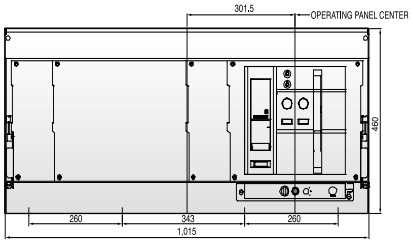
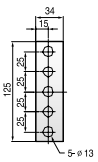
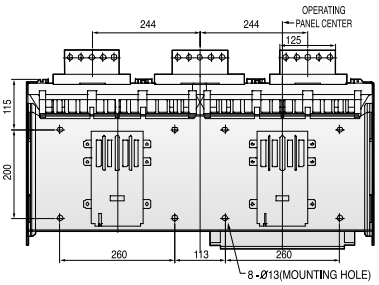
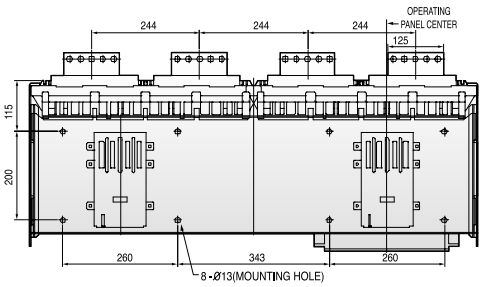
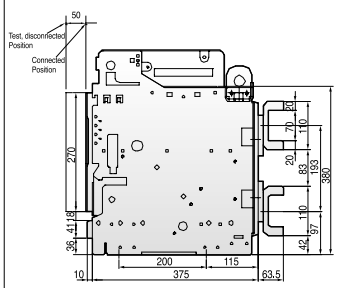
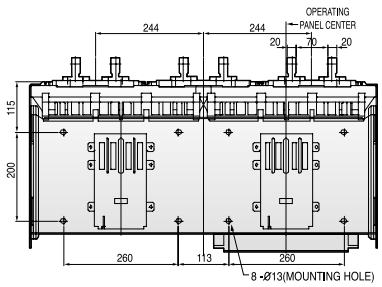
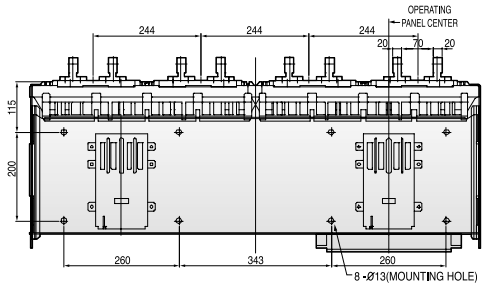
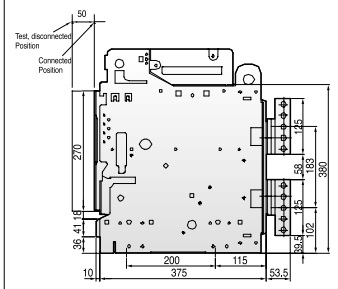
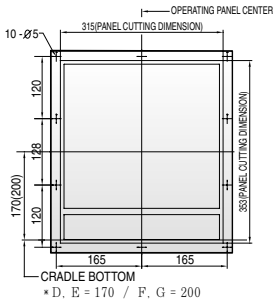
2. External Dimension

Draw-out Type 6300AF(4000~6300A)

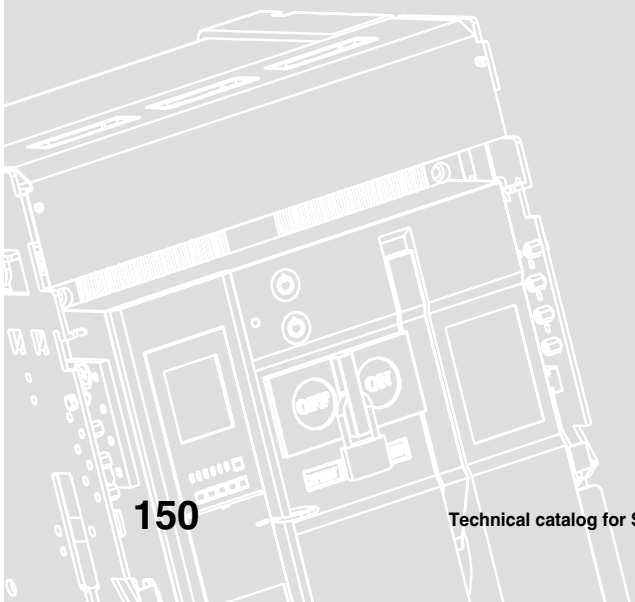
Front View [3P]	Front View [4P]	Conductor
		
■ Horizontal Type(3P Plan View)	■ Horizontal Type(4P Plan View)	■ Horizontal Type(Side View)
		
■ Vertical Type(3P Plan View)	■ Vertical Type(4P Plan View)	■ Vertical Type(Side View)
		

Panel Cutting Dimension

■ Common use for all types



L. Ordering Sheet



Ordering Sheet

1. Susol/Metasol ACB

If rated current or the order you placed is different from the ordering sheet listed below, please fill out another ordering sheet upon your specification.

Receipt	LS Industrial Systems co., Ltd Team Esq.	Order Day	YYYY MM DD	Distributor Name	
Project		Contractor			
Delivery place		Delivery date		PNL Maker	

ACB Main body	Type of ACB	· Metasol ☐ AN Note 1)	☐ AS	· Susol ☐ AH			
	Frame size	☐ D (630~2000AF)	☐ E (2000~4000AF) Note 2)	☐ F (4000~5000AF)	☐ G (4000~6300AF)		
	Ratings	AF					
	Rated current (CT)	A					
	Trip Relay	☐ NO					
		☐ YES					

TYPE	Frequency		Control voltage			Comm.		Optional function		
	60Hz	50Hz	NO	AC/DC 110~220V	DC 24~48V	NO	YES	Earth leakage detection	External CT ground fault	Pre-Trip Alarm
Normal	☐ NG0	☐ NG5	•	-	-	•	-	-	-	-
Ammeter	☐ AG0	☐ AG5	•	-	-	•	-	-	-	-
	☐ AG1	☐ AG6	-	•	-	•	-	-	-	-
	☐ AG2	☐ AG7	-	-	•	•	-	-	-	-
	☐ AZ0	☐ AZ5	•	-	-	•	-	•	-	-
	☐ AZ1	☐ AZ6	-	•	-	•	-	•	-	-
	☐ AZ2	☐ AZ7	-	-	•	•	-	•	-	-
	☐ AE0	☐ AE5	•	-	-	•	-	-	•	-
	☐ AE1	☐ AE6	-	•	-	•	-	-	•	-
	☐ AE2	☐ AE7	-	-	•	•	-	-	•	-
	☐ AC1	☐ AC6	-	•	-	-	•	-	-	-
	☐ AC2	☐ AC7	-	-	•	-	•	-	-	-
	☐ AK1	☐ AK6	-	•	-	-	•	•	-	-
	☐ AK2	☐ AK7	-	-	•	-	•	•	-	-
	☐ AX1	☐ AX6	-	•	-	-	•	-	•	-
	☐ AX2	☐ AX7	-	-	•	-	•	-	-	•

TYPE	Frequency		Control voltage			Comm.		Optional function		
	60Hz	50Hz	NO	AC/DC 110~220V	DC 24~48V	NO	YES	Earth leakage detection	External CT ground fault	Pre-Trip Alarm
Power Meter	☐ PC1	☐ PC6	-	•	-	-	•	-	-	-
	☐ PC2	☐ PC7	-	-	•	-	•	-	-	-
	☐ PK1	☐ PK6	-	•	-	-	•	•	-	-
	☐ PK2	☐ PK7	-	-	•	-	•	•	-	-
	☐ PX1	☐ PX6	-	•	-	-	•	-	•	-
	☐ PX2	☐ PX7	-	-	•	-	•	-	•	-
	☐ PA1	☐ PA6	-	•	-	-	•	-	-	•
	☐ PA2	☐ PA7	-	-	•	-	•	-	-	•
Supreme Meter	☐ SC1	☐ SC6	-	•	-	-	•	-	-	-
	☐ SC2	☐ SC7	-	-	•	-	•	-	-	-
	☐ SK1	☐ SK6	-	•	-	-	•	•	-	-
	☐ SK2	☐ SK7	-	-	•	-	•	•	-	-
	☐ SX1	☐ SX6	-	•	-	-	•	-	•	-
	☐ SX2	☐ SX7	-	-	•	-	•	-	•	-
	☐ SA1	☐ SA6	-	•	-	-	•	-	-	•
	☐ SA2	☐ SA7	-	-	•	-	•	-	-	•

Note) 1. Standard function: Ground fault detection 2. Communication function is not available under no control voltage 3. AN, AS type is not available for S Meter
4. P(Power), S(Supreme) Meter is also available for Generator protection 5. P, S Meter needs the accessory(VDM) for voltage measurement

	No.of poles	☐ 3-pole	☐ 4-pole				
	Installation type	☐ Draw-out type	☐ Fixed type				
	Phase arranging order	☐ Standard type (R, S, T, N)	☐ Reverse phase type (N, R, S, T)				
	Closing type	☐ Manual closing					
		☐ Electrical closing					
		· Charge method : Charging completion contact(1b) is basically installed	☐ Standard type (OFF-Charge method)				
			☐ Rapid auto-reclosing type (ON-Charge method)				
		· Motor operating voltage	☐ AC/DC 100V~130V	☐ DC 125V	☐ DC 24V~30V	☐ DC 48V~60V	
			☐ AC/DC 200V~250V	☐ AC 380V~415V	☐ AC 440V~480V	☐ AC 48V	
	Closing voltage	☐ AC/DC 100V~130V	☐ DC 125V	☐ AC/DC 200V~250V	☐ DC 24V~30V	☐ DC 48V~60V	☐ AC 380V~480V ☐ AC 48V
	Trip voltage	☐ AC/DC 100V~130V	☐ DC 125V	☐ AC/DC 200V~250V	☐ DC 24V~30V	☐ DC 48V~60V	☐ AC 380V~480V ☐ AC 48V
ACB Cradle	Cradle type	☐ No Safety Shutter (E class)	☐ Safety Shutter Attachment (F class)				
	Installation type	☐ Manual connection	☐ Automatic connection				
	Bus-bar type	☐ Horizontal	☐ Vertical	☐ Plane	☐ Top: Horizontal, Bottom: Vertical	☐ Top: Vertical, Bottom: Horizontal	☐ Customer mounting

ACB Accessory	ACB Main body	Standard Accessory	· Aux. contact	☐ Standard type (3a3b, standard installation)	☐ Extended type (5a5b) Note 4)	☐ High capacity (5a5b) Note 4)	
			· Key Lock		☐ Single Key (ON-Lock)	☐ Double Key (ON-Lock)	
			· Undervoltage trip device (UVT, Instantaneous type)	☐ AC/DC 100V~130V	☐ DC 125V	☐ AC/DC 200V~250V	
				☐ DC 24V~30V	☐ DC 48V~60V	☐ AC 380V~480V	☐ AC 48V
			· Mechanical operation contact (MOC), Door Interlock (DI)		☐ Non-attachment type	☐ Attachment type	
			· Mechanical Interlock (MI)		☐ Non-attachment type	☐ Attachment type	
			· Counter Note 3)		☐ Non-attachment type	☐ Attachment type	
			· Miss insertion preventive device (MIP)		☐ Non-attachment type	☐ Attachment type	
			· Automatic spring discharge device		☐ Non-attachment type	☐ Attachment type	
			· Double trip device (Same with Shunt voltage)		☐ Non-attachment type	☐ Attachment type	
			· Ready-to-close contact		☐ Non-attachment type	☐ Attachment type	
			· Trip Alarm switch, Manual Reset Button		☐ Non-attachment type	☐ Attachment type	
			☐ Key Interlock(K2, ON-Lock)		☐ ON/OFF Button Lock		
			☐ Automatic spring discharge device		☐ Electrical Remote Reset		
	ACB Cradle	Standard Accessory	☐ Safety Shutter Lock				
			☐ Arc cover Note 3)				
	Separate purchase	Main body mounting	☐ Insulation barrier Note 3)				
		Cradle mounting	· Cell switch (CL)	☐ 4c	☐ 8c		
			☐ Door Interlock				
			· Mechanical operation contact (MOC)		☐ Standard type (10a10b)	☐ High capacity (10a10b)	
			· Mechanical Interlock (MI)		☐ Wire type (2 terminals)	☐ Wire type (3 terminals)	
			· Shortening b-contact (SBC, 4b Max)	☐ 1b	☐ 2b	☐ 3a	☐ 4a
			· Miss insertion preventive device (MIP)		☐ Non-attachment type	☐ Attachment type	
			☐ Cradle fixing block	☐ Control terminal cover	☐ Spring energy auto releasing device		
			☐ Racking Interlock	☐ Insulation barrier Note 3)			
		External mounting	· UVT time delay controller	☐ AC/DC 100V~130V	☐ DC 125V	☐ AC/DC 200V~250V	
				☐ DC 48V~60V	☐ AC 380V~480V	☐ AC 48V	
			☐ Door Frame (DF)	☐ Condenser trip device (CTD)	☐ OCR Tester		
			☐ Dust Cover	☐ Lifting Hook	☐ Condensor Trip Device(CTD)	☐ Voltage Divide Module(VDM)	
			☐ TRIOU(Remote Closing/Trip, Modbus is basically installed) additional function(Multiple selection is available) ☐ Profibus-DP Comm ☐ Temperature Monitoring				

Note) 1. In case of D type of Metasol (AN), frame size is in the range of 630~1600AF, in case of E type, it is in the range of 2000~3200AF.
2. In case of E type of Susol (AH), frame size is available in the range of 630~4000AF.
3. The standard accessory for Susol (AH).
4. Aux. contact with extended/high capacity type adopts the rapid auto-reclosing method and available up to 6a6b.

Memo

Memo

Title : Technical catalogue of Susol & metasol ACB

Document No : Tech, ACB 695-001

Issued team : Electric equip.)
Technology management team

Issued date : June, 2007

Super Solution

Green Innovators of Innovation

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Technical Catalog for Susol&Metasol ACB 2007.07/(02) 2012.10 HUMANPOWER