Leading Innovation, Creating Tomorrow

Metasol

Meta Solution

Low voltage circuit breakers

Technical Manual

LS Industrial Systems
www.lsis.biz

Contents

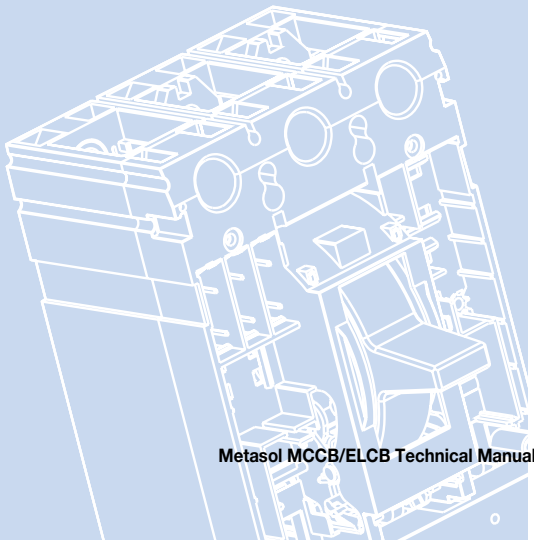
Upgrade of Meta-MEC series

··· Metasol series low voltage circuit breakers

- *Compatible and differentiated design*
  - Compatible with the Meta-MEC
  - Outlook differentiated design
- *Same External dimension with MCCB and ELCB*
- *Upgrade the coordination*

  Upgrade the coordination with Susol / Meta-MEC mass capacity
- *Upgrade breaking capacity*
  - N100AF : 10 ➡ 18kA
  - S125AF : 25 ➡ 37kA
  - S250AF : 25 ➡ 37kA
  - H250AF : 35 ➡ 50kA
  - N400AF : 25 ➡ 37kA
  - S400AF : 35 ➡ 50kA
  - S800AF : 50 ➡ 65kA
- *Ics = 100% Icu*
- *External differentiated Design*

A. Overview



1. Standard and Approvals

The Metasol series MCCB and ELCB meet the following international standards

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

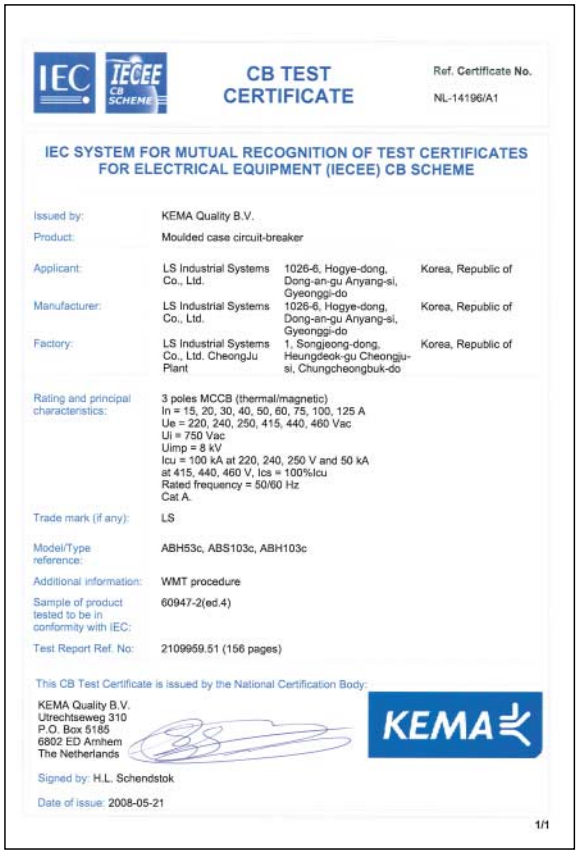
- **IEC 60947-2**
  Low-voltage switchgear and controlgear - Part 2: Circuit-breakers

Metasol circuit breakers have obtained the certificates below and under certain circumstances, the certificates can be provided.

- CB Certificate (KEMA - IEC 60947)
- Test report (KEMA)

CE mark

The CE mark shows that the manufacturer meets all the essential requirements of the relevant European directive to affix the CE mark on the product.
By affixing the CE mark, it shows that the manufacturer meets all the requirements including those of the product valuation process, and authorized representative's intentions.



IEC IECEE CB SCHEME

CB TEST CERTIFICATE

Ref. Certificate No. NL-14196/A1

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

Issued by:	KEMA Quality B.V.		
Product:	Moulded case circuit-breaker		
Applicant:	LS Industrial Systems Co., Ltd.	1026-6, Hogye-dong, Dong-an-gu Anyang-si, Gyeonggi-do	Korea, Republic of
Manufacturer:	LS Industrial Systems Co., Ltd.	1026-6, Hogye-dong, Dong-an-gu Anyang-si, Gyeonggi-do	Korea, Republic of
Factory:	LS Industrial Systems Co., Ltd. CheongJu Plant	1, Songjeong-dong, Heungdeok-gu Cheongju-si, Chungcheongbuk-do	Korea, Republic of
Rating and principal characteristics:	3 poles MCCB (thermal/magnetic) In = 15, 20, 30, 40, 50, 60, 75, 100, 125 A Ue = 220, 240, 250, 415, 440, 460 Vac Ui = 750 Vac Uimp = 8 kV Icu = 100 kA at 220, 240, 250 V and 50 kA at 415, 440, 460 V, Ics = 100%Icu Rated frequency = 50/60 Hz Cat A.		
Trade mark (if any):	LS		
Model/Type reference:	ABH53c, ABS103c, ABH103c		
Additional information:	WMT procedure		
Sample of product tested to be in conformity with IEC:	60947-2(ed.4)		
Test Report Ref. No:	2109959.51 (156 pages)		

This CB Test Certificate is issued by the National Certification Body:

KEMA Quality B.V.
Utrechtseweg 310
P.O. Box 5185
6802 ED Arnhem
The Netherlands

KEMA

Signed by: H.L. Schendstok

Date of issue: 2008-05-21

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IEC IECEE CB SCHEME

CB TEST CERTIFICATE

Ref. Certificate No. NL-14216/A2

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

Issued by:	KEMA Quality B.V.		
Product:	Moulded case circuit-breaker (earth leakage circuit-breaker)		
Applicant:	LS Industrial Systems Co., Ltd.	1026-6, Hogye-dong, Dong-an-gu Anyang-si, Gyeonggi-do	Korea, Republic of
Manufacturer:	LS Industrial Systems Co., Ltd.	1026-6, Hogye-dong, Dong-an-gu Anyang-si, Gyeonggi-do	Korea, Republic of
Factory:	LS Industrial Systems Co., Ltd. CheongJu Plant	1, Songjeong-dong, Heungdeok-gu Cheongju-si, Chungcheongbuk-do	Korea, Republic of
Rating and principal characteristics:	3 pole Earth leakage circuit-breaker (thermal/magnetic with electronic ground fault detection: 30 mA, 100/200/500 mA) In = 15, 20, 30, 40, 50, 60, 75,100 and 125A Ue = 220, 240, 250 and 415, 440, 460 Vac Ui = 460 Vac Uimp = 6 kV Icu = 100 kA at 220, 240, 250 V and Icu = 50 kA at 415, 440, 460 V Ics = 100%Icu Rated frequency = 50/60 Hz Cat A		
Trade mark (if any):	LS		
Model/Type reference:	EBS 103c, EBH 53c, EBH103c		
Additional information:	WMT procedure		
Sample of product tested to be in conformity with IEC:	60947-2(ed.4)		
Test Report Ref. No:	2109959.54		

This CB Test Certificate is issued by the National Certification Body:

KEMA Quality B.V.
Utrechtseweg 310
P.O. Box 5185
6802 ED Arnhem
The Netherlands

KEMA

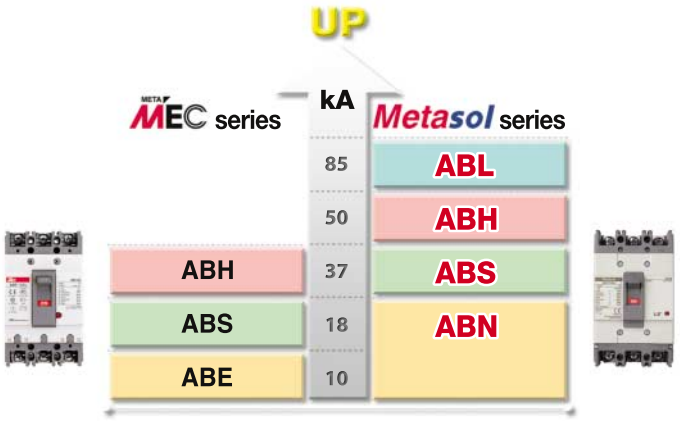
Signed by: H.L. Schendstok

Date of issue: 2008-06-05

1/1

2. Metasol series characteristics

Breaking capacity improvement



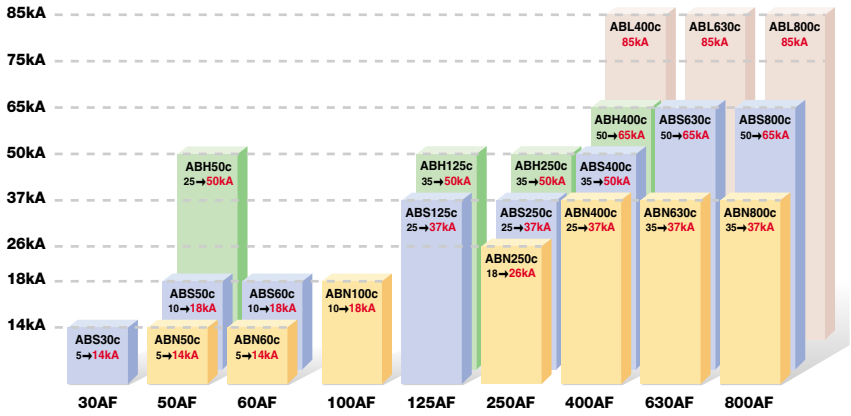
- N100AF : 10 ⇒ 18kA
- S125AF : 25 ⇒ 37kA
- S250AF : 25 ⇒ 37kA
- H250AF : 35 ⇒ 50kA
- N400AF : 25 ⇒ 37kA
- S400AF : 35 ⇒ 50kA
- S630AF : 50 ⇒ 65kA
- S800AF : 50 ⇒ 65kA

Upgrade of Meta-MEC series

Metasol MCCB

Breaking capacity comparison table - Present upgrade status

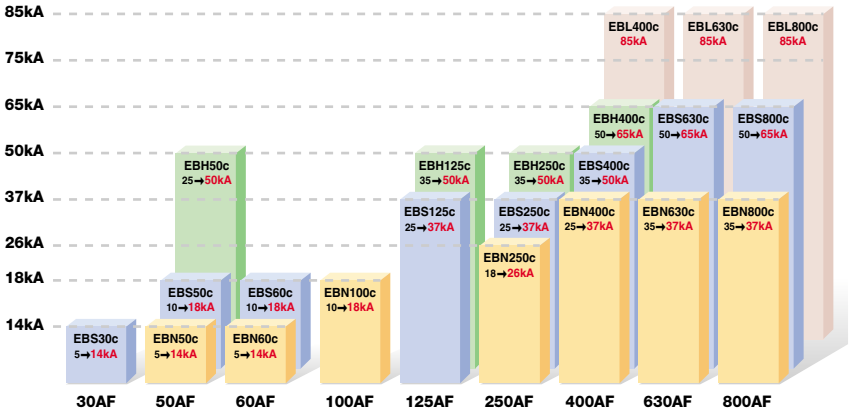
460V



Metasol ELCB

Breaking capacity comparison table - Present upgrade status

460V



3. Externals and Inscriptions

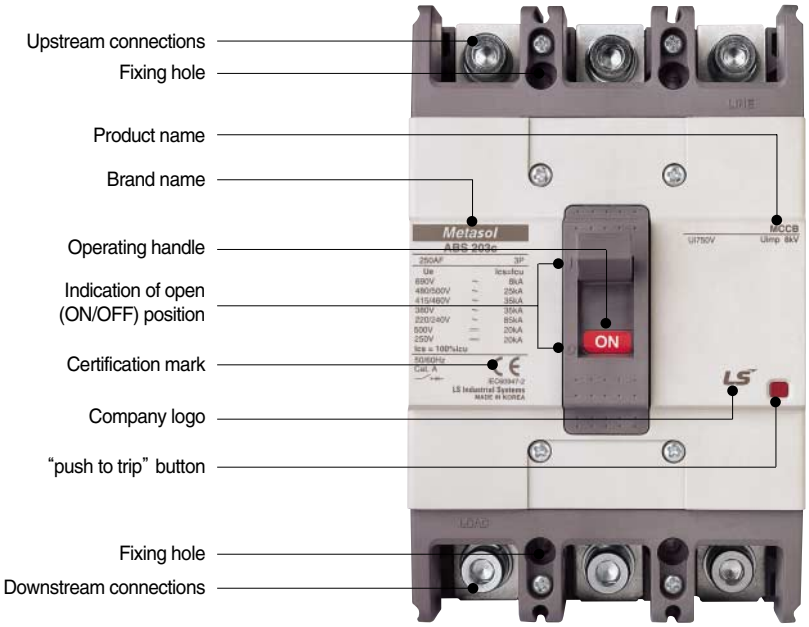
A

Metasol MCCB

MCCB model
- ABN: Economic type
- ABS: Standard type
- ABH: High capacity type

Standardized characteristics
Ui: Rated insulation voltage
Uimp: Impulse withstand voltage
Ue: Rated operational voltage
Icu: Ultimate breaking capacity
Ics: Service breaking capacity

Rated frequency
Utilization category
Manufacturer
Standard
Symbol indicating suitability for isolation as defined by IEC 947-2



A

Metasol ELCB

ELCB model

- EBN: Economic type
- EBS: Standard type
- EBH: High capacity type

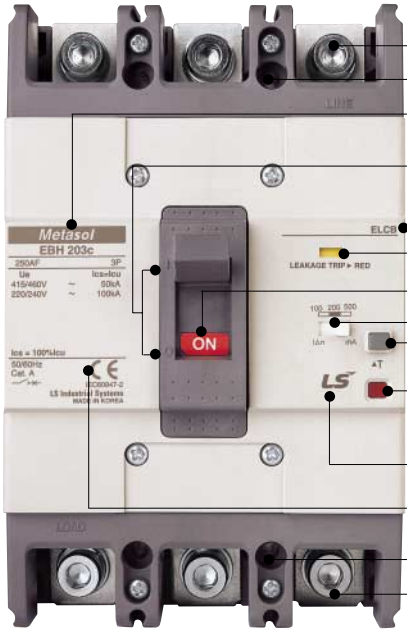
Rated frequency

Symbol indicating
suitability for isolation
as defined by IEC 947-2

Standard

Manufacturer

Utilization category



Upstream connections

Fixing hole

Brand name

Indication of open
(ON/OFF) position

Product name

Earth leakage trip indicator

Operating handle

Residual current selector

Trip test button(Earth leakage)

Trip test button(Mechanical)

Company logo

Certification mark

Fixing hole

Downstream connections

4. Ratings

A

Metasol MCCB

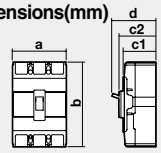
AF			30AF			50AF									60AF		
Frame type			ABS			ABN			ABH			ABH			ABN		
Type			ABS32c	ABS33c	ABS34c	ABN52c	ABN53c	ABN54c	ABS52c	ABS53c	ABS54c	ABH52c	ABH53c	ABH54c	ABN62c	ABN63c	ABN64c
Ratings	No. of poles		2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
	Rated current (In)	A	(3, 5, 10) 15, 20, 30			15, 20, 30, 40, 50			15, 20, 30, 40, 50			15, 20, 30, 40, 50			15, 20, 30, 40, 50, 60		
	Rated operational	AC (V)	690			690			690			690			690		
	voltage (Ue)	DC (V)	500			500			500			500			500		
	Rated insulation voltage (Ui)	V	750			750			750			750			750		
	Rated impulse withstand voltage (Uimp)	kV	8			8			8			8			8		
Rated ultimate short circuit		690V	2.5			2.5			5			10			2.5		
breaking capacity AC		480/500V	7.5			7.5			10			35			7.5		
(KA) Icu (Sym)		415/460V	14 (10)			14			18			50			14		
KSC 8321		380V	18 (14)			18			22			50			18		
IIEC947-2		220/250V	30 (25)			30			35			100			30		
	DC	500V (3극)	5			5			10			30			5		
		250V (2극)	5			5			10			30			5		
Ics=% × Icu			100			100			100			100			100		
Magnetic trip range			Rated current 3~10A : 12In			Rated current 15~30A : 400A			Rated current 15~30A : 400A			Rated current 15~30A : 400A			Rated current 15~30A : 400A		
			Rated current 15~30A : 400A			Rated current 40~50A : 12In			Rated current 40~50A : 12In			Rated current 40~50A : 12In			Rated current 40~60A : 12In		
Endurance		Mechanical	25000			25000			25000			25000			25000		
(Number of operations)		Electrical	10000			10000			10000			10000			10000		
Dimensions(mm)		a	50	75	100	50	75	100	50	75	100	60	90	120	50	75	100
		b	130			130			130			155			130		
		c1	60			60			60			60			60		
		c2	64			64			64			64			64		
		d	82			82			82			82			82		
Type of trip unit			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type		
Trip test button			O			O			O			O			O		
Connection	front-connection		O			O			O			O			O		
	rear-connection		O			O			O			O			O		
	Plug-in		-	O	-	-	O	-	-	O	-	-	O	-	-	O	-
Mounting (standard)			screw fixing			screw fixing			screw fixing			screw fixing			screw fixing		
Accessories	Auxiliary switch	AX	O			O			O			O			O		
	Alarm switch	AL	O			O			O			O			O		
	Shunt trip	SHT	O			O			O			O			O		
	Undervoltage trip	UVT	O			O			O			O			O		
	Extended rotary handle	D (Direct)	-	O	O	-	O	O	-	O	O	-	O	O	-	O	O
		E (Extended)	-	O	O	-	O	O	-	O	O	-	O	O	-	O	O
	Terminal cover	Long Type	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
		Short Type	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	Insulation barrier	B	O			O			O			O			O		

	100AF						125AF						250AF								
	ABS			ABN			ABS			ABH			ABN			ABS			ABH		
	ABS62c	ABS63c	ABS64c	ABN102c	ABN103c	ABN104c	ABS102c	ABS103c	ABS104c	ABH102c	ABH103c	ABH104c	ABN202c	ABN203c	ABN204c	ABS202c	ABS203c	ABS204c	ABH202c	ABH203c	ABH204c
	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
	15, 20, 30, 40, 50, 60			15, 20, 30, 40, 50, 60, 75, 100			15, 20, 30, 40, 50, 60, 75, 100, 125			15, 20, 30, 40, 50, 60, 75, 100, 125			100, 125, 150, 175, 200, 225, 250			100, 125, 150, 175, 200, 225, 250			100, 125, 150, 175, 200, 225, 250		
	690			690			690			690			690			690			690		
	500			500			500			500			500			500			500		
	750			750			750			750			750			750			750		
	8			8			8			8			8			8			8		
	5			5			8			10			8			8			10		
	10			10			26			35			18			26			35		
	18			18			37			50			26			37			50		
	22			22			42			50			30			42			50		
	35			35			85			100			65			85			100		
	10			10			20			30			10			20			30		
	10			10			20			30			10			20			30		
	100			100			100			100			100			100			100		
	Rated current 15~30A : 400A			Rated current 15~30A : 400A			Rated current 15~30A : 400A			Rated current 15~30A : 400A			12In			12In			12In		
	Rated current 40~60A : 12In			Rated current 40~100A : 12In			Rated current 40~125A : 12In			Rated current 40~125A : 12In											
	25000			25000			25000			25000			20000			20000			20000		
	10000			10000			10000			10000			5000			5000			5000		
	50	75	100	50	75	100	60	90	120	60	90	120	105		140	105		140	105		140
	130			130			155			155			165			165			165		
	60			60			60			60			60			60			60		
	64			64			64			64			64			64			64		
	82			82			82			82			87			87			87		
	Thermal magnetic type			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type			Thermal magnetic type		
	O			O			O			O			O			O			O		
	O			O			O			O			O			O			O		
	O			O			O			O			O			O			O		
	-	O	-	-	O	-	-	O	-	-	O	-	-	O	-	-	O	-	-	O	-
	screw fixing			screw fixing			screw fixing			screw fixing			screw fixing			screw fixing			screw fixing		
	O			O			O			O			O			O			O		
	O			O			O			O			O			O			O		
	O			O			O			O			O			O			O		
	O			O			O			O			O			O			O		
	-	O	O	-	O	O	-	O	O	-	O	O	O	O	O	O	O	O	O	O	O
	-	O	O	-	O	O	-	O	O	-	O	O	O	O	O	O	O	O	O	O	O
	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	O			O			O			O			O			O			O		

4. Ratings

A

Metasol MCCB

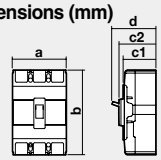
AF			400AF											
Frame type			ABN			ABS			ABH			ABL		
Type			ABN402c	ABN403c	ABN404c	ABS402c	ABS403c	ABS404c	ABH402c	ABH403c	ABH404c	ABL402c	ABL403c	ABL404c
Ratings	No. of poles		2, 3, 4											
	Rated current (In)	A	250, 300, 350, 400											
	Rated operational	AC (V)	690											
	voltage (Ue)	DC (V)	500											
	Rated insulation voltage (Ui)	V	750											
	Rated impulse withstand voltage (Uimp)	kV	8											
Rated ultimate short circuit		690V	5			8			10			4		
breaking capacity AC		480/500V	18			35			50			65		
(KA) Icu (Sym)		415/460V	37			50			65			85		
KSC 8321		380V	42			65			70			100		
IIEC947-2		220/250V	50			75			85			125		
	DC	500V (3극)	10			20			40			40		
		250V (2극)	10			20			40			40		
Ics=% × Icu			100			100			100			75		
Magnetic trip range			8~12In											
Endurance		Mechanical	4000											
(Number of operations)		Electrical	1000											
Dimensions(mm)		a	140		185	140		185	140		185	140		185
		b	257											
		c1	109											
		c2	113											
		d	145											
Type of trip unit			Thermal magnetic type											
Trip test button			O											
Connection	front-connection		O											
	rear-connection		O											
	Plug-in			O			O			O			O	
Mounting (standard)			screw fixing											
Accessories	Auxiliary switch	AX	O											
	Alarm switch	AL	O											
	Shunt trip	SHT	O											
	Undervoltage trip	UVT	O											
	Extended rotary handle	N (Direct)	O											
		E (Extended)	O											
	Terminal cover	Long Type	O											
		Short Type	O											
	Insulation barrier	B	O											

	630AF									800AF								
	ABN			ABS			ABL			ABN			ABS			ABL		
	ABN602c	ABN603c	ABN604c	ABS602c	ABS603c	ABS604c	ABL602c	ABL603c	ABL604c	ABN802c	ABN803c	ABN804c	ABS802c	ABS803c	ABS804c	ABL802c	ABL803c	ABL804c
	2, 3, 4									2, 3, 4								
	500, 630									700, 800								
	690									690								
	500									500								
	750									750								
	8									8								
	8			10			14			8			10			14		
	25			45			65			25			45			65		
	37			65			85			37			65			85		
	45			75			100			45			75			100		
	50			85			125			50			85			125		
	10			20			40			10			20			40		
	10			20			40			10			20			40		
	100			100			75			100			100			75		
	8~12In									8~12In								
	2500									2500								
	500									500								
	210		280	210		280	210		280	210		280	210		280	210		280
	280									280								
	109									109								
	113									113								
	145									145								
	Thermal magnetic type									Thermal magnetic type								
	O									O								
	O									O								
	O									O								
		O			O			O			O			O			O	
	screw fixing									screw fixing								
	O									O								
	O									O								
	O									O								
	O									O								
	O									O								
	O									O								
	O									O								
	O									O								
	O									O								

4. Ratings

A

Metasol ELCB

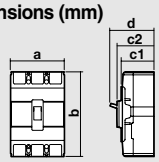
AF			30AF		50AF						60AF	
Frame type			EBS		EBN		EBS		EBH		EBN	
Type			EBS33c	EBS34c	EBN52c	EBN53c	EBS53c	EBS54c	EBH53c	EBH54c	EBN63c	
Rating	Wiring system		1Ø2W, 1Ø3W, 3Ø3W, 3Ø4W		1Ø2W,	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W 1Ø3W 3Ø3W	
	Type and poles		3P3E	4P3E	2P2E	3P3E	3P3E	4P3E	3P3E	4P3E	3P3E	
	Protective function		Overload, short circuit and Ground fault		Overload, short circuit and Ground fault		Overload, short circuit and Ground fault		Overload, short circuit and Ground fault		Overload, short circuit and Ground fault	
	Rated operational voltage (Ue)	AC (V)	220/460		220/460		220/460		220/460		220/460	
	Rated impulse withstand voltage (Uimp)	kV	6		6		6		6		6	
	Rated current (In)	A	15, 20, 30		15, 20, 30, 40, 50		15, 20, 30, 40, 50		15, 20, 30, 40, 50		60	
	Rated residual current	mA	30,100/200/500mA		30,100/200/500mA		30,100/200/500mA		30,100/200/500mA		30,100/200/500mA	
	Residual current off-time	sec	≤0.1sec		≤0.1sec		≤0.1sec		≤0.1sec		≤0.1sec	
Rated short circuit breaking capacity (KA) Icu IEC947-2		415/460V	14		14		18		50		14	
		220/250V	30		30		35		100		30	
Magnetic trip range			Rated current 3~10A : 12In		Rated current 15~30A : 400A		Rated current 15~30A : 400A		Rated current 15~30A : 400A		12In	
			Rated current 15~30A : 400A		Rated current 40~50A : 12In		Rated current 40~50A : 12In		Rated current 40~50A : 12In			
ndurance (Number of operations)		Mechanical	25000		25000		25000		25000		25000	
		Electrical	10000		10000		10000		10000		10000	
Dimensions (mm) 		a	75	100	75	75	75	100	90	120	75	
		b	130		130		130		155		130	
		c1	60		60		60		60		60	
		c2	64		64		64		64		64	
		d	82		82		82		82		82	
Type of trip unit			Thermal magnetic type		Thermal magnetic type		Thermal magnetic type		Thermal magnetic type		Thermal magnetic type	
Trip test button			O		O		O		O		O	
Connection	front-connection		O		O		O		O		O	
	rear-connection		O		O		O		O		O	
Mounting (standard)			screw fixing		screw fixing		screw fixing		screw fixing		screw fixing	
Accessories	Auxiliary switch	AX	O		O		O		O		O	
	Alarm switch	AL	O		O		O		O		O	
	Extended rotary handle	D (Direct)	O		O		O		O		O	
		E (Extended)	O		O		O		O		O	
	Terminal cover	Long Type	O	O	O	O	O	O	O	O	O	
		Short Type	O	O	O	O	O	O	O	O	O	
	Insulation barrier	B	O		O		O		O		O	

	100AF					125AF				250AF					
	EBS		EBN			EBS		EBH		EBN		EBS		EBH	
	EBS63c	EBS64c	EBN102c	EBN103c	EBN104c	EBS103c	EBS104c	EBH103c	EBH104c	EBN202c	EBN203c	EBS203c	EBS204c	EBH203c	EBH204c
	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W 3Ø4W
	3P3E	4P3E	2P2E	3P3E	4P3E	3P3E	4P3E	3P3E	4P3E	2P2E	3P3E	3P3E	4P3E	3P3E	4P3E
	Overload, short circuit and Ground faul		Overload, short circuit and Ground faul			Overload, short circuit and Ground faul		Overload, short circuit and Ground faul		Overload, short circuit and Ground faul		Overload, short circuit and Ground faul		Overload, short circuit and Ground faul	
	220/460		220/460			220/460		220/460		220/460		220/460		220/460	
	6		6			6		6		6		6		6	
	60		60, 75, 100			15, 20, 30, 40, 50, 60, 75, 100, 125		15, 20, 30, 40, 50, 60, 75, 100, 125		100, 125, 150, 175, 200, 225, 250		100, 125, 150, 175, 200, 225, 250		100, 125, 150, 175, 200, 225, 250	
	30,100/200/500mA		30,100/200/500mA			30,100/200/500mA		30,100/200/500mA		30,100/200/500mA		30,100/200/500mA		30,100/200/500mA	
	≤0.1sec		≤0.1sec			≤0.1sec		≤0.1sec		≤0.1sec		≤0.1sec		≤0.1sec	
	18		18			37		50		25		37		50	
	35		35			85		100		65		85		100	
	12In		Rated current 15~30A : 400A Rated current 40~100A : 12In			Rated current 15~30A : 400A Rated current 40~125A : 12In		Rated current 15~30A : 400A Rated current 40~100A : 12In		2In		12In		12In	
	25000		25000			25000		25000		20000		20000		20000	
	10000		10000			10000		10000		5000		5000		5000	
	75	100	75	75	100	90	120	90	120	105		105	140	105	140
	130		130			155		155		165		165		165	
	60		60			60		60		60		60		60	
	64		64			64		64		64		64		64	
	82		82			82		82		87		87		87	
	Thermal magnetic type		Thermal magnetic type			Thermal magnetic type		Thermal magnetic type		Thermal magnetic type		Thermal magnetic type		Thermal magnetic type	
	O		O			O		O		O		O		O	
	O		O			O		O		O		O		O	
	O		O			O		O		O		O		O	
	screw fixing		screw fixing			screw fixing		screw fixing		screw fixing		screw fixing		screw fixing	
	O		O			O		O		O		O		O	
	O		O			O		O		O		O		O	
	O		O			O		O		O		O		O	
	O		O			O		O		O		O		O	
	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	O		O			O		O		O		O		O	

4. Ratings

A

Metasol ELCB

AF			400AF								
Frame type			EBN		EBS		EBH		EBL		
Type			EBN403c	EBN404c	EBS403c	EBS404c	EBH403c	EBH404c	EBL403c	EBL404c	
Rating	Wiring system		1Ø2W 1Ø3W 3Ø3W		1Ø2W 1Ø3W 3Ø3W		1Ø2W 1Ø3W 3Ø3W		1Ø2W 1Ø3W 3Ø3W		
	Type and poles		3P3E	4P3E	3P3E	4P3E	3P3E	4P3E	3P3E	4P3E	
	Protective function		Overload, short circuit and Ground fault								
	Rated operational voltage (Ue)	AC (V)	220/460								
	Rated impulse withstand voltage (Uimp)	kV	6								
	Rated current (In)	A	250, 300, 350, 400								
	Rated residual current	mA	30, 100/200/500mA								
	Residual current off-time	sec	≤0.1sec								
Rated short circuit breaking capacity (KA) Icu IEC947-2		415/460V	37		50		65		85		
		220/250V	50		75		85		125		
Ics=% x Icu			100		100		100		75		
Magnetic trip range			8~12In								
ndurance (Number of operations)		Mechanical	4000								
		Electrical	1000								
Dimensions (mm)		a	140	185	140	185	140	185	140	185	
		b	257								
		c1	109								
		c2	113								
		d	145								
Type of trip unit			Thermal magnetic type								
Trip test button			O								
Connection	front-connection		O								
	rear-connection		O								
Mounting (standard)			screw fixing								
Accessories	Auxiliary switch	AX	O								
	Alarm switch	AL	O								
	Shunt trip	SHT	O								
	Undervoltage trip	UVT	O								
	Extended rotary handle	N (Direct)	O								
		E (Extended)	O								
	Terminal cover	Long Type	O		O	O	O	O	O	O	
		Short Type	O		O	O	O	O	O	O	
	Insulation barrier	B	O								

	630AF			800AF		
	EBN	EBS	EBL	EBN	EBS	EBL
	EBN603c	EBS603c	EBL603c	EBN803c	EBS803c	EBL803c
	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W	1Ø2W 1Ø3W 3Ø3W
	3P3E	3P3E	3P3E	3P3E	3P3E	3P3E
	Overload, short circuit and Ground fault			Overload, short circuit and Ground fault		
	220/460			220/460		
	6			6		
	500, 630			700, 800		
	30, 100/200/500mA			30, 100/200/500mA		
	≤0.1sec			≤0.1sec		
	37	65	85	37	65	85
	50	85	125	50	85	125
	100	100	75	100	100	75
	8~12In			8~12In		
	2500			2500		
	500			500		
	210	210	210	210	210	210
	280			280		
	109			109		
	113			113		
	145			145		
	Thermal magnetic type			Thermal magnetic type		
	O			O		
	O			O		
	O			O		
	screw fixing			screw fixing		
	O			O		
	O			O		
	O			O		
	O			O		
	O			O		
	O			O		
	O	O	O	O	O	O	O	O	O	O
	O	O	O	O	O	O	O	O	O	O
	O			O		

A

5. Line-up and body structure

Breaking capacity

Metasol MCCB

AF / Type	30AF	50AF	60AF	100AF	125AF	250AF
ABN		ABN50c 14kA	ABN60c 14kA	ABN100c 18kA		ABN250c 26kA
ABS	ABS30c 14kA	ABS50c 18kA	ABS60c 18kA		ABS125c 37kA	ABS250c 37kA
ABH		ABH50c 50kA			ABH125c 50kA	ABH250c 50kA

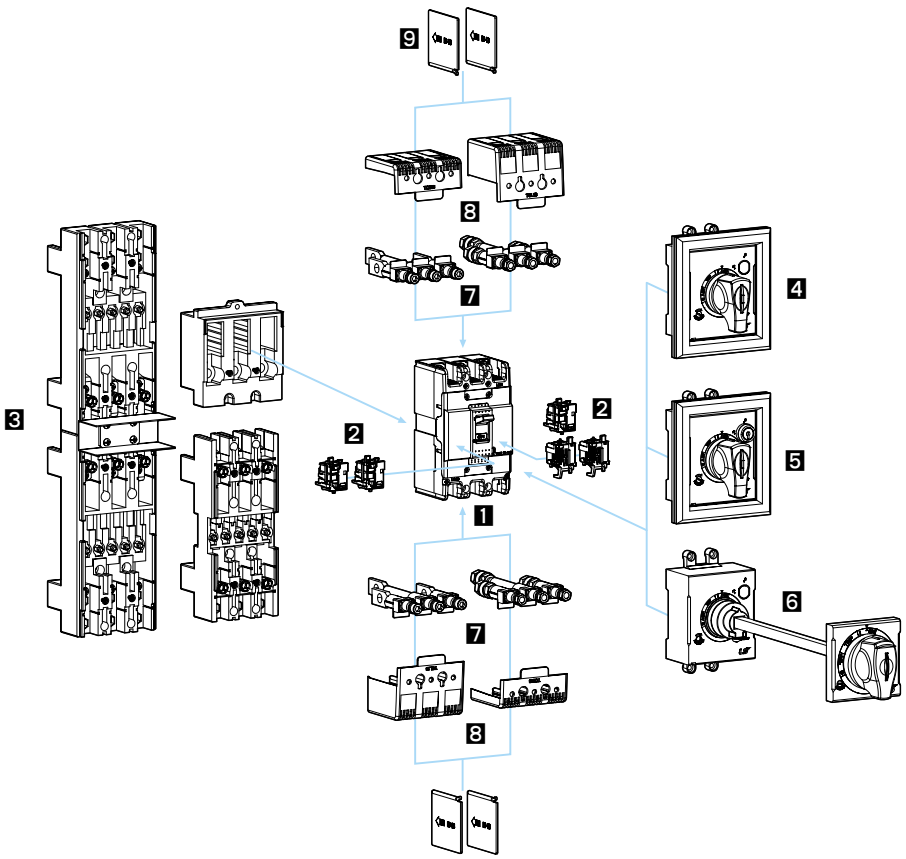
AF / Type	400AF	630AF	800AF
ABN	ABN400c 37kA	ABN630c 37kA	ABN800c 37kA
ABS	ABS400c 50kA	ABS630c 65kA	ABS800c 65kA
ABH	ABH400c 65kA		
ABL	ABL400c 85kA	ABL630c 85kA	ABL800c 85kA

Metasol ELCB

AF / Type	30AF	50AF	60AF	100AF	125AF	250AF
EBN		EBN50c 14kA	EBN60c 14kA	EBN100c 18kA		EBN250c 26kA
EBS	EBS30c 14kA	EBS50c 18kA	EBS60c 18kA		EBS125c 37kA	EBS250c 37kA
EBH		EBH50c 50kA			EBH125c 50kA	EBH250c 50kA

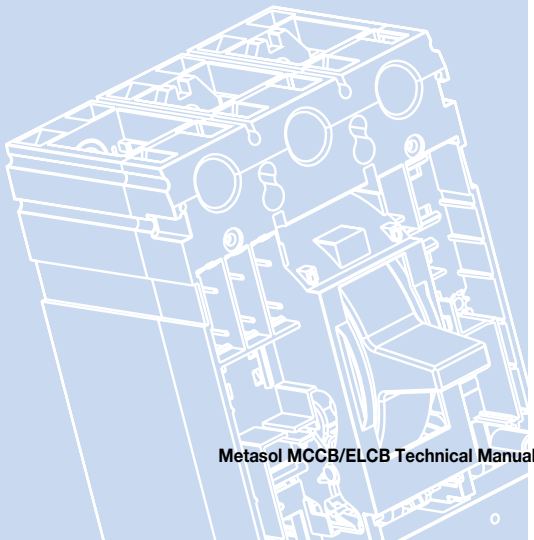
AF / Type	400AF	630AF	800AF
EBN	EBN400c 37kA	EBN630c 37kA	EBN800c 37kA
EBS	EBS400c 50kA	EBS630c 65kA	EBS800c 65kA
EBH	EBH400c 65kA		
EBL	EBL400c 85kA	EBL630c 85kA	EBL800c 85kA

System overview (MCCB/ELCB)



1 Breaker (MCCB/ELCB)
2 Internal auxiliaries
3 Plug-in kit
4 Rotary handle (direct)
5 Rotary handle (direct, key lock)
6 Rotary handle (extended)
7 Rear terminal
8 Terminal cover (Short, Long)
9 Insulation barrier

B. Structure and operating



1. Basic functions of the MCCB and ELCB

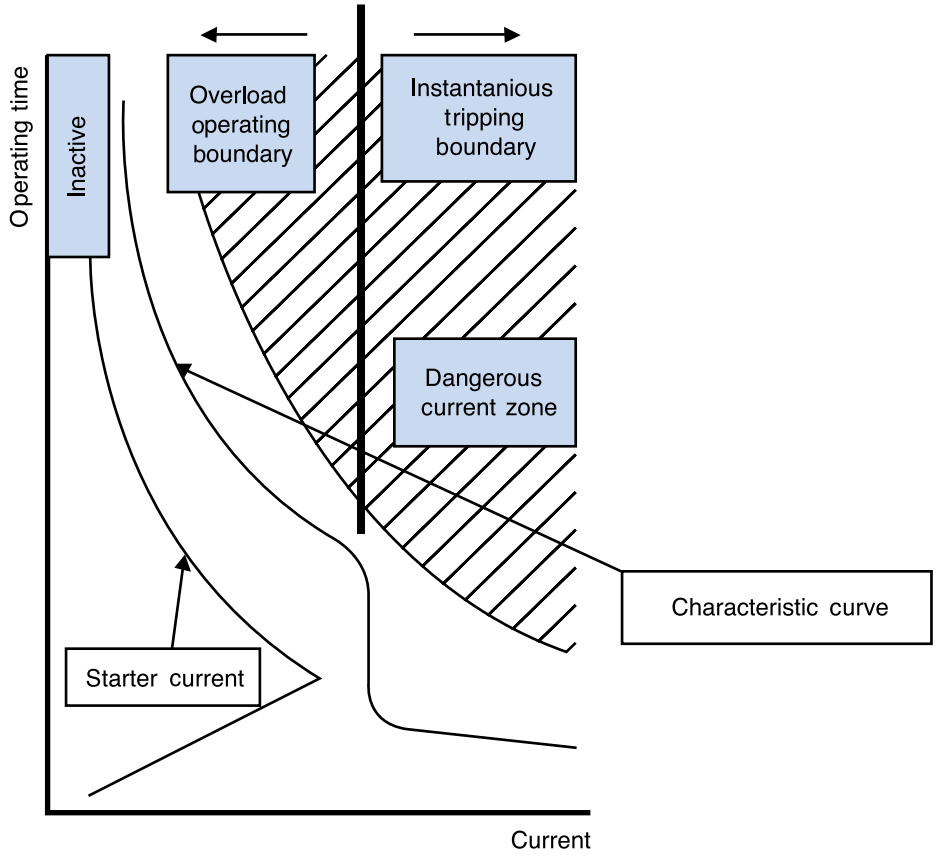
The basic functions of MCCB

By isolating the circuit from the fault current, MCCB can prevent load handling equipment damage and accidents like fire by isolating circuits.

1. Accident protection (instantaneous operation)
When a faulty large current flows, the MCCB isolates the circuit instantly. This is called instantaneous operation.

2. Overload protection (time-delay)
If the current flows constantly exceed the rated current, the electric wire can heat up and cause a fire.
Before the temperature of a wire reaches a dangerous level, the MCCB isolates the circuit. This is a time-delayed feature.

3. Motor trip inactive operation
If there is motor on the circuit, when it trips, a large current which is above the tripping current will flow.
At this time if the MCCB trips, it's a fault. The MCCB should not trip from the current surge from a motor.



▶ The MCCB's function depends on the three above mentioned conditions.

The basic function of an ELCB

1. The necessity of ELCBs

In respect to human lives and property, concerns for electrical shock accidents are increasing in the construction and electrical construction industries, as well as in regular houses, buildings, schools , public buildings and the places with legal ELCB installation obligations are increasing. ELCBs not only protect from electrical shock accidents but also can prevent fire caused by electric leakage. Generally electric leakage is very little compared to the overload current so an MCCB or fuse cannot prevent an earth leakage accident. An ELCB is needed to detect such small amounts of current leakage.

2. Earth leakage accident protection

1) Electric shock accidents

If the current leakage occurs through the human body, it will pass through to the ground and when it exceeds maximum tolerance, it can cause death. Other electrical accidents are usually limited to damaging electric facilities but earth leakage can electrocute people, especially with low voltage circuits. When these circuits are accessible to people, attention to safety is necessary.

2) Leakage current fire

If the current leakage flows close to construction materials like wood, Styrofoam or flammables, the current leakage fire can occur because of Joule heat. It's said a leakage current of a few amperes is enough to cause a fire.

3) Arc faults

Grounding often occurs with arc faults. The center of the arc has a high temperature, around 10,000℃, which cannot be compared with Joule heat. Even with a low ground current, electric facilities can be damaged by these faults. Big accidents caused by this are reported in and outside of Korea.

The most famous example of such an accident is a large apartment accident in New York in 1964. An arc fault continued for one second and it totally destroyed the switchboard and two 5000A main power lines melting and vaporizing them. In the meantime about 10,000 households could not use water, electricity or elevators. If we neglect arc faults like these, the effects will gradually increase and damage buildings, plants, equipment and in the worst case harm people. For these reasons it is important to detect arc faults ASAP and deal with them properly.

> In addition to the features of the MCCB, the ELCB offers protection against earth leakage. This means protection from electrocution for people, current leakage protection and arc fault protection.

2. Structure of MCCB and ELCB

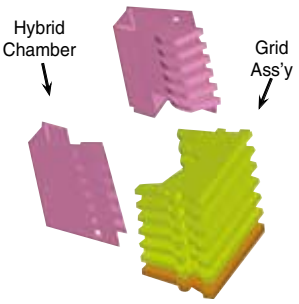
Structure of MCCB

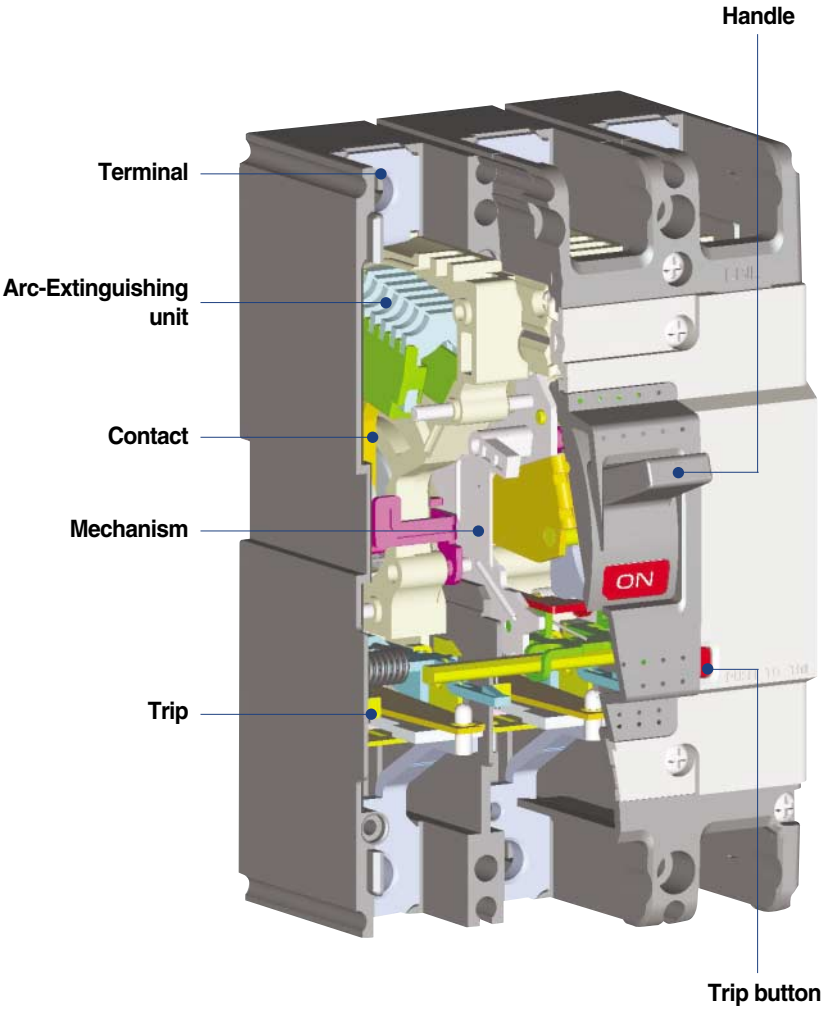
Arc-Extinguishing Unit

We have applied our company's licensed technology PASQ type arc-extinguishing unit.

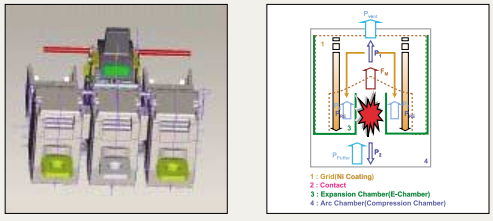
PASQ : Puffer Assisted Self-Quenching

- superior performance in suppressing arc voltage quickly





⦿ Application of PASQ arc extinguishing

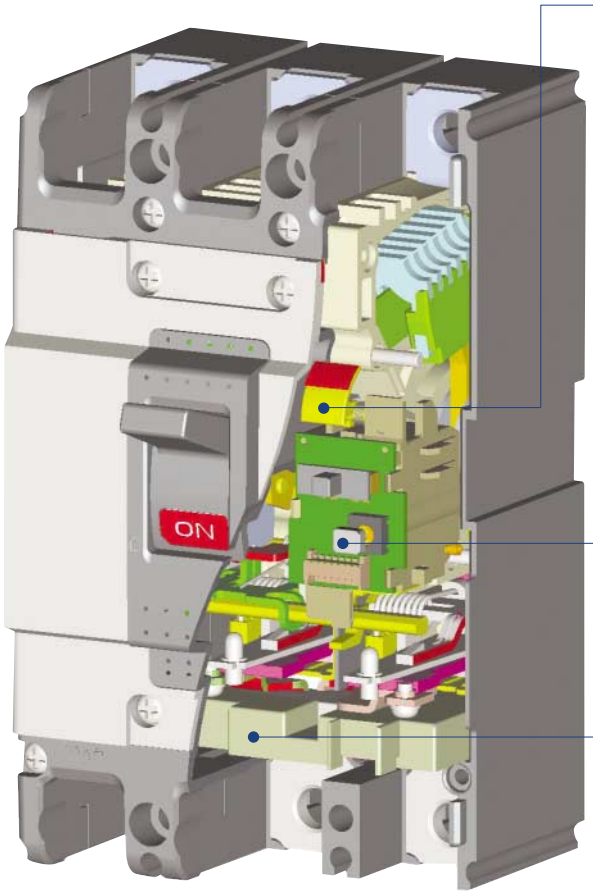


⦿ Current limit structure application (Opening time)

- Current limit repulsion maximizing structure (U-shape fixed design)
- Movable element toggle system
  - while moving element's repulsion operation by short circuit current, inversion structure over a certain angle

Fig. B-1. Metasol Circuit Breaker's extinguishing unit characteristics

Structure of ELCB

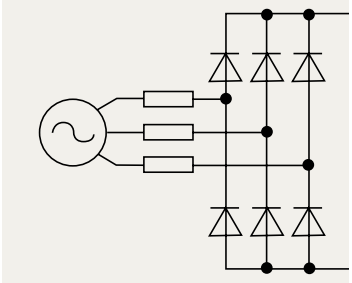


- **Residual indication LED**
  Under normal operating conditions, it will be yellow but when it is tripped due to leakage, it will be red.

- Residual test Button
  To prevent resistance burn out when the button is pressed, we specially redesigned it and improved reliability.

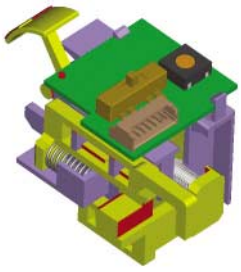
- Residual detection unit(ZCT + Main board)
  Residual detection unit(ZCT + Main board)
  To improve reliability, we chose a three-phase input system so even when channel voltage is faulty(during disconnection of any single channel), it can break leakage current safely.

⊙ Three-phase power supply system application



- **In case of 1 phase loss residual operation upgrade**

⊙ Obtaining coil driving reliability through optimal design



- **Apply trip lever's sliding structure**
- **Trip force optimal design through analysis**
- **Obtain leakage test unit reliability by applying button type**

2. Structure of MCCB and ELCB

Switch

1. Dividing switch by ON and OFF

Switch performs on and off switching by transferring manual manipulation force to moving contact and it has two different types, Quick Make and Slow Make.

(1) **Quick Make** is an operation which drives the switch spring by operating the handle ON and OFF then inverts the internal toggle link which switches the moving contact rapidly connected to the poly pole in common. Because it switches regardless of the operator's handle operating speed, it's called "Quick Make".
Because of resistance against melting and fusion, and load breaking characteristics by ON and OFF switching are superior, relatively big circuit breakers are also adopting this operation device.

(2) **Slow Make** is an operation which inverts the Toggle Link by operating the handle ON and OFF and switches the contact.The contact's switch speed is decided by the handle operating speed and it's called "Slow Make", but over current tripping operations happen separately from the handle operating and after tripping is over, it resets automatically. So this operation is used to make operate simple for the small frame(circuit breaker for panel board etc.) with a relatively low rated current which general consumers use.

2. Switch operation

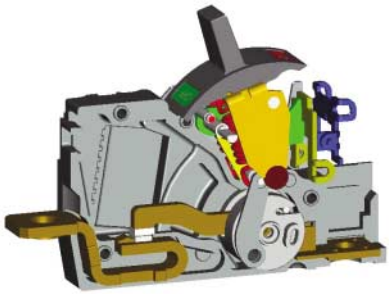
[Fig.B-2] shows ON, OFF and TRIP position. When the handle moves from ON to OFF, the main spring passes the toggle link's dead point and at this time, the breaking operating happens rapidly. Also it happens in the same way from OFF to ON.
Automatic tripping by over current makes the bracket rotate with over current elements(bimetal, electromagnet, O.D.P.) etc.'s action and supports cradle of trip structure. By exceeding the dead point with the toggle link's spring action, the contact will automatically be opened very fast. While it's tripping, the handle stays in the middle of ON and OFF positions and it means over current voltage has been tripped. Additionally, the automatic tripping action is structured as "Trip-Free", so even though the handle is held on the ON side, if over current flows, contact point's opening operation will not be interrupted.
Because each pole has to be insulated electrically in a poly pole's circuit breaker, it should be isolated from the case and the contact is fixed to common cross bar by insulation. The cross bar is connected to mechanism units so concurrent opening and concurrent break are possible.

Contact units

Fixed contacts and moving contacts are the MCCB's most important parts and in extreme conditions will be applied during opening and closing.
The material for a contact point should have below three conditions.

- High resistance against melting and fusion
- Low contact resistance
- High durability

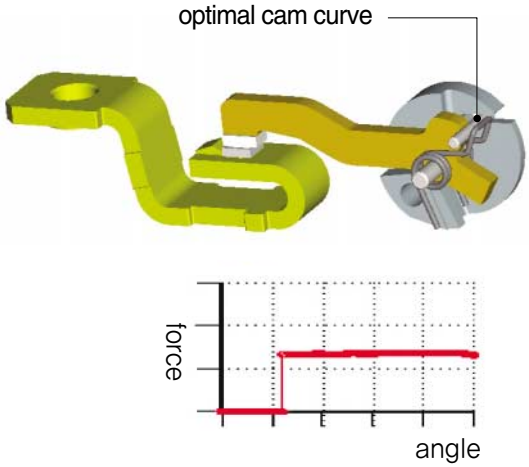
For the material of MCCB's contact, silver tungsten or silver oxidized cadmium are used in the right place and this gives the contact points maximum durability, increasing breaking capacity and possible size miniaturization.



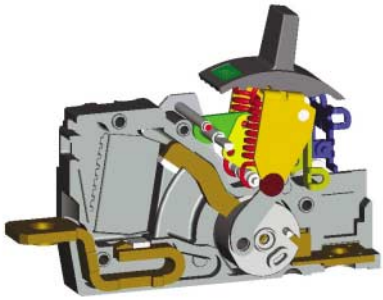
a) "ON"

■ **ON position**

- Keeping unvarying contact force during closed state.
- Regardless of tripping, optimization of opening velocity by optimal cam curve



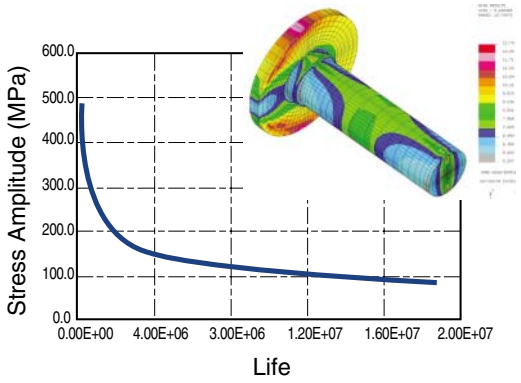
Unvarying contact force

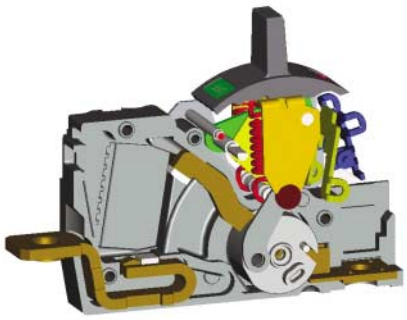


b) "OFF"

■ **OFF position**

- From OFF position press toward TRIP
- Reset pin moment < Main spring moment





c) "TRIP"

■ **TRIP position**

- To check auxiliary switch operation and manual reset function, it makes tripping possible from outside mechanically.

Fig.B-2. Metasol Circuit Breaker switch operation and characteristics

2. Structure of MCCB and ELCB

Overcurrent trip devices

Overcurrent trip devices are divided by thermal-magnetic types, hydraulic-magnetic types and electronic types by operation principal.

Thermal-Magnetic Type is used in the Metasol Circuit Breakers.

1. Thermal-Magnetic Type

(1) Time-delay operation

When over current flows, bimetal will be heated up and bent in the direction of the arrow. Then it operates the trip cross bar and automatically breaks.

(2) Instantaneous operation

If an instant large current like short circuit current flows, before bimetal curves, the fixed core which is attached to current path attracts the moving core, it operates trip cross bar and then automatically breaks.

2. Hydraulic-magnetic type

Electromagnetic core unit for tripping is an O.D.P.(Oil Dash Pot) structure which is composed by putting the plunger's attraction and back spring inside of non magnetic cylinder together and injecting silicon oil then sealing it.

(1) Time-delay operation

When overcurrent flows, magnetic force driven to the coil exceeds spring power so plunger moves to armature. Then it attracts armature and automatically it breaks circuit breaker.

(2) Instantaneous operation

If a much larger current flows, the magnetic flux of magnetic circuit becomes very big, even if the plunger does not move, the armature will be attracted and will break the circuit instantly.

3. Electronic type

Electronic type is over current trip element which is composed with CT and Solid State Relay instead of bimetal and electromagnet so when overcurrent flows, the current converted by CT will be applied to maximum current detecting circuit and it converts to voltage. A micro processor will compare the converted part small and big and apply trigger sign. Then it will operate the release magnet and break the fault current.

Electronic type has three different operations, long time, short time and instantaneous. Its tripping is simpler than the mechanical type and it is possible to adjust extensively.

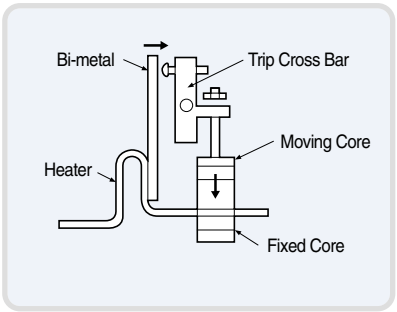


Fig. B-3. Thermal-magnetic type trip device

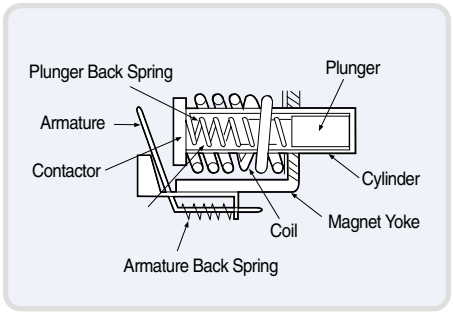


Fig. B-4. Hydraulic-magnetic type trip unit

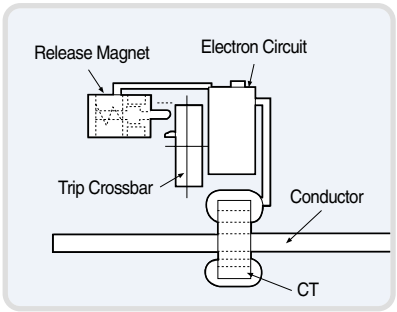


Fig. B-5. Electronic electric type trip unit

Arc-extinguishing

In the case of breaking the circuit in which current is flowing, if there is an arc between contactors and the center temperature of arc reaches 8,000~12,000℃ the explosive expansion pressure can fuse and wear out contactors and deteriorates and break down insulation.
Therefore, the circuit breaker should break promptly to minimize the effect.
The extinguishing device which the MCCB mainly uses is a cold cathode(de-ion) arc extinguishing chamber using a metal plate. Its shape is arranged in the grid with V shape notches in proper intervals perpendicularly from the original arc route. [Fig. B-6]
If arcing occurs from a contactor's opening, the arc moves to the inner side of the V shaped grid.
The arc will be cooled by the grid and split into a shorter arc between each grid square and then arc voltage will increase. Because of arc gas originating from the insulation plate which is part of the arc extinguishing chamber, the mold case's internal pressure goes up. Then by compressing the arc with high temperature and restraining emission of free electrons, it extinguishes the arc quickly and protects circuit with recovery of inter-pole voltage.

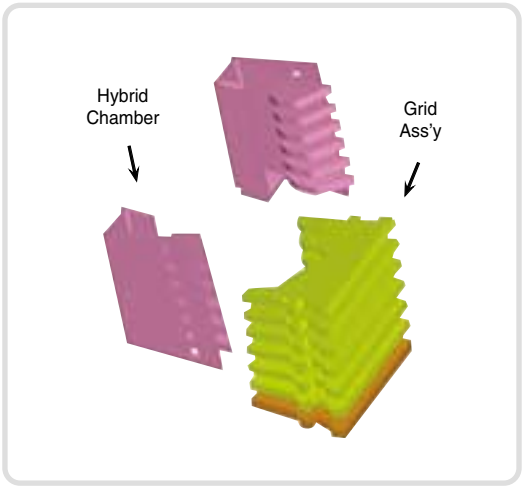


Fig. B-6. Arc-extinguishing unit

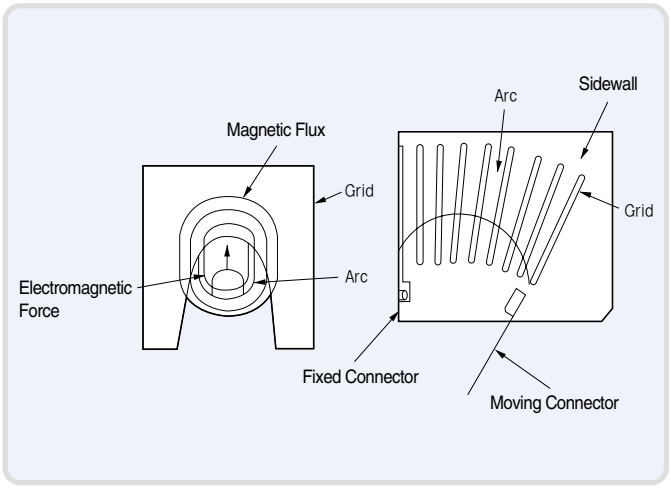


Fig. B-7. Effect of magnetic field

Leakage detection and trip devices (only applicable to ELCB)

1. Zero-phase sequence current transformer (ZCT)

The ZCT needs to be considered separately from the regular current transformer(CT) because it has to detect extremely small current leakage. A highly permeable magnetic material like the permalloy core is commonly used. As in Fig. B-8, the permalloy core, the primary conductor through which the main circuit current flows and secondary winding which is coiled around the core are fundamental in it's composition. The principal of detecting works by the core's vector synthesis with magnetic flux which is from the primary conductor phase current and by the magnetic flux within the flux difference of each phase, electromotive force occurs at secondary winding. At this time, if each phase current's vector sum is zero regardless of primary current size, the magnetic flux will be offset in the core and electromotive force will not occur at secondary winding. But if there is leakage or a grounding fault current, the current balance of each phase breaks down and by the magnetic flux within the size of leakage and grounding current, the core will be excited and electromotive force will occur at the secondary winding.

2. Structure of MCCB and ELCB

Leakage detection and trip devices (only applicable to ELCB)

2. Electronic circuit unit

The composition of its electronic circuit unit is as seen in Fig. B-9. The control power is adopted on the internal main line's R, S, T phase and through absorption circuit, it rectifies to DC on the power circuit. Then through a noise filter, it is permitted to send to the IC. On the other hand, the signal force from ZCT can pass the sensi selective circuit through noise filter and is permitted to send to IC. The inside of the highly reliable IC which is designed exclusively for the ELCB takes and amplifies the signal force from the ZCT, then determines the size. If it exceeds the standard, the output will be generated and Thy on the right side of IC becomes ON. When Thy of IC's right side element is ON, the current flows on the trip coil and it trips ELCB. To prevent faulty operation from noises and surges, this circuit composition breaks noise which flows from the signal element(ZCT) and power element of the electronic circuit unit and absorbs various surges which flow from the power element(main line).

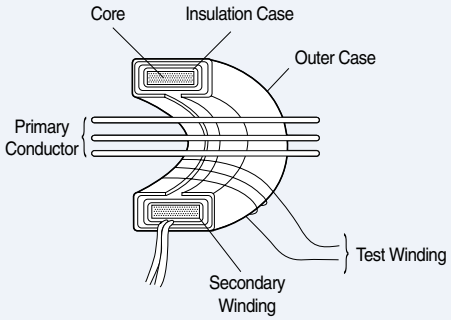


Fig. B-8. Structure of ZCT

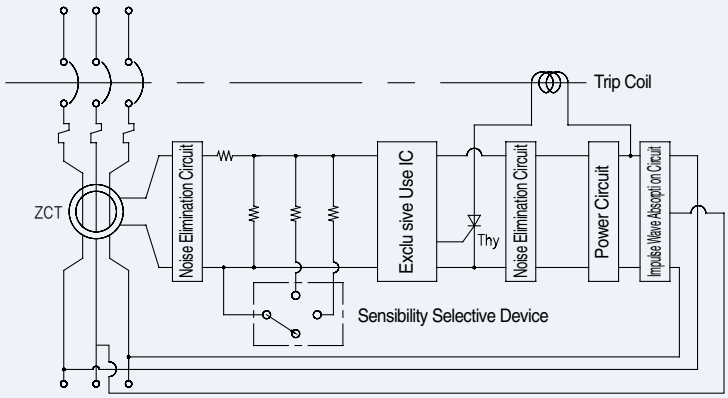


Fig. B-9. Electronic circuit unit

3. Trip coil

When the grounding current exceeds the stated value, the electronic circuit's Thy turns ON and it causes the current flow on the trip coil. Then the trip coil attracts armature by excitation and trips the ELCB instantaneously. Fig. B-10. shows an example of the trip coil.

4. Test device

Because handling grounding faults can save lives, an operating check is necessary. By making grounding simulation circuit as in Fig. B-11 and pressing the test button, the test device makes the current flow and tests if it operates for sure during grounding fault. All ELCBs have this test device.

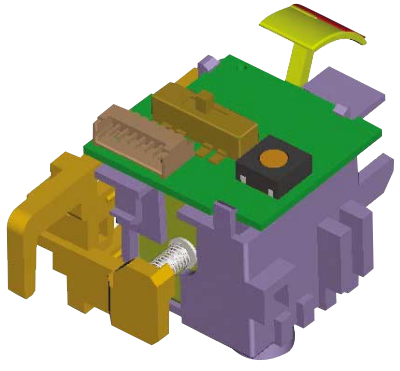


Fig. B-10. Trip coil

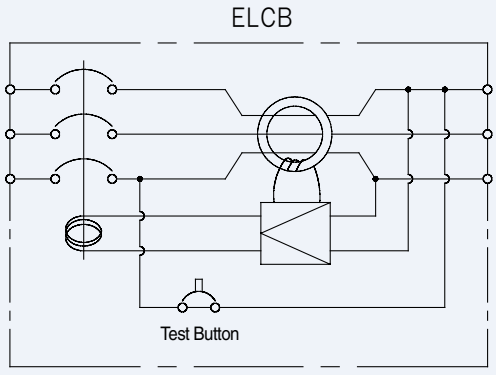
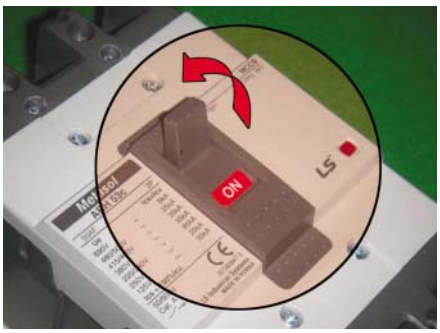


Fig. B-11. Test device circuit

3. Metasol MCCB's operation and position description

On position

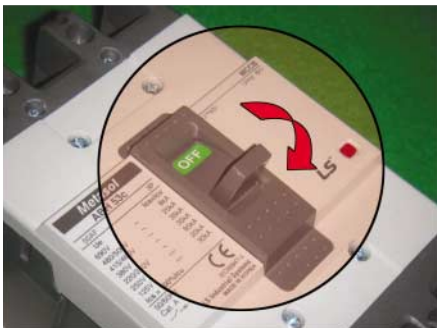
- Closed circuit position (switch on)
- Move the handle to the top, ON position to apply power.
- Red ON sign will appear.



ON

Off position

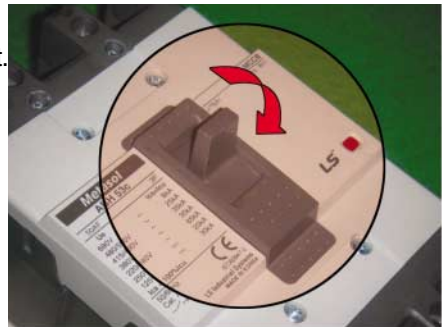
- Open position (switch off)
- Move the handle to the bottom, OFF position to cut the power.
- Green OFF sign will appear.



OFF

Trip position

- When the handle is in the trip position, first move the handle to the OFF position and then to the ON position to close the circuit.
- When the circuit breaker is ON position, if you press trip button, the circuit will be opened and the handle will be moved to the middle, trip position.



TRIP

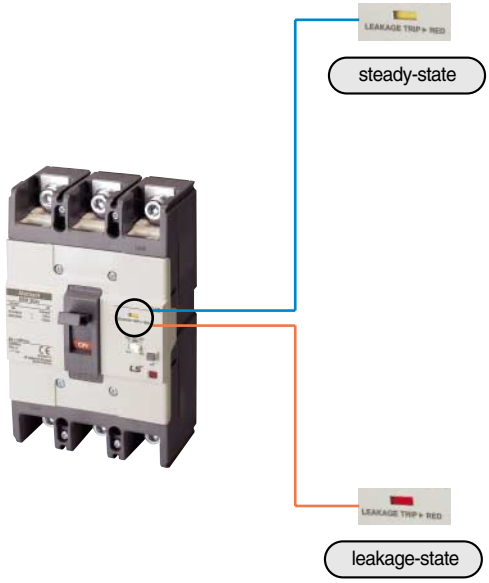
Verify the main contact position

- The Metasol circuit breakers are suitable for insulation defined by IEC 60947.
- When the handle is in the OFF position, the main terminal is always open.
- The OFF position is the only completely safe position and it is the open position which switches equipment OFF. And this is entirely your responsibility.

4. Metasol ELCB's operation and position description

Normal operating conditions (Circuit Breaker ON position)

- Closed circuit position (switch ON)
- Move the handle to the top, ON position to apply power.
- Red ON sign will appear.
- Leakage indicator stays yellow.

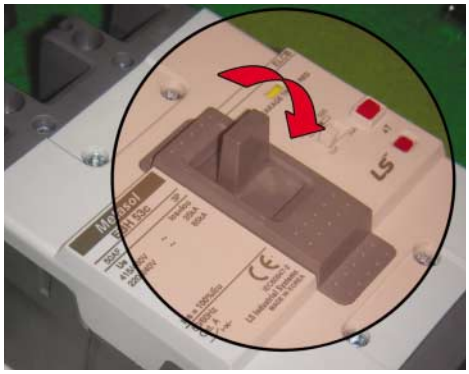


Leakage break condition

- Circuit Breaker's handle is in Trip position.
- Leakage indicator will be red.

Trip position

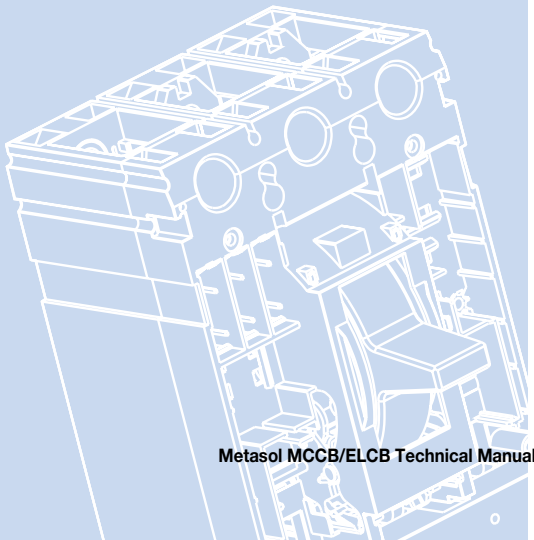
- When the handle is in the trip position, first move the handle to the OFF position and then to the ON position to close the circuit.
- When the circuit breaker is in the ON position, if you press the trip button, the circuit will be opened and the handle will be moved to the middle, trip position.
- When the handle moves to the OFF position, the leakage indicator will change from red to yellow.



Verify the main contact position

- The Metasol ELCBs are suitable for insulation defined by IEC 60947-2.
- When the handle is in OFF position, the main terminal is always open.
- The OFF position is the only safe position and it is the starting position to operate equipment which is OFF. And this is entirely your responsibility.

C. Product characteristics



1. 100AF Product characteristics

The trip devices of Metasol 100AF Circuit Breakers(MCCB, ELCB) are Thermal-Magnetic type devices and they protect against overload/short circuit fault current.

Product frames

MCCB ELCB

MCCB rated current by product

AF (trip device)	Rated current (Standard 40°C), In (A)										
	3	5	10	15	20	30	40	50	60	75	100
ABS30c	●	●	●	●	●	●					
ABN50c/ABS50c				●	●	●	●	●			
ABN60c/ABS60c				●	●	●	●	●	●		
ABN100c				●	●	●	●	●	●	●	●

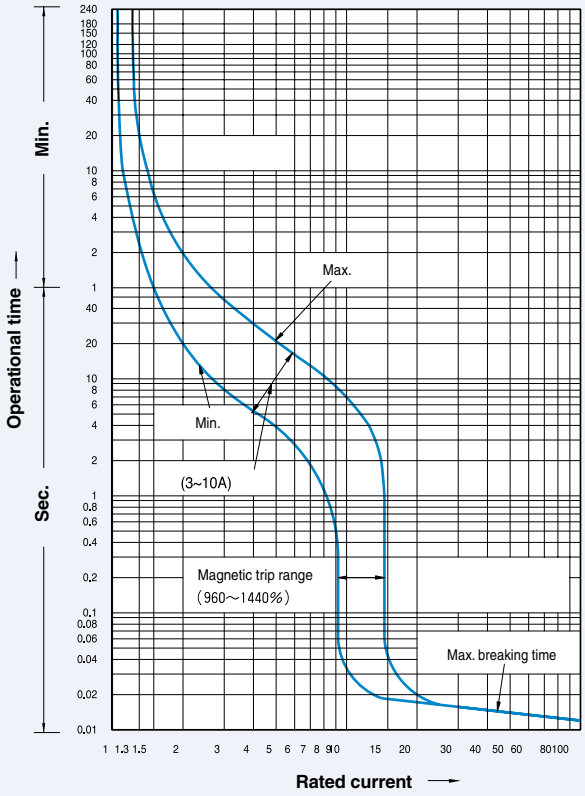
ELCB rated current by product

AF (trip device)	Rated current (Standard 40°C), In (A)										
	3	5	10	15	20	30	40	50	60	75	100
EBS30c	●	●	●	●	●	●					
EBN50c/EBS50c				●	●	●	●	●			
EBN60c/EBS60c									●		
EBN100c				●	●	●	●	●	●	●	●

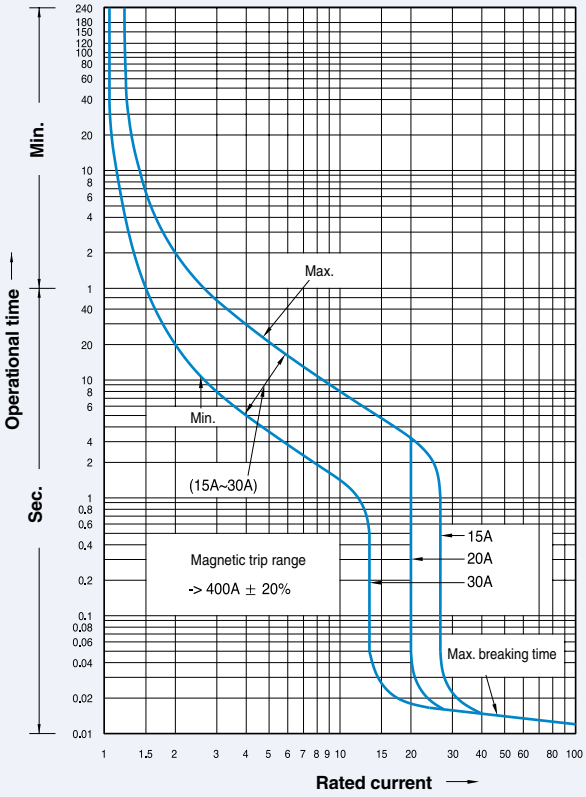
* There are 2 different ELCB products by rated sensitivity current, the 30mA fixed type and the 100/200/500mA adjustable type.

Characteristic curves

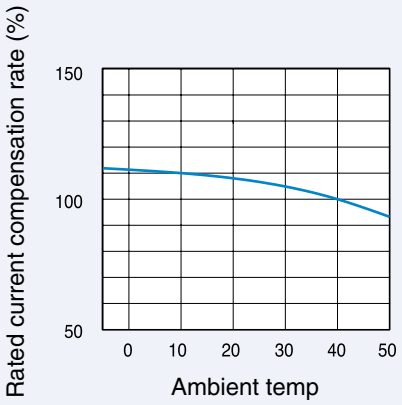
• Rated current: 3~10A



• Rated current: 15~30A



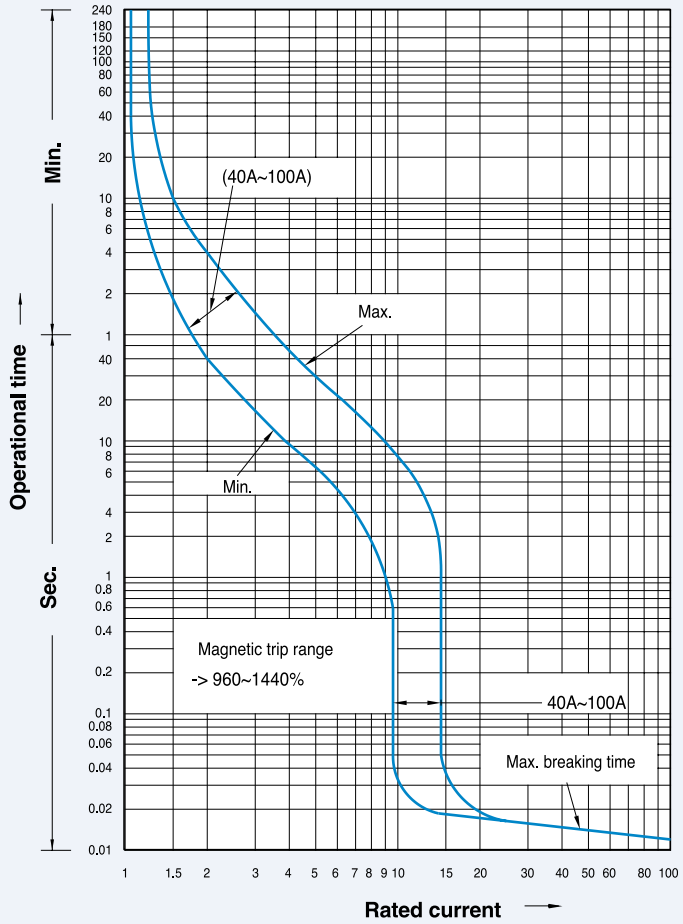
Compensation curves (Rated current: 3~30A)



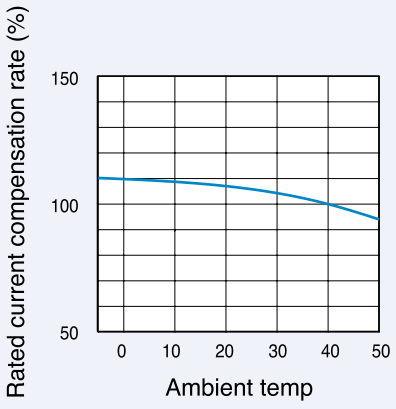
C

1. 100AF Product characteristics

Characteristic curves (Rated current: 40~100A)



Compensation curves (Rated current: 40~100A)



2. 125AF Product characteristics

The trip devices of the Metasol 125AF Circuit Breakers(MCCB, ELCB) are Thermal-Magnetic type devices and they protect against overload/short circuit fault current.

Product frame

MCCB ELCB

MCCB rated current by product

AF (trip device)	Rated current (Standard 40℃), In (A)								
	15	20	30	40	50	60	75	100	125
ABH50c	●	●	●	●	●				
ABS125c/ABH125c	●	●	●	●	●	●	●	●	●

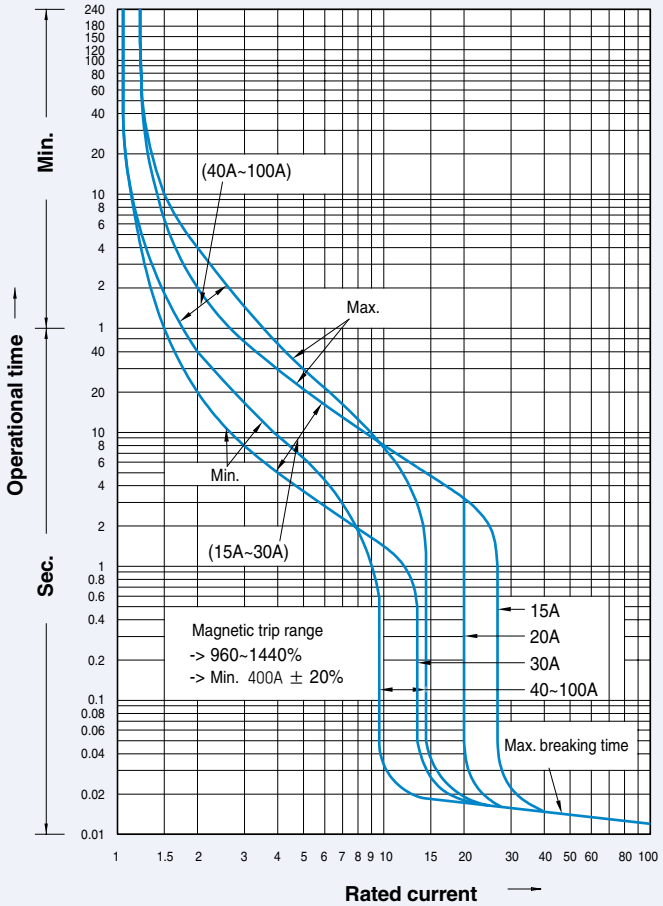
ELCB rated current by product

AF (trip device)	Rated current (Standard 40℃), In (A)								
	15	20	30	40	50	60	75	100	125
EBH50c	●	●	●	●	●				
EBS125c/EBH125c	●	●	●	●	●	●	●	●	●

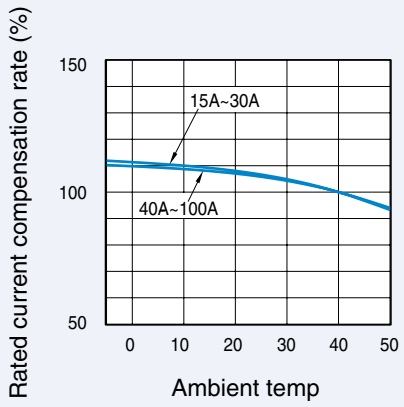
*There are 2 different ELCB products with a rated sensitivity current, the 30mA fixed type and the 100/200/500mA adjustable type.
*ELCB only has 3 pole/4 pole products

2. 125AF Product characteristics

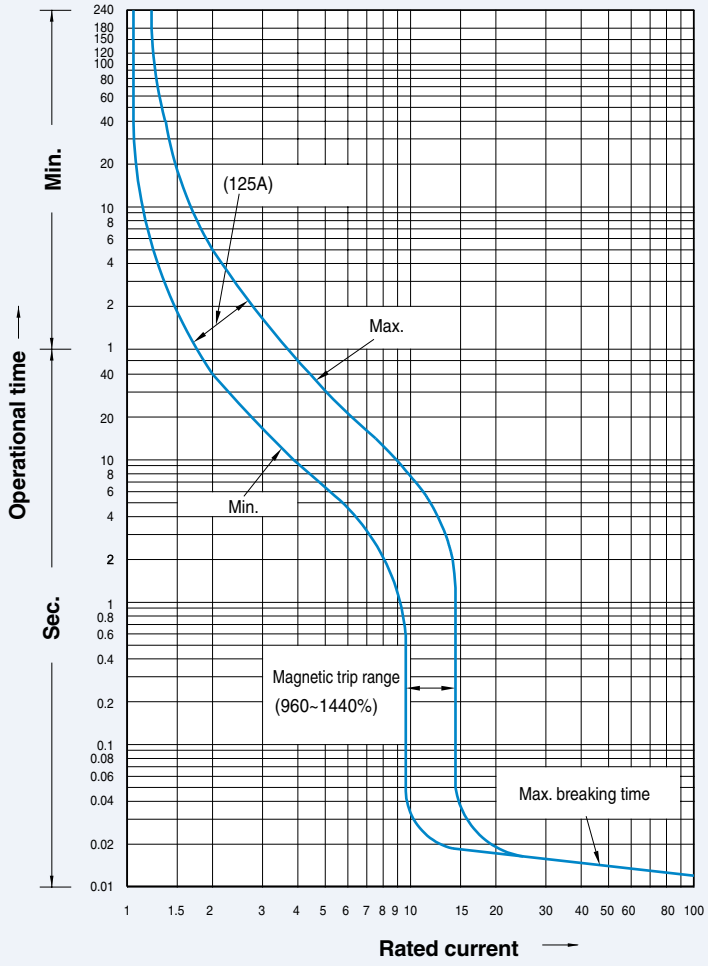
Characteristic curves (Rated current: 15~30A, 40~100A)



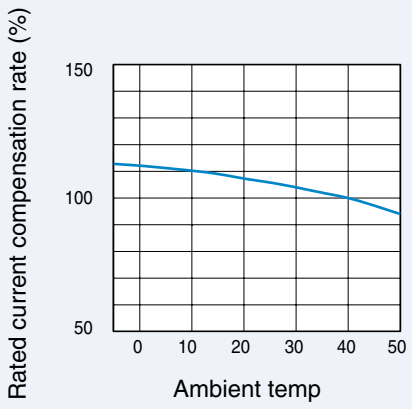
Compensation curves (Rated current: 15~30A, 40~100A)



Characteristic curves (Rated current: 125A)



Compensation curves (Rated current: 125A)



C

3. 250AF Product characteristics

The trip devices of Metasol 250AF Circuit Breakers(MCCB, ELCB) are Thermal-Magnetic type devices and they protect against overload/short circuit fault current.

Product frame

MCCB ELCB

MCCB rated current by product

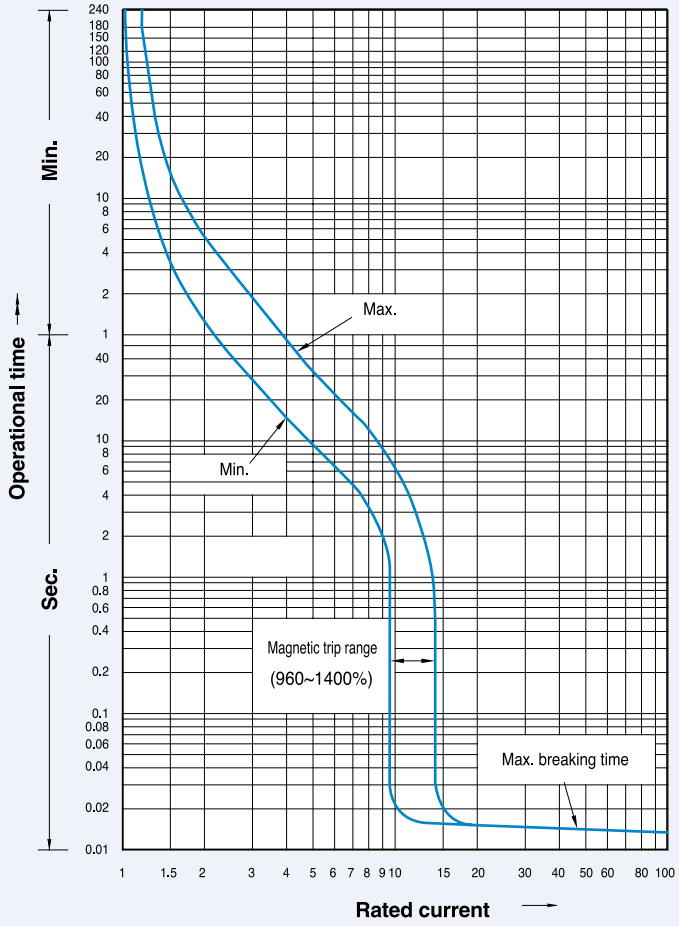
AF (trip device)	Rated current (standard 40℃), In (A)						
	100	125	150	175	200	225	250
ABN250c/ABS250c /ABH250c	●	●	●	●	●	●	●

ELCB rated current by product

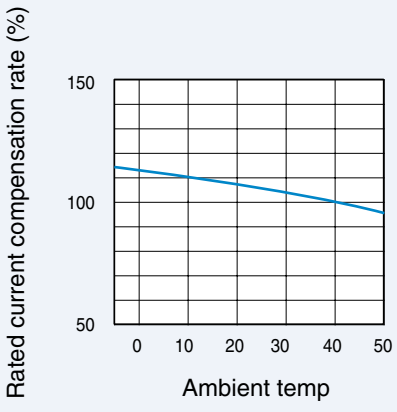
AF (trip device)	Rated current (standard 40℃), In (A)						
	100	125	150	175	200	225	250
EBN250c/EBS250c /EBH250c	●	●	●	●	●	●	●

*There are 2 different ELCB products by rated sensitivity current, the 30mA fixed type and the 100/200/500mA adjustable type.

Characteristic curves (Rated current: 100~225A)

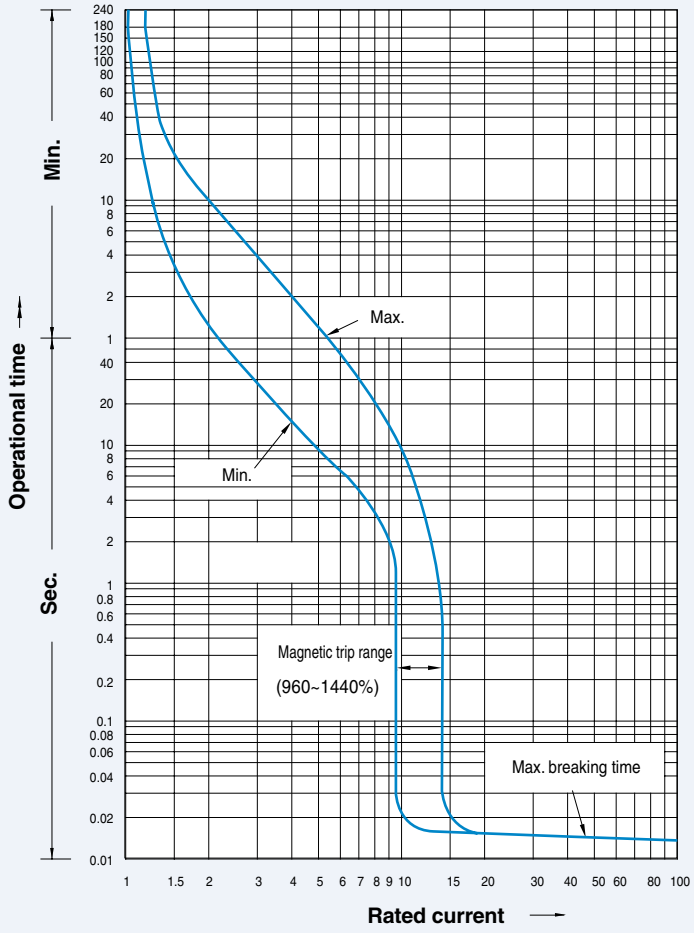


Compensation curves (Rated current: 100~225A)

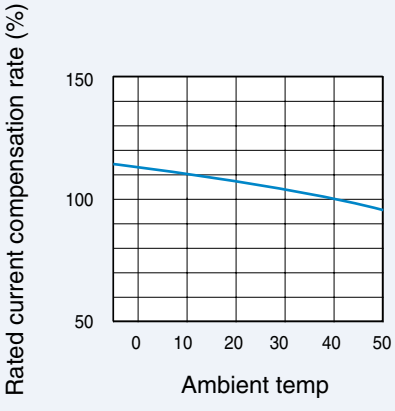


3. 250AF Product characteristics

Characteristic curves (Rated current: 250A)



Compensation curves (Rated current: 250A)



4. 400~800AF Product characteristics

The trip devices of Metasol 400~800AF Circuit Breakers(MCCB, ELCB) are Thermal-Magnetic type devices and they protect against overload/short circuit fault current.

Product frame

MCCB

ELCB

MCCB rated current by product

AF (trip device)	Rated current (standard 40℃), In (A)							
	400AF				630AF		800AF	
	250	300	350	400	500	620	720	800
ABN400c, ABS400c, ABH400c, ABL400c, ABN630c, ABS630c, ABL630c, ABN800c, ABS800c, ABL800c	●	●	●	●	●	●	●	●

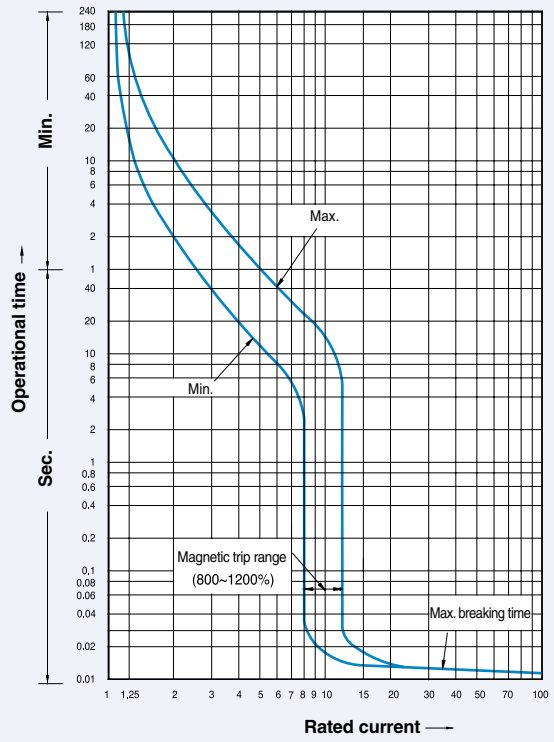
ELCB rated current by product

AF (trip device)	Rated current (standard 40℃), In (A)							
	400AF				630AF		800AF	
	250	300	350	400	500	620	720	800
EBN400c, EBS400c, EBH400c, EBL400c, EBN630c, EBS630c, EBL630c, EBN800c, EBS800c, EBL800c	●	●	●	●	●	●	●	●

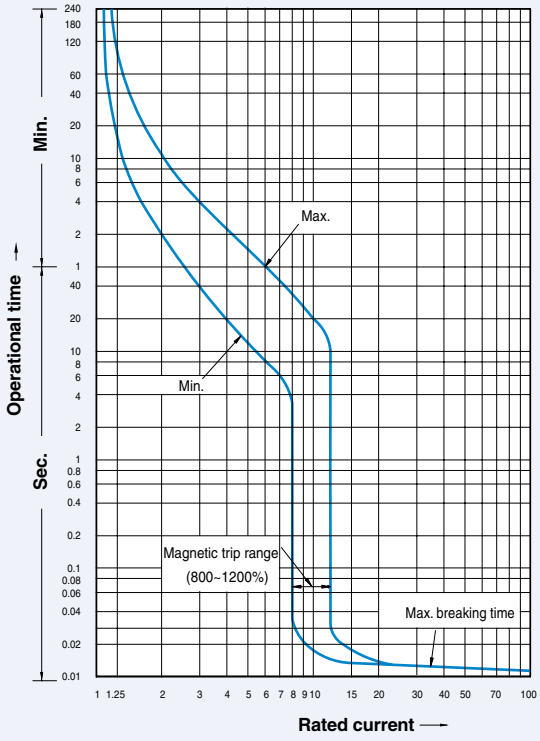
4. 400~800AF Product characteristics

Characteristic curves

• **Rated current: 250~400A**

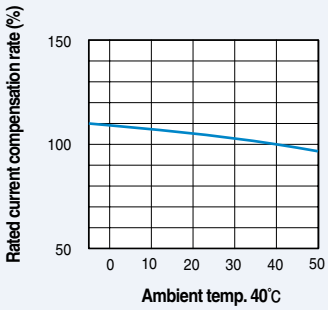


• **Rated current: 500~800A**

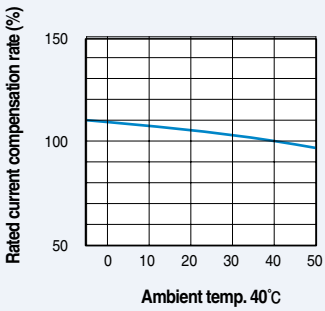


Compensation curves

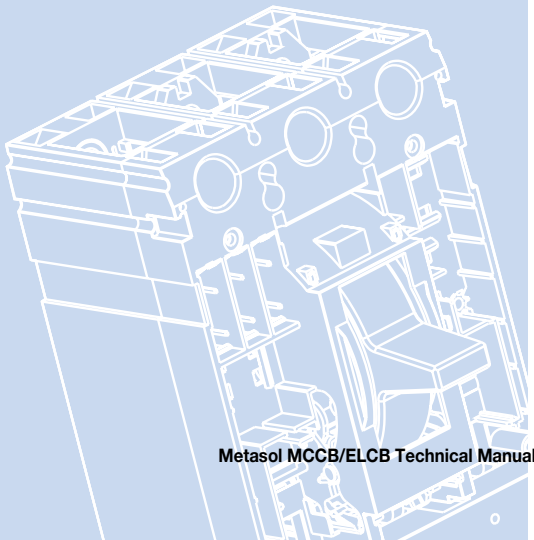
• **Rated current: 250~400A**



• **Rated current: 500~800A**



D. Operating conditions



Operating conditions

1. Standard usage environment

Standard usage environment for Metasol MCCB

Depending on different environment conditions, MCCB's functions(short circuit and overload protection), durability and insulation efficiency can be effected a lot so it should be installed under precise conditions. Especially circuit breakers which use a thermal-magnetic type trip unit change characteristics depending on the temperature so when you use them, you have to adjust their rated current.

1) Ambient temperature: -5℃~+40℃ (average over 24hr should not exceed 35℃.)
2) Relative humidity: within 45~85%
3) Altitude: below 2,000m (when it's over 1,000m, you might consider adjusting air pressure by doing a humidity and voltage test.)
4) Places without excessive steam, oil, smoke, dust, salinity and corrosive materials.

- If standard circuit breaker used at temperatures over 40℃, try to use the adjusted current by temperature from the catalogue.
- Insulation resistance and electric efficiency might drop under high humidity.

- Electric current flow switch, tripping and short circuit breaking will still function at -20℃.
- Passing through an extremely cold area around -40℃or storage is no problem.
- When you use thermal-magnetic type trip unit, it' s set for 40℃ so it might change characteristics.

- When the breaker is stored in an environment with excessive dust or humidity, it is strongly recommended to use a dust cover and/or dehumidifier.
- Excessive vibration may cause trips, breaks in connections or damage to mechanical devices.

- If it is left ON or OFF for a long time, it is good to switch the overload current regularly.
- In environments containing corrosive gas, it is necessary to put the device in a sealed protective structure.

2. Special usage environment

In case of temperatures over 40℃

Because the temperature of MCCB's parts is the sum of increased temperature from current flow and environment temperature, when the environment temperature is over 40℃, current flow needs to be reduced so the MCCB's insulation temperature doesn't exceed permissible temperature.
Standard temperature of the Metasol circuit breaker is up to 40℃ so when it's higher temperature, rated current needs to be lowered as specified in the current rating adjustment table.

Metasol MCCB current rating adjustment by temperature table

Ampere Frame	Circuit breaker type	Rated current	Current rating adjustment by temperature table (A)						
			10℃	20℃	30℃	40℃	45℃	50℃	55℃
30	ABS30c	3	3	3	3	3	3	3	3
		5	5	5	5	5	5	5	4
		10	10	10	10	10	10	9	9
		15	15	15	15	15	15	14	13
		20	20	20	20	20	19	19	18
		30	30	30	30	30	29	28	27
50	ABN50c, ABS50c	40	40	40	40	40	39	38	36
		50	50	50	50	50	49	47	45
60	ABN60c, ABS60c	60	60	60	60	60	58	56	55
100	ABN100c	75	75	75	75	75	73	71	68
		100	100	100	100	100	97	94	91
125	ABH50c, ABS125c, ABH125c	125	125	125	125	125	121	116	107
250	ABN200c, ABS200c, ABH250c	150	150	150	150	150	145	140	128
		175	175	175	175	175	169	163	150
		200	200	200	200	200	193	186	171
		225	225	225	225	225	217	209	193
		250	250	250	250	250	241	233	214
400	ABN400c, ABS400c ABH400c, ABL400c	250	250	250	250	250	246	242	238
		300	300	300	300	300	295	291	287
		350	350	350	350	350	345	339	332
		400	400	400	400	400	394	388	381
630	ABN630c, ABS630c, ABL630c	500	500	500	500	500	492	485	477
		630	630	630	630	630	621	611	602
800	ABN800c, ABS800c, ABL800c	700	700	700	700	700	689	679	668
		800	800	800	800	800	788	776	764

Metasol ELCB current rating adjustment by temperature table

Ampere Frame	Circuit breaker type	Rated current	Current rating adjustment by temperature table (A)						
			10℃	20℃	30℃	40℃	45℃	50℃	55℃
30	EBS30c	15	15	15	15	15	15	15	15
		20	20	20	20	20	19	19	18
		30	30	30	30	30	29	28	27
50	EBN50c, EBS50c	40	40	40	40	40	39	38	36
		50	50	50	50	50	49	47	45
60	EBN60c, EBS60c	60	60	60	60	60	58	56	55
100	EBN100c	75	75	75	75	75	73	71	68
		100	100	100	100	100	97	94	91
125	EBH50c, EBS125c, EBH125c	125	125	125	125	125	121	116	107
250	EBN200c, EBS200c, EBH250c	150	150	150	150	150	145	140	128
		175	175	175	175	175	169	163	150
		200	200	200	200	200	193	186	171
		225	225	225	225	225	217	209	193
		250	250	250	250	250	241	233	214
400	EBN400c, EBS400c EBH400c, EBL400c	250	250	250	250	250	246	242	238
		300	300	300	300	300	295	291	287
		350	350	350	350	350	345	339	332
		400	400	400	400	400	394	388	381
630	EBN630c, EBS630c, EBL630c	500	500	500	500	500	492	485	477
		630	630	630	630	630	621	611	602
800	EBN800c, EBS800c, EBL800c	700	700	700	700	700	689	679	668
		800	800	800	800	800	788	776	764

2. Special usage environment

In Case of temperatures below -5℃

Because the MCCB cannot ignore the effect of inside metal parts and insulation delicate character against low temperature and mechanical parts lubricating oil viscosity change, it's necessary not to let the temperature go down extremely using a space heater etc. Also in case of a Thermal type trip unit, it tends to change its characteristic to be difficult to operate so it needs to be adjusted to verify the level of protection.
The MCCB's electric current flow switch, tripping and short circuit breaking will still function at -20℃ but to prevent the effects from low temperature as much as possible, it is recommended to install a space heater etc. Also when it's transported or passing through extremely cold area up to -40℃, it won't take serious damage but to minimize the effect of delicate character, MCCB's switch needs to be in OFF or Tripposition.

High humidity condition (relative humidity over 85%)

Using the MCCB in places with high humidity can cause a decrease in insulation and an increase in mechanism accessories' corrosion so it's necessary to install a moisture proof structure inside or perform frequent repair inspections. Also In case of installing an MCCB inside of sealed structure, due to equipment operation and interruption etc., the inside temperature of switchboard and panel board will change rapidly and it can cause condensation so a space heater needs to be installed inside.

Conditions with existing corrosive gas

Because silver or silver alloy is used for MCCB's contact point's material, when it contacts corrosive gas, corrosive film will be formatted on the contact surface and then there will be a possibility of contact point's contacting fault. But because corrosive film tends to come off easily mechanically, when there are a lot of makes and breaks(switches), it's not a particular problem. But if there is infrequent switching, care must be taken to switch it regularly. With corrosive gas, the lead wire etc. of MCCB's moving contact can be corroded and hardened, then they can easily cause disconnection.
To prevent this, silver plating is effective so if it is used in high density of corrosive gas condition, it is necessary to use the MCCB with a silver plated lead line which increases resistance against corrosion.

Conditions with existing explosive gas

In principle an MCCB which switches current should not be installed in this dangerous place.

Altitude effect

When MCCB is used over 2,000m above sea level, its operating efficiency will be affected by air pressure and temperature drop. For example, at 2,200m air pressure will be decreased to 80% and at 5,500m to 50%. But short circuit efficiency is not affected. When it is used at high altitude, you can calculate as below referring to adjustment factor table of high altitude.
*See adjustment factor table of high altitude(ANSI C37. 29-1970)

1) Voltage adjustment calculation :
-. Altitude 4,000m, rated voltage AC 600V,
600V(rated voltage) X 0.82(adjustment factor) = 492V

2) Current adjustment calculation:
-. Altitude 4,000m, rated current 800A,
800A(rated current) X 0.96(adjustment factor) = 768A

[Adjustment factor table by altitude]

Altitude	Voltage Adjustment Factor	Current Adjustment Factor
2,000m	1.00	1.00
3,000m	0.91	0.98
4,000m	0.82	0.96
5,000m	0.73	0.94
6,000m	0.65	0.92

3. Usage conditions involving vibration and impact

Effect of vibration and impact

Excessive vibration and impact to the circuit breaker can cause safety problems of dynamic intensity, current flow and operation characteristic which results in damage and loss. It is necessary to consider these environmental stresses when choosing the circuit breaker. These stresses occur from vibration during transporting, self impact while operating the switch and the effect of nearby devices. The standard for electrical devices' standard vibration and impact resistance is specified in the [small electric devices vibrating test] etc. and we are testing MCCB's vibration and impact resistance in accordance with this standard for these conditions.

Vibration

The measurement of vibration is indicated by complex amplitude of vibrations and the number of vibrations, in relation to acceleration as below:

$\alpha g = 0.002 \times$ no. of vibrations(Hz) $\times$ amplitude of vibrations(mm)

* αg : gravitational acceleration($g = 9.8m/sec^2$)'s multiple

The vibration test contains a resonance test, a vibration resistance test, a fault operation test, as explained below.

1) Resonance Test
   Amplitude from 0.5~1mm in a sine wave's frequency range of 0~55Hz slowly changes and it can be seen if there is vibration on a certain part of the MCCB.

2) Vibration Resistance Test
   Apply sine wave vibration for two hours with an amplitude from 0.5~1mm with a frequency of 55Hz(if there is a resonance point, test resonance frequency from all other items) and check to see if there is any problem.

3) Fault Operation Test
   Change amplitude and frequency, apply 10 minutes of vibration for each condition and check if there are any faults.

Impact

The measurement of impact indicates the maximum acceleration applied to devices and accessories to a multiple of the acceleration of gravity g ($9.8m/sec^2$).

Effect of high frequency

Due to the heat emission from the skin effect of the conductor and core loss of structural body, the circuit breaker containing the thermal magnetic type trip unit should be used with a reduced current rating. Percentage of reduction is different depending on the frame size and the regular current rating but it is reduced to 70~80% at 400Hz. And, because the core loss causes a reduction in the absorption force, the instantaneous tripping current will be increased.

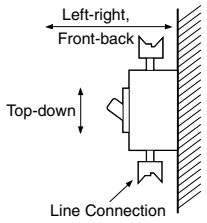
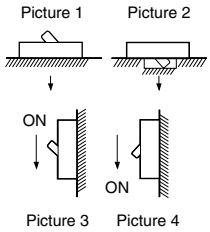
* Core loss : It is current loss of the magnetic core which occurs because of the changing magnetic force over time. The two types of this are hysteresis loss and eddy-current loss.

* Hysteresis loss : The type of loss which accounts for most no-load loss in electric devices and is calculated with the following formula :
  $Ph = \sigma fBmN$
  Bm : Max. magnetic flux density, N : phase(1.6~2.0), f : frequency, σ : hysteresis phase

* Eddy current : The current which flows because of voltage which is inducted because of magnetic flux change inside of conductors. An eddy current which appears in a transformer windings or core is part of the excitation current and it's considered as a type of transformer loss.

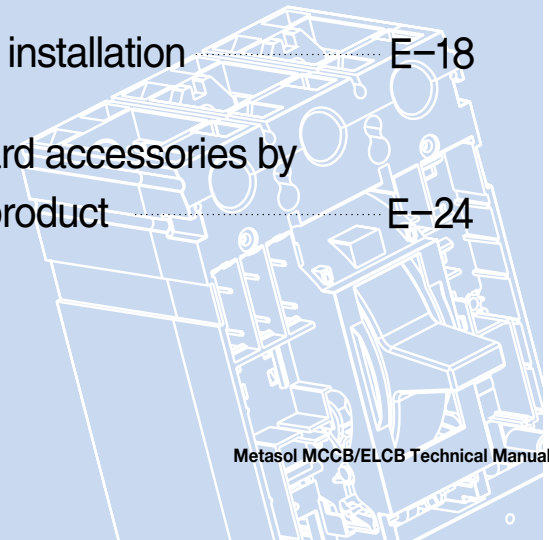
3. Usage environments involving vibration and impact

[Vibration and impact resistance efficiency table]

		Vibration resistance	Impact resistance
Test condition	**Installation position Direction of vibration and impact**	● perpendicular installation ● up and down, right and left, front and rear 	● Fig. 1, 2, 3, 4 (→indicates direction of drop away) 
	MCCB's status	(1) Current Breaking (ON or OFF position) (2) Sending rated current until MCCB's temperature is constant and keeping current flowing status	Current Breaking (ON or OFF position)
Test result	**Judging Condition**	● When it's ON, it should not change to OFF ● When it's OFF, it should not change to ON ● There should not be abnormal conditions like damage, transformation, lose screw units etc. ● After test, switching operation and trip characteristic should be normal.	

D

E. Installation method



1. Precautions for safe use

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

⚠ Precautions for safety reasons

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

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

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

⚠ Danger

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

⚠ Warning

1. Before installing the product, please read precautions and install it according to instruction.
2. There is a danger of fault operation or accident from incorrect installation.
   Please let a qualified person(electrictrician) install and repair circuit breaker.
3. Please avoid installation in environments with rain, oil, dust, direct sunlight etc.
   There is a danger of electric shock, leakage, short circuit, fire and fault operation.
   1) Usage Temperature : -5~40℃
   2) Relative Humidity : 45~85%
   3)Altitude : below 2000m
   4)No abnormal vibration, impact, excessive vapor, oil, smoke, dust, corrosive gas and flammable gas.
4. Please connect to the product's rated power. If the rating is not correct, it will cause damage or loss
5. If there is shortage of terminal's tightening torque, it will cause overheating or fire so please fix the terminal firmly referring to the stated tightening torque on each product's user manual.
   *for more details see the installation method for different types of product.
6. When you install the terminal, please install connection conductor and each phase in parallel. There is a danger of short circuit fault between each phase.
7. You can not test insulation resistance measurement and internal voltage between each phase. If you do those tests between each line of circuit, please separate this product from the circuit. There might be a fault
8. Please be sure to ground the earth terminal of electrical machinery.
9. Please make sure to install an insulation barrier between each phase. If it's not installed, there is a danger of short circuit between phases.
   If you install the product very compactly, please insulate between products.
10. If the circuit breaker operates and breaks automatically, please remove the cause and then operate the handle.
11. Please do not make unauthorized alterations.
12. Please follow your own country's guidelines for disposal of this product.
13. Please do not connect aluminum terminal and conductor directly to circuit breaker's terminal.

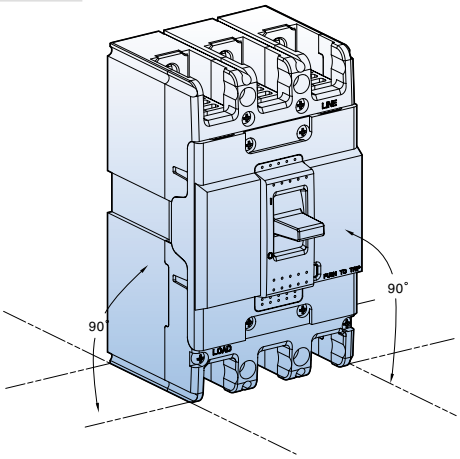
2. Installation method of 100AF

If 100AF circuit breaker is to be installed, it can be installed as below.

Installation of 100AF circuit breaker

1. When the circuit breaker is to be installed, place it perpendicular as Fig. 1, so when you look at it from the front or side, it maintains a 90°angle. Then use proper installation screws for the circuit breaker which were offered with the product and install it as shown in Fig 3.
2. When the circuit breaker is to be installed, it needs to be installed to maintain the insulation distance with metal conductor as in Fig. 2.
   *The unit of measurement in the Fig. is mm.
3. When you install products very closely as in Fig. 2, you need to install a barrier between them.
   *According to a type of product, you can purchase insulation barriers additionally.

Fig. 1



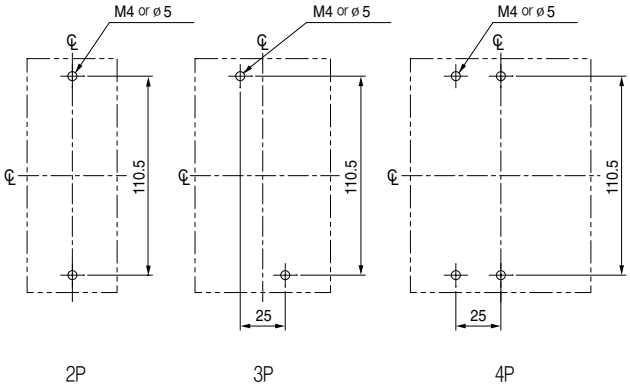
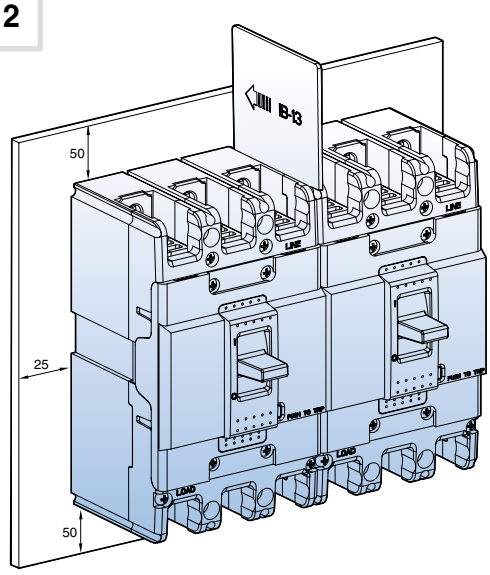
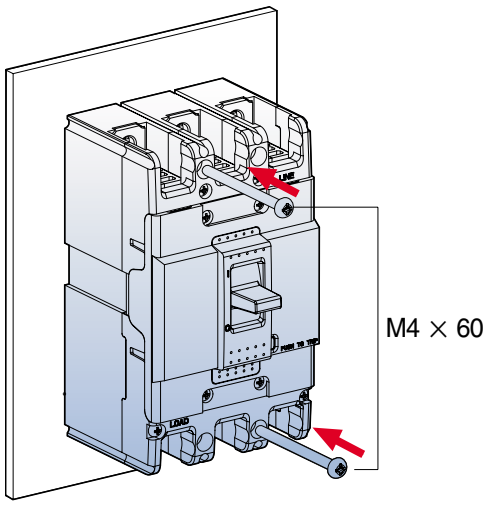


Fig. 2



* In the case of installing products very closely, a barrier has to be inserted between products.

Fig. 3



E

2. Installation method of 100AF

4. As seen in Fig. 4, please connect the wire to the product and tighten.
5. As seen in Fig. 5, please install the insulation barrier enclosed with the product.
6. If the terminal cover is to be purchased separately and installed, then as seen in Fig. 6, please insert in the direction of arrow and align with the circuit breaker's installation notch.

Fig. 4

Tightening Torque
M5 : 23~28 kgf.cm
M8 : 55~75 kgf.cm

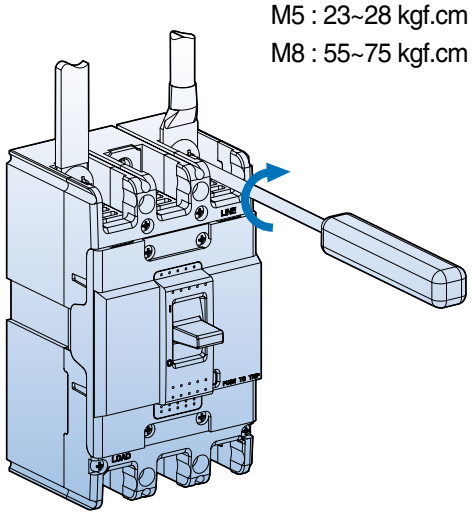


Fig. 5

2P : 1ea
3P : 2ea
4P : 3ea

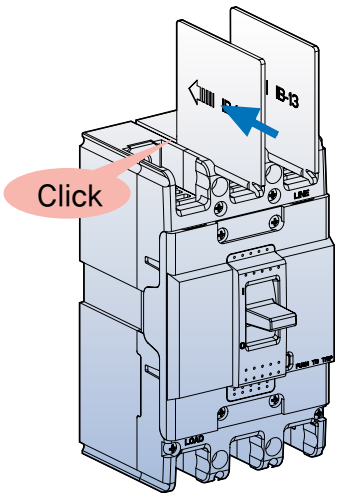
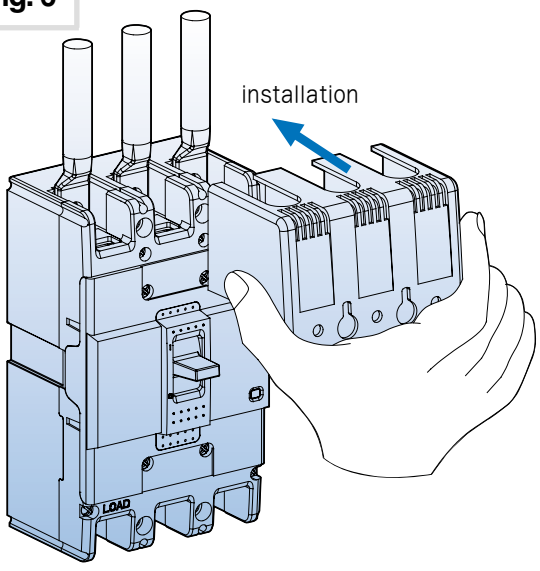


Fig. 6



E

3. Installation method of 125AF

If 125AF circuit breaker is to be installed, it can be installed as below.

Installation of 125AF circuit breaker

1. When the circuit breaker is to be installed, place it perpendicular as Fig. 1, so when you look at it from the front or side, it maintains a 90°angle. Then use proper installation screws for the circuit breaker which were offered with the product and install it as shown in Fig. 3.
2. When the circuit breaker is to be installed, it needs to be installed to maintain the insulation distance with metal conductor as in Fig. 2.
   *The unit of measurement in the Fig. is mm.
3. When you install products very closely as in Fig. 2, you need to install a barrier between them.
   *According to a type of product, you can purchase insulation barriers additionally.

Fig. 1

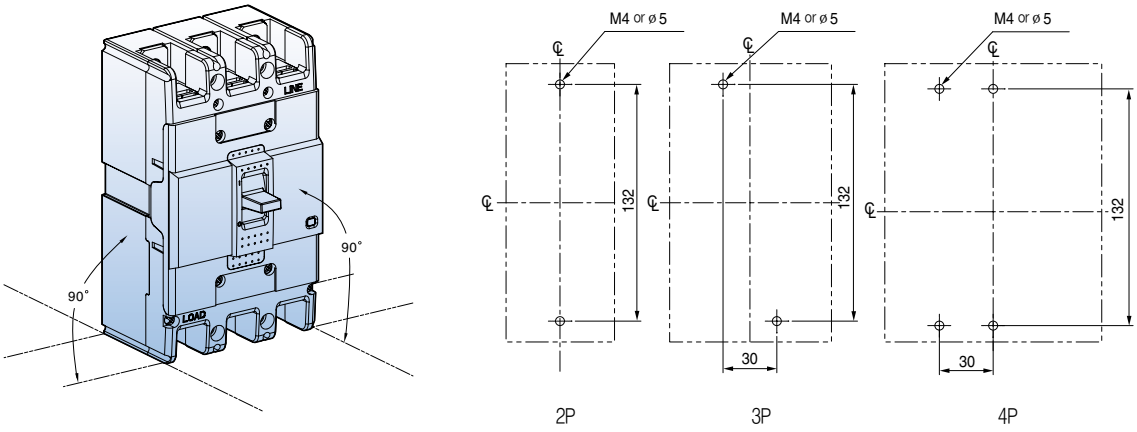
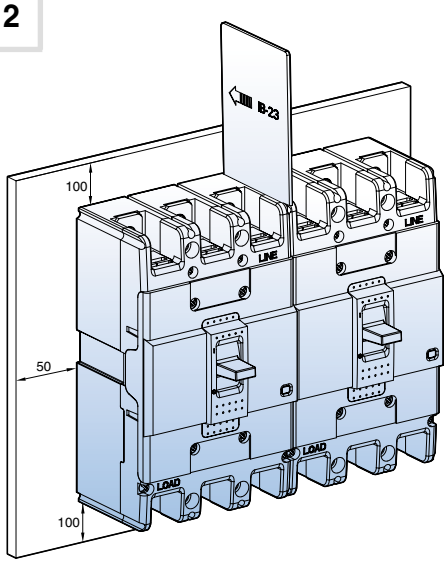
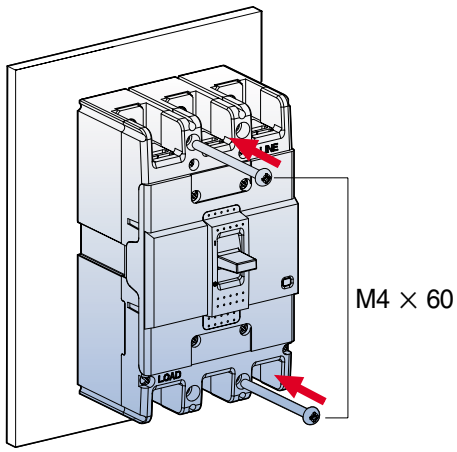


Fig. 2



* In the case of installing products very closely, a barrier has to be inserted between products.

Fig. 3



E

3. Installation Method of 125AF

4. As seen in Fig. 4, please connect the wire to the product and tighten.
5. As seen in Fig. 5, please install the insulation barrier enclosed with the product.
6. If the terminal cover is to be purchased separately and installed, then as seen in Fig. 6, please insert in the direction of arrow and align with the circuit breaker's installation notch.

Fig. 4

Tightening Torque
M8 : 55~75 kgf.cm

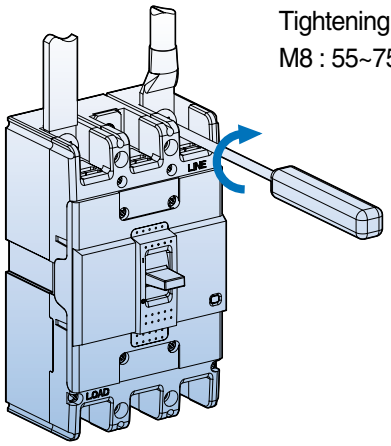


Fig. 5

2P : 1ea
3P : 2ea
4P : 3ea

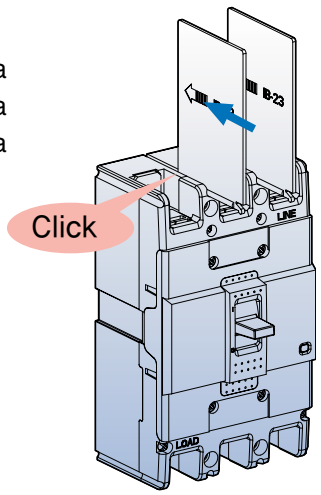
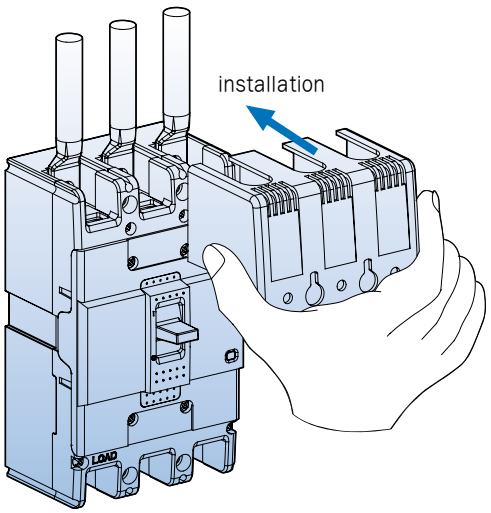


Fig. 6



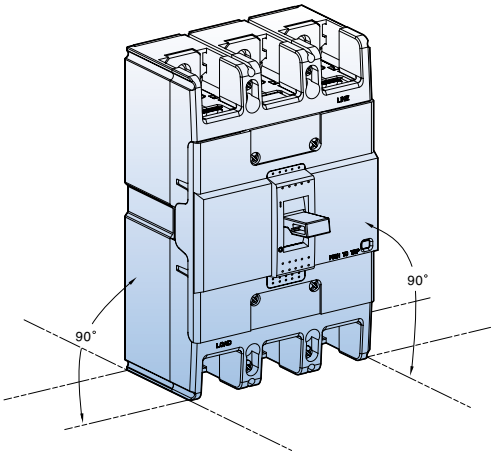
4. Installation Method of 250AF

If 250AF circuit breaker is to be installed, it can be installed as below.

Installation of 250AF circuit

1. When the circuit breaker is to be installed, place it perpendicular as Fig. 1, so when you look at it from the front or side, it maintains a 90°angle. Then use proper installation screws for the circuit breaker which were offered with the product and install it as shown in Fig. 3.
2. When the circuit breaker is to be installed, it needs to be installed to maintain the insulation distance with metal conductor as in Fig. 2.
   *The unit of measurement in the Fig. is mm.
3. When you install products very closely as in Fig. 2, you need to install a barrier between them.
   *According to a type of product, you can purchase insulation barriers additionally.

Fig. 1



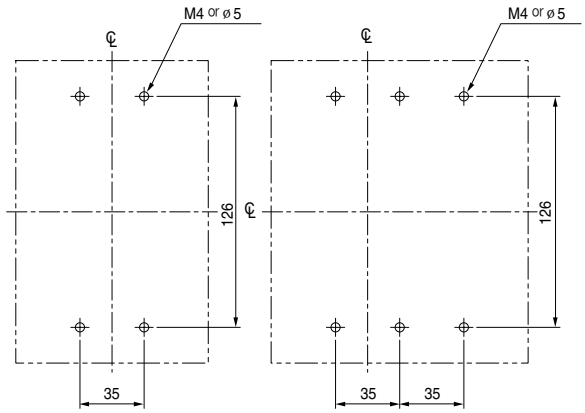
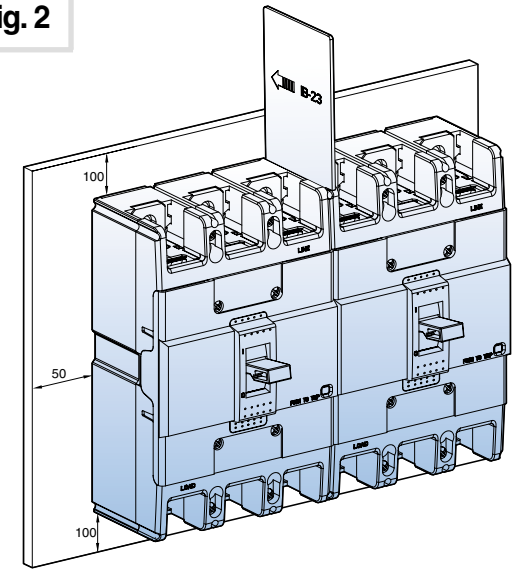
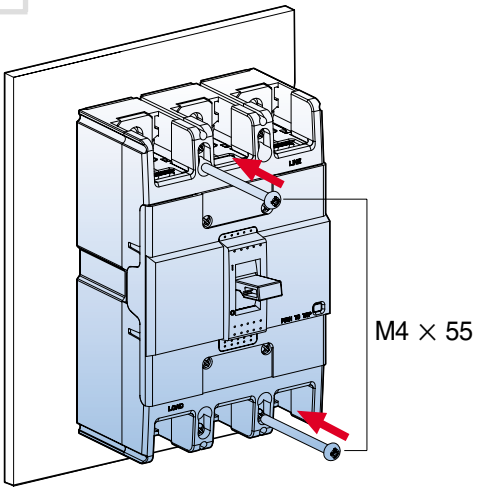


Fig. 2



* In the case of installing products very closely, a barrier has to be inserted between products.

Fig. 3

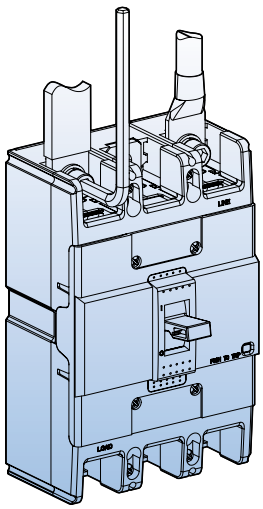


E

4. Installation method of 250AF

4. As seen in Fig. 4, please connect the wire to the product and tighten.
5. As seen in Fig. 5, please install the insulation barrier enclosed with the product.
6. If the terminal cover is to be purchased separately and installed, then as seen in Fig. 6, please insert in the direction of arrow and align with the circuit breaker's installation notch.

Fig. 4



Tightening Torque
80 ~ 130Kgf • cm

Fig. 5

2P : 1ea
3P : 2ea
4P : 3ea

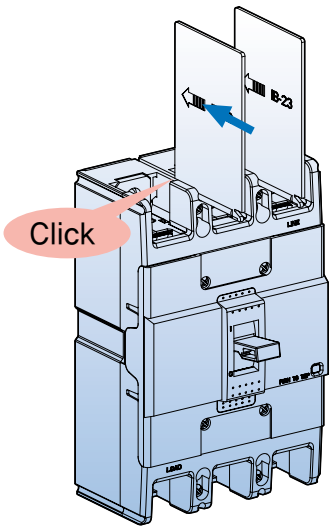
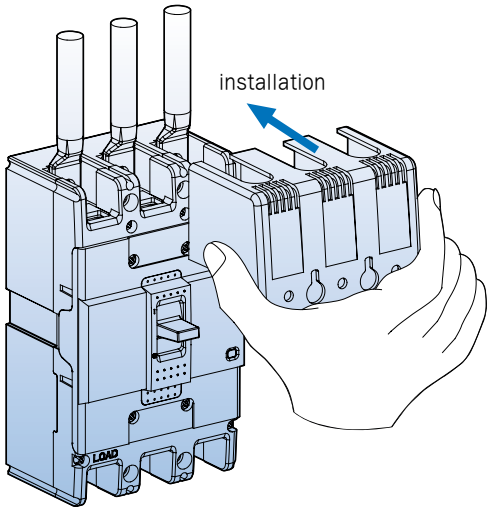


Fig. 6



E

5. Installation Method of 400AF

If 400AF circuit breaker is to be installed, it can be installed as below.

Installation of 400AF circuit

1. When the circuit breaker is to be installed, place it perpendicular as Fig. 1, so when you look at it from the front or side, it maintains a 90°angle. Then use proper installation screws for the circuit breaker which were offered with the product and install it as shown in Fig. 3.
2. When the circuit breaker is to be installed, it needs to be installed to maintain the insulation distance with metal conductor as in Fig. 2.
   *The unit of measurement in the Fig. is mm.
3. When you install products very closely as in Fig. 2, you need to install a barrier between them.
   *According to a type of product, you can purchase insulation barriers additionally.

Fig. 1

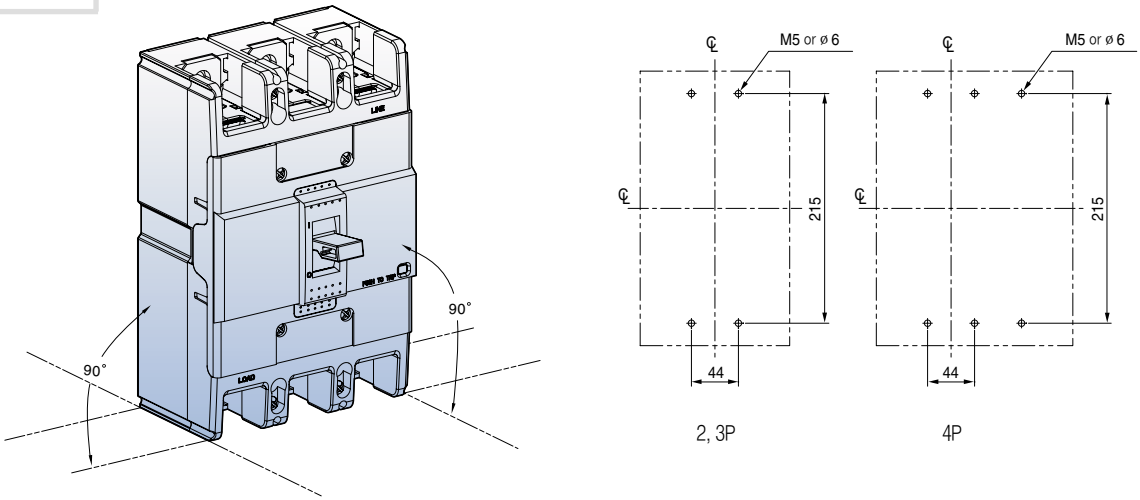
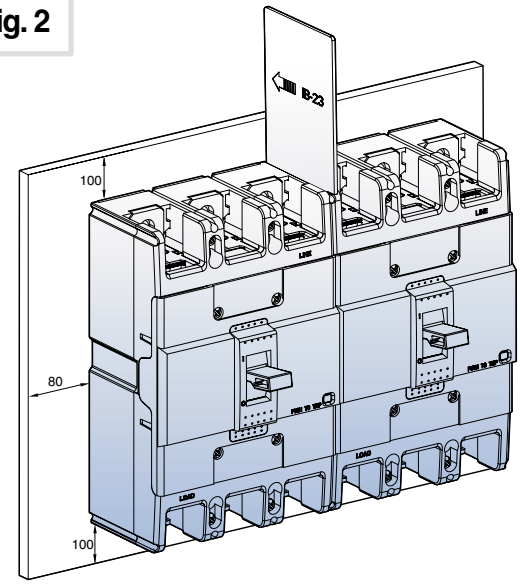
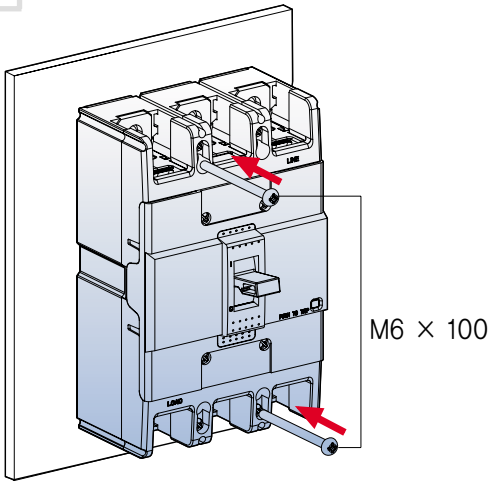


Fig. 2



* In the case of installing products very closely, a barrier has to be inserted between products.

Fig. 3

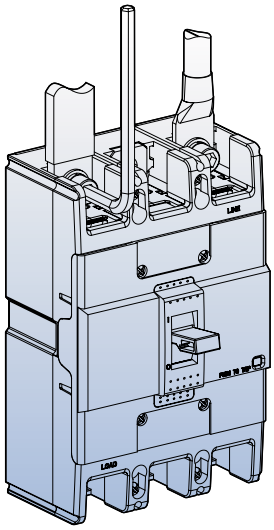


E

5. Installation Method of 400AF

4. As seen in Fig. 4, please connect the wire to the product and tighten.
5. As seen in Fig. 5, please install the insulation barrier enclosed with the product.
6. If the terminal cover is to be purchased separately and installed, then as seen in Fig. 6, please insert in the direction of arrow and align with the circuit breaker's installation notch and install with screw

Fig. 4



Tightening Torque
M10 : 240~300 kgf • cm

Fig. 5

2P : x
3P : 2ea
4P : 3ea

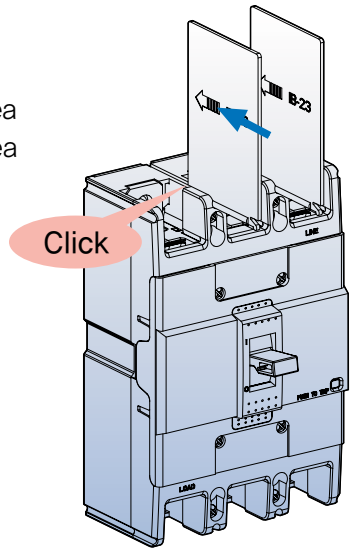
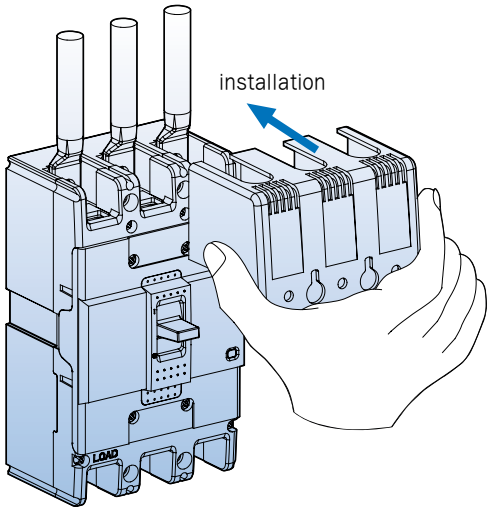


Fig. 6



E

6. Installation Method of 630/800AF

If 630/800AF circuit breaker is to be installed, it can be installed as below.

Installation of 630/800AF circuit

1. When the circuit breaker is to be installed, place it perpendicular as Fig. 1, so when you look at it from the front or side, it maintains a 90°angle. Then use proper installation screws for the circuit breaker which were offered with the product and install it as shown in Fig. 3.
2. When the circuit breaker is to be installed, it needs to be installed to maintain the insulation distance with metal conductor as in Fig. 2.
   *The unit of measurement in the Fig. is mm.
3. When you install products very closely as in Fig. 2, you need to install a barrier between them.
   *According to a type of product, you can purchase insulation barriers additionally.

Fig. 1

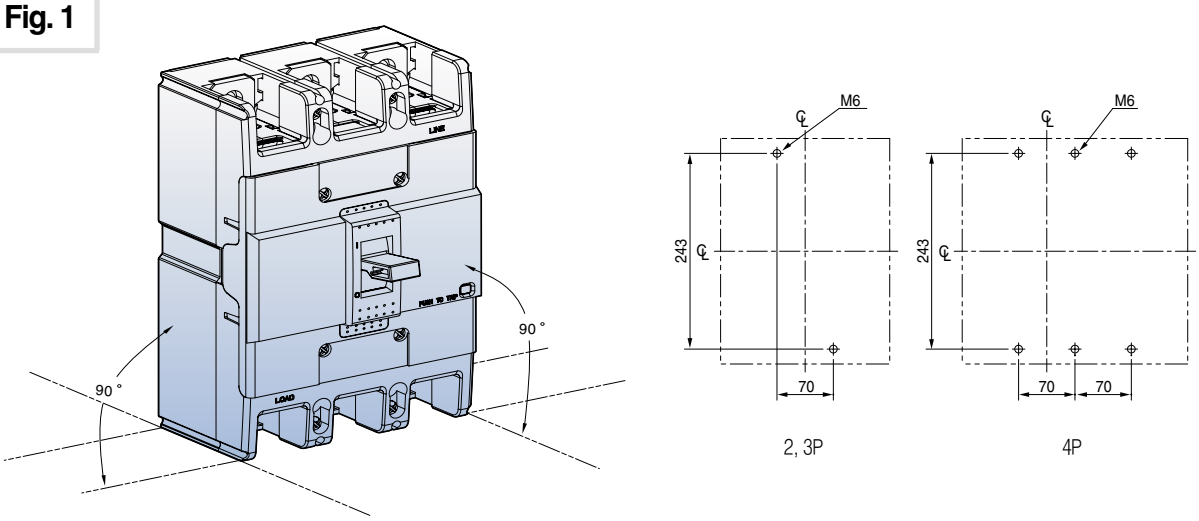
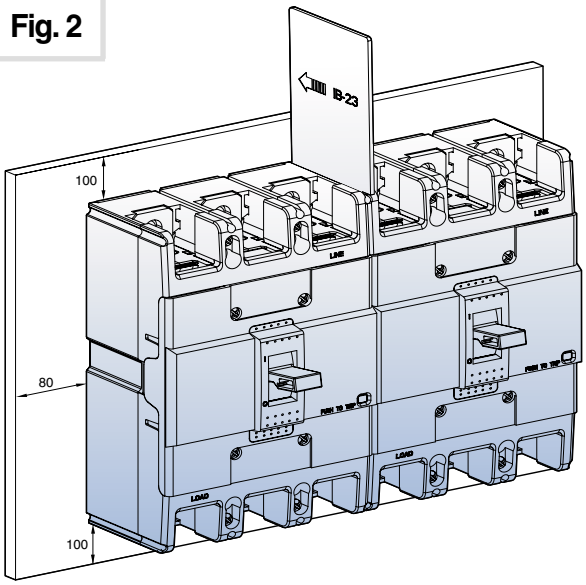
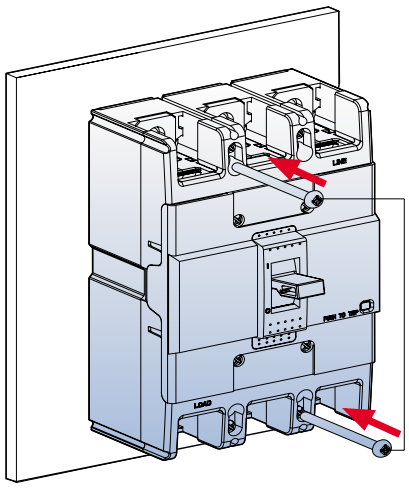


Fig. 2



* In the case of installing products very closely, a barrier has to be inserted between products.

Fig. 3

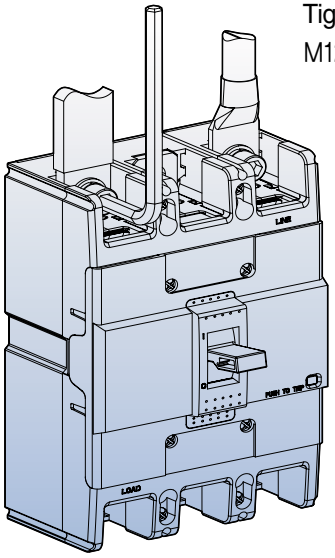


E

6. Installation Method of 630/800AF

4. As seen in Fig. 4, please connect the wire to the product and tighten.
5. As seen in Fig. 5, please install the insulation barrier enclosed with the product.
6. If the terminal cover is to be purchased separately and installed, then as seen in Fig. 6, please insert in the direction of arrow and align with the circuit breaker's installation notch and install with screw

Fig. 4



Tightening Torque
M12 : 400~500 kgf • cm

Fig. 5

2P : x
3P : 2ea
4P : 3ea

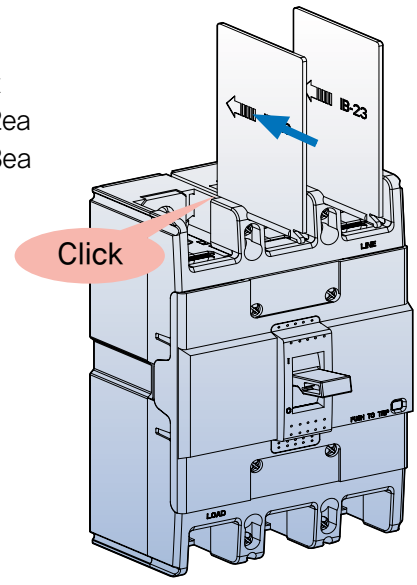
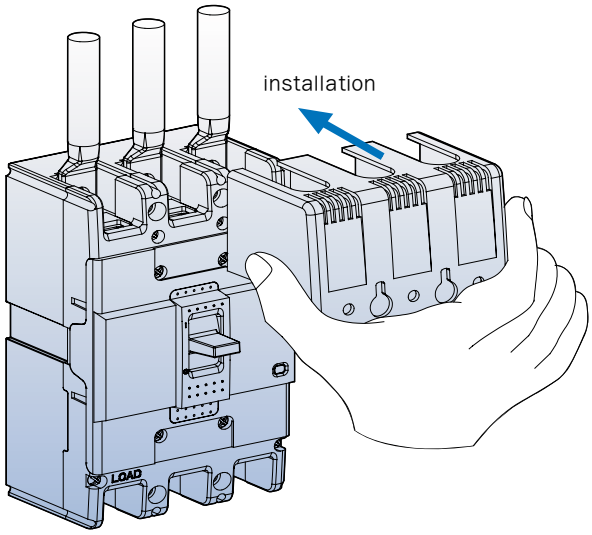


Fig. 6



E

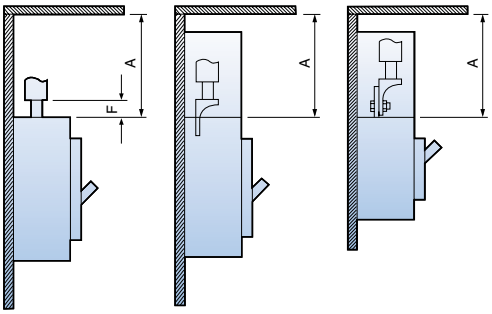
7. Insulation distance

The circuit breaker should be installed with a secure insulation distance for the safety.

In the case of installing the circuit breaker, it is necessary to secure the distance between them, the panel or the booth bar or other nearby equipment. This insulation distance is different depending on breaking capacity and it is decided by the standard of IEC60947-2. You can check it through the test. If the circuit breaker operates from a short circuit, there is a high temperature ionized gas and the gas will be emitted to the emission part on circuit breaker's power side. This gas can cause short circuits or ground faults so enough insulation distance is necessary between the circuit breaker and panel.

In the case of an iron panel (Insulation distance to ceiling panel)

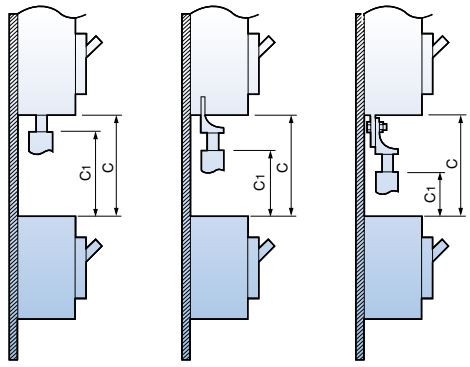
Frame size	Description	A(mm)	
		460V	250V
100AF	ABN50c	40	25
	ABN60c	40	25
	ABN100c	50	30
	ABS30c	30	25
	ABS50c	40	30
	ABS60c	40	30
125AF	ABS125c	50	40
	ABH50c	50	40
	ABH125c	100	80
250AF	ABN250c	100	80
	ABS250c	100	80
	ABH250c	100	80
400AF	ABN400c	100	80
	ABS400c	100	80
	ABH400c	100	80
	ABL400c	100	80
630AF	ABN630c	100	80
	ABS630c	100	80
	ABL630c	100	80
800AF	ABN800c	100	80
	ABS800c	100	80
	ABL800c	100	80



In the case of one circuit breaker on top of another

- C1 : the shortest distance to upper side circuit breaker charging unit
- C : C1 + charging part exposure length

Frame size	Description	C1 (mm)		C (mm)
		460V	250V	
100AF	ABN50c	40	25	The dimension of bare conduct + C1
	ABN60c	40	25	
	ABN100c	50	30	
	ABS30c	30	25	
	ABS50c	40	30	
	ABS60c	40	30	
125AF	ABS125c	50	40	
	ABH50c	50	40	
	ABH125c	100	80	
250AF	ABN250c	100	80	
	ABS250c	100	80	
	ABH250c	100	80	
400AF	ABN400c	100	80	
	ABS400c	100	80	
	ABH400c	100	80	
	ABL400c	100	80	
630AF	ABN630c	100	80	
	ABS630c	100	80	
	ABL630c	100	80	
800AF	ABN800c	100	80	
	ABS800c	100	80	
	ABL800c	100	80	



in the case of connecting electric wire directly

in the case of using compression terminal to connect electric wire

in the case of connecting electric wire with compression terminal to circuit breaker's booth bar

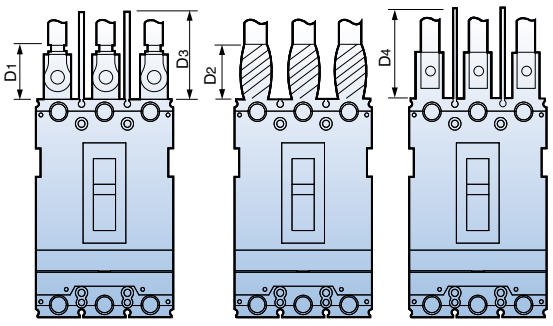
E

7. Insulation distance

Insulation distance of circuit breaker's main terminal

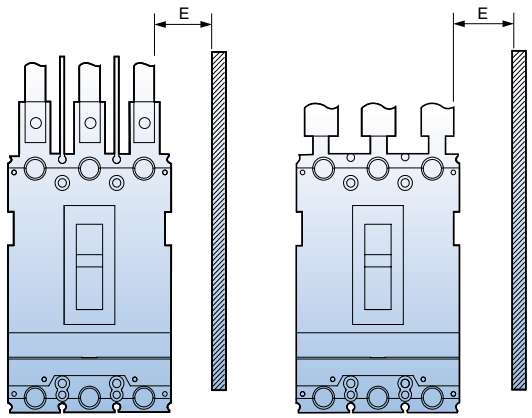
- D1 : in the case of winding up with tape, connect with compression terminal
- D2 : in the case of winding up with tape, connect with booth bar
- D3 : in the case of attaching an insulation barrier, connect with compression terminal
- D4 : in the case of attaching an insulation barrier, connect with booth bar

Frame size	Description	D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)
100AF	ABN50c	The dimension of bare conduct + 20	40	The dimension of bare conduct + 20	40
	ABN60c		40		40
	ABN100c		50		50
	ABS30c		30		30
	ABS50c		40		40
	ABS60c		40		40
125AF	ABS125c		50		50
	ABH50c		50		50
	ABH125c		50		50
250AF	ABN250c		50		50
	ABS250c		50		50
	ABH250c		50		50
400AF	ABN400c		100		100
	ABS400c		100		100
	ABH400c		100		100
	ABL400c		100		100
630AF	ABN630c		150		150
	ABS630c		150		150
	ABL630c		150		150
800AF	ABN800c		150		150
	ABS800c		150		150
	ABL800c		150		150



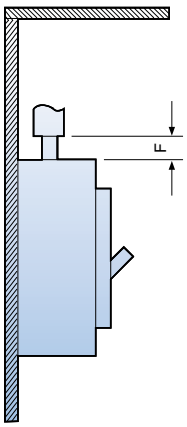
In the case of an iron panel (insulation distance to side panel)

Frame size	Description	E(mm)	
		460V	250V
100AF	ABN50c	25	15
	ABN60c	25	15
	ABN100c	25	15
	ABS30c	20	15
	ABS50c	25	15
	ABS60c	25	15
125AF	ABS125c	25	15
	ABH50c	25	15
	ABH125c	50	20
250AF	ABN250c	50	15
	ABS250c	50	15
	ABH250c	50	15
400AF	ABN400c	80	40
	ABS400c	80	40
	ABH400c	80	40
	ABL400c	80	40
630AF	ABN630c	80	40
	ABS630c	80	40
	ABL630c	80	40
800AF	ABN800c	80	40
	ABS800c	80	40
	ABL800c	80	40



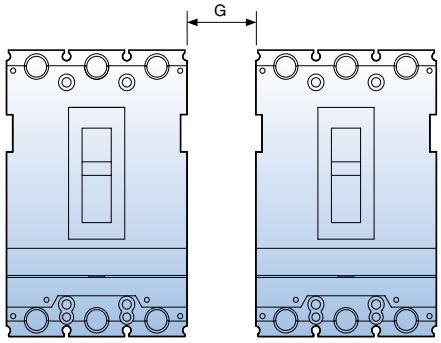
Distance of bare cables or busbars

Frame size	Description	F(mm)
100AF	ABN50c	10
	ABN60c	10
	ABN100c	-
	ABS30c	5
	ABS50c	10
	ABS60c	10
125AF	ABS125c	-
	ABH50c	10
	ABH125c	20
250AF	ABN250c	-
	ABS250c	-
	ABH250c	-
400AF	ABN400c	10
	ABS400c	10
	ABH400c	10
	ABL400c	10
630AF	ABN630c	10
	ABS630c	10
	ABL630c	10
800AF	ABN800c	10
	ABS800c	10
	ABL800c	10



Minimal distance between two adjacent breakers (with terminal covers)

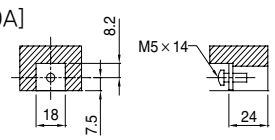
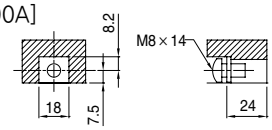
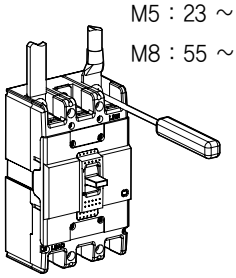
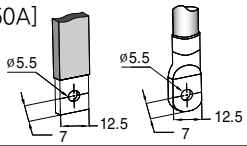
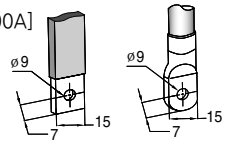
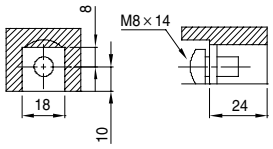
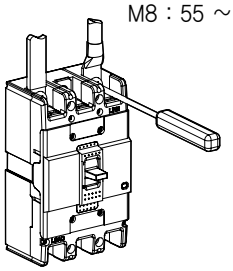
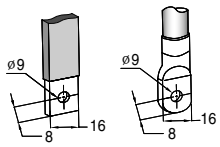
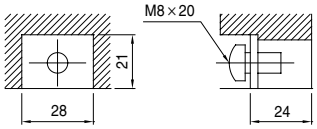
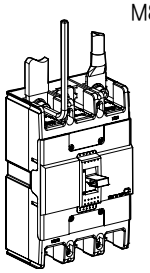
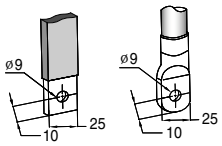
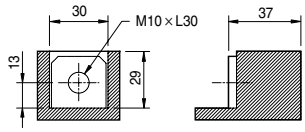
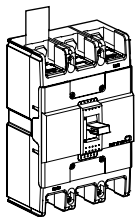
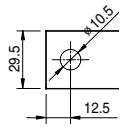
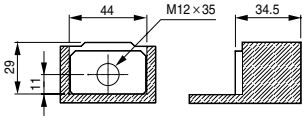
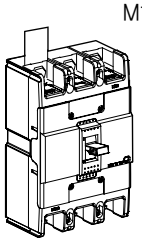
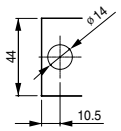
Frame size	Description	G(mm)
100AF	ABN50c	0
	ABN60c	0
	ABN100c	0
	ABS30c	0
	ABS50c	0
	ABS60c	0
125AF	ABS125c	0
	ABH50c	0
	ABH125c	0
250AF	ABN250c	0
	ABS250c	0
	ABH250c	0
400AF	ABN400c	0
	ABS400c	0
	ABH400c	0
	ABL400c	0
630AF	ABN630c	0
	ABS630c	0
	ABL630c	0
800AF	ABN800c	0
	ABS800c	0
	ABL800c	0



E

8. Connection

Connection

Frame type	Terminal (mm)	Tightening torque (kgf · cm)	Conductor (mm)
ABN 100c	[15~50A]  [60~100A] 	M5 : 23 ~ 28 M8 : 55 ~ 75 	[15~50A]  [60~100A] 
ABH 125c		M8 : 55 ~ 75 	
ABH 250c		M8 : 80 ~ 130 	
400AF		M10 : 240~300 	
630AF 800AF		M12 : 400~500 	

E

9. Back type installation

Precautions for safe use

⚠ Danger

Please shut off the power during wiring work for installation, repair and inspection. There is a danger of burn from electric shocks and short circuits.

⚠ Warning

1. Please refrain from using damaged and and altered products.
2. Please let a qualified person with technical knowledge do installation, repair and inspection work.
3. Please refrain from using in extreme conditions with high temperature, high humidity, dust, corrosive gas, excessive vibration and impact etc. It can cause fire and faulty operation.
4. Please use accessories which are suitable for the product's rating and number of poles.
5. Please install as per the manual. If it's installed incorrectly, there is a possibility of injury from obstacles causing malfunction or other unforeseen accidents.
6. If there is shortage of tightening torque at the terminal, it can cause overheating or fire so please fix the terminal firmly by referring to the stated tightening torque.
7. When you tighten the terminal, please install connection conductor in parallel. There is a danger of short circuit fault.
8. If you use the products very close to each other, please install an insulation barrier between terminals.
   If you don't have an insulation barrier, please insulate the compression terminal or conductor's exposure unit with an insulating panel or insulating tape, or install a terminal cover(sold separately). There is a danger of short circuit fault between each phase.
9. Please be careful not to cause damage while transporting or installing.
10. Please do not make unauthorized alterations.
11. Please follow your own country's guidelines for disposal of this product.

Installation method of back type terminal

1. Please install back type terminal to circuit breaker as seen in Fig. 1 and Fig. 2.
2. To prevent fire, please tighten the conductor with fixed torque as seen in tightening torque on page 52.
3. After installing the back type terminal, please install a terminal cover(sold separately) to the circuit breaker.
4. The minimum diameter of the panel hole to install a back type terminal should be 20mm(under 100AF)/ 30mm(over 250AF).

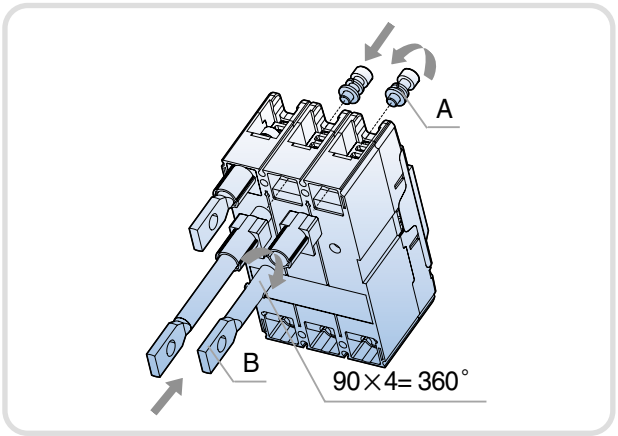


Fig. 1. Bar back type installation

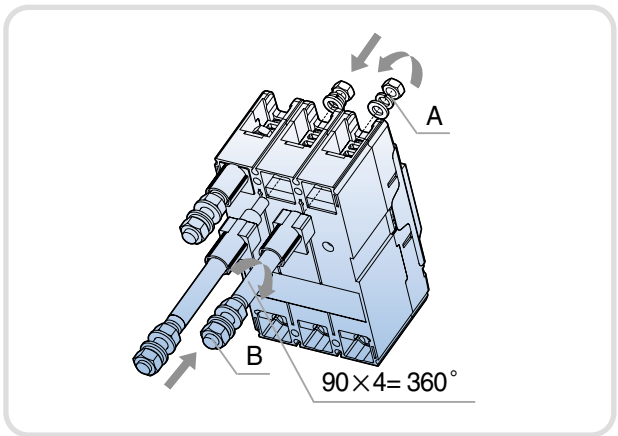


Fig. 2. Round back type installation

9. Back type installation

Back type installation is applied when the terminal of circuit breaker needs to be connected to the back side not the front. There are flat bar types and round types depending on the terminal connecting method(shape).

Bar/back type terminal by product

MCCB/ELCB	2 Pole circuit breaker	3 Pole circuit breaker	4 Pole circuit breaker
ABN100c	RTB1-102	RTB1-103	RTB1-104
ABH125c	RTB2-102	RTB2-103	RTB2-104
ABH250c	RTB3-202	RTB3-203	RTB3-204
400AF	X-402	X-403	X-404
630 ~ 800AF	X-802	X-803	X-804

Round/back type terminal by product

MCCB/ELCB	2 Pole circuit breaker	3 Pole circuit breaker	4 Pole circuit breaker
ABN100c 50AF	RTR1-52	RTR1-53	RTR1-54
ABN100c 100AF	RTR1-102	RTR1-103	RTR1-104
ABH125c	RTR2-102	RTR2-103	RTR2-104
ABH250c	RTR3-202	RTR3-203	RTR3-204

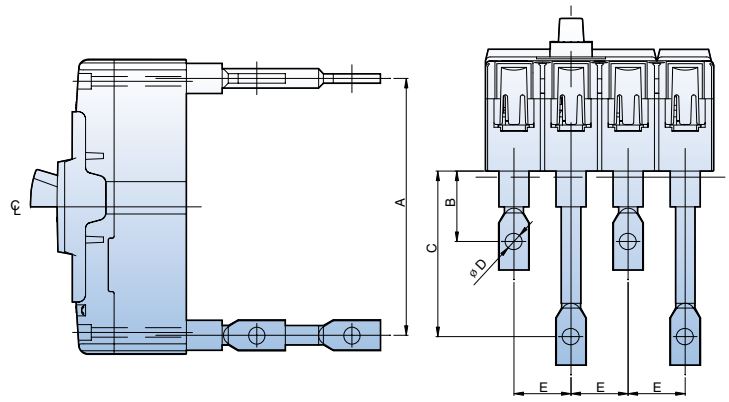
Bar/back type tightening

Type	Tightening Torque	
	A	B
RTB1 -102 **RTB1 -103** **RTB1 -104**	M6 40~50 kgf.cm	M8 70~90 kgf.cm
RTB2 -102 **RTB2 -103** **RTB2 -104**	M6 40~50 kgf.cm	M8 120~150 kgf.cm
RTB3 -202 **RTB3 -203** **RTB3 -204**	M6 50~65 kgf.cm	M8 120~150 kgf.cm

Round/back type tightening

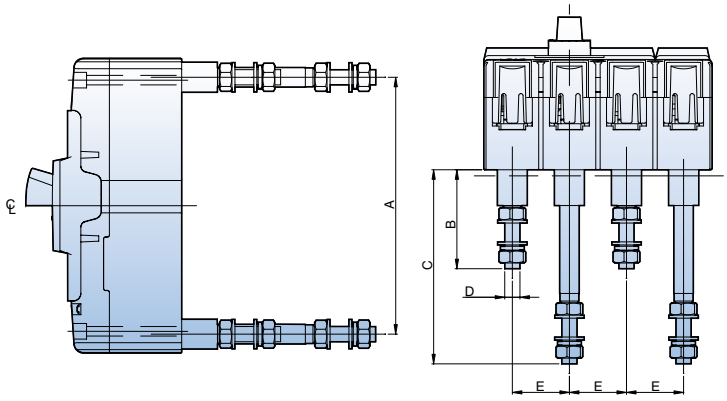
Type	Tightening Torque	
	A	B
RTR1-52 **RTR1-53**	M4 13~18 kgf.cm	M6 40~50 kgf.cm
RTR1 -102 **RTR1 -103** **RTR1 -104**	M6 40~50 kgf.cm	M8 70~90 kgf.cm
RTR2 -102 **RTR2 -103** **RTR2 -104**	M6 40~50 kgf.cm	M8 120~150 kgf.cm
RTR3 -202 **RTR3 -203** **RTR3 -204**	M6 50~65 kgf.cm	M8 120~150 kgf.cm

Bar type rear connection terminals



MCCB	A	B	C	D	E
ABN100c	115	37	87	Ø 8.5	25
ABH125c	135	37	87	Ø 8.5	30
ABH250c	144	57.5	93.5	Ø 8.5	35
ABS400c	225	72	-	Ø 14	44
ABS630c, ABS800c	243	108.7	-	Ø 14	70

Round type rear connection terminals



MCCB	A	B	C	D	E
ABN100c 50AF	115	42	92	M6	25
ABN100c 100AF	115	52	102	M8	25
ABH125c	135	52	102	M8	30
ABH250c	144	70	106	M8	35

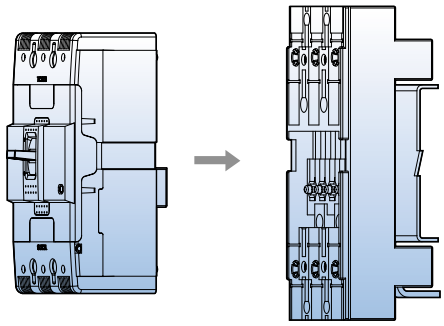
10. Plug-in installation

Plug-in installation

The plug-in method involves connection and installation methods to allow removing and replacing of the circuit breaker promptly without touching the terminal connecting unit where possible. If a plug-in type MCCB is installed at important electric facilities like a ship or a broadcasting company etc., the circuit breaker can be replaced and repaired quickly and easily without a power failure of the bus. Metasol circuit breakers can be installed by the plug-in method.

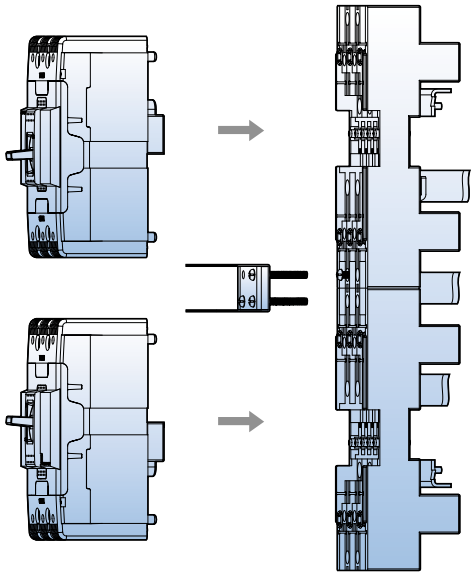
Standard type

It can be applied widely to switchboards because it is compatible with products of various breaking capacity up to rating current 250A.



Panel board double line arrangement usage

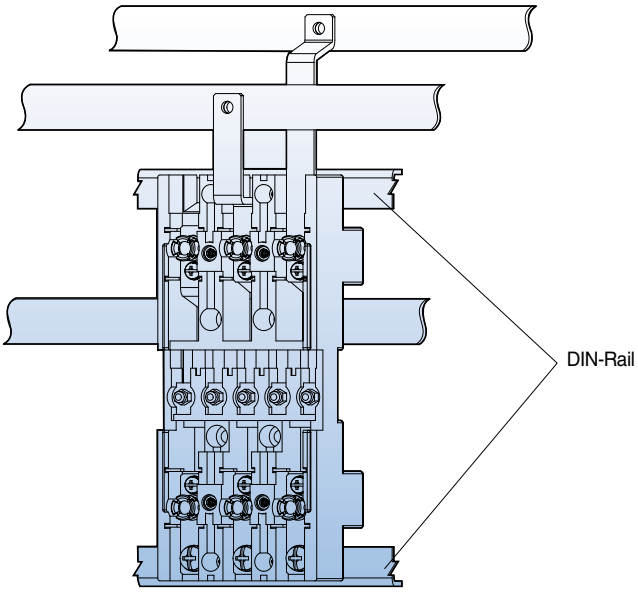
It is designed to make panel board's branch circuit breaker double line's arrangement possible. And its rated current is up to 125A so it can be widely applied for branches.



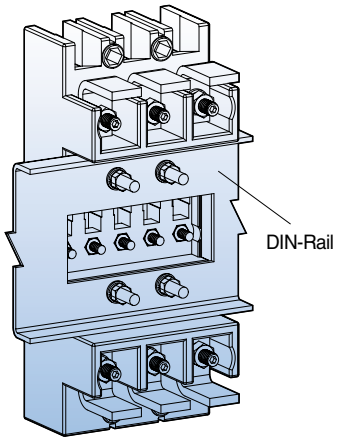
Plug-in device

MCCB	Arrangement	Type	Means
ABN100c	Normal	PB-A3-FR	
	Single row	PB-A3-1DB	
	Double row	PB-A3-2DB	For distribution board
	-	PB-A3-FRL	
ABH125c	Normal	PB-C3-FR	
	Single row	PB-C3-1DB	
	Double row	PB-C3-2DB	For distribution board
	-	PB-C3-FRL	
ABH250c	Normal	PB-D3-FR	
400AF	-	PB-I3-FRL	
630/800AF	-	PB-J3-FRL	

Mounting type



[Installing on the front of the mounting rail]



[Installing on the back of the mounting rail]

10. Plug-in installation

Precautions for safe use of Plug-in device

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

⚠ Precautions for Safety Reasons

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

⚠ **Danger** : If you violate this instruction, it can result in death or serious injury.
⚠ **Warning** : If you violate this instruction, it can result in light injury or material damage.

⚠ Danger

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

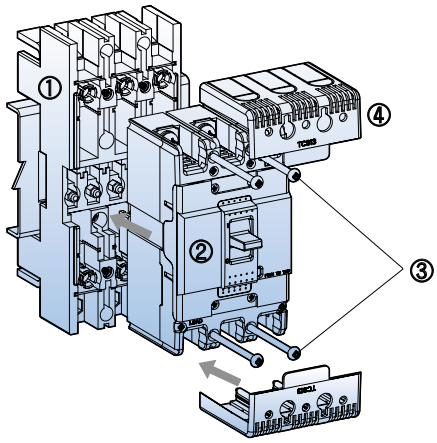
⚠ Warning

1. Before installing the product, please read precautions and install it accordingly.
2. There is a danger of fault operation or accident from incorrect installation.
   Please let a qualified person(electrician) install and repair the circuit breaker.
3. Please avoid installation in environments with rain, oil, dust, direct sunlight etc. There is a danger of electric shock, leakage, short circuit, fire and fault operation.
   1) Usage Temperature : -5~40° 2) Relative Humidity : 45~85% 3)Altitude : below 2000m
   4)Avoid abnormal vibration, impact, excessive vapor, oil, smoke, dust, corrosive gas and flammable gas.
4. Please connect to the power which is suitable for the product's rated voltage and current. If the rated voltage and current are not correct, it can cause damage or loss.
5. If there is shortage of tightening torque at the terminal, it can cause overheating or fire so please fix the terminal firmly referring to the stated tightening torque on each product's user manual.
6. When you assemble the terminal, please install the connection conductor and each phase in parallel. There is a danger of short circuit faults between each phase.
7. Please be careful not to damage the unit while transporting and installing.
8. Please follow your own country's guidelines for disposal of this product.
9. Please do not connect aluminum terminal and conductor directly to circuit breaker's terminal. It will cause corrosion and heating.
10. Please do not make unauthorized alterations.

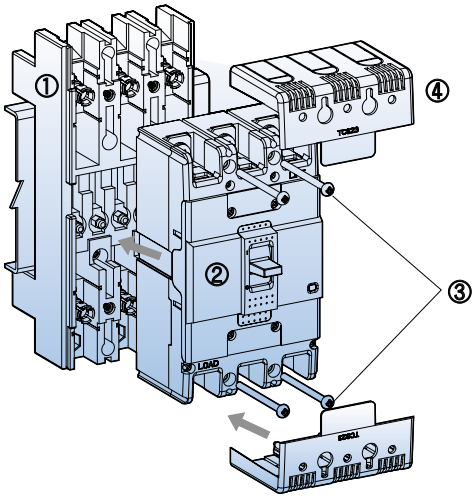
Plug-in installation by type of product (100/125/250AF)

(1) Assemble product ② to plug-in base ① in the direction of arrow.
(2) Fix product ② to plug-in base ① using 4ea of installation screw ③.
(3) Install terminal cover ④ to product ②'s line and load side.

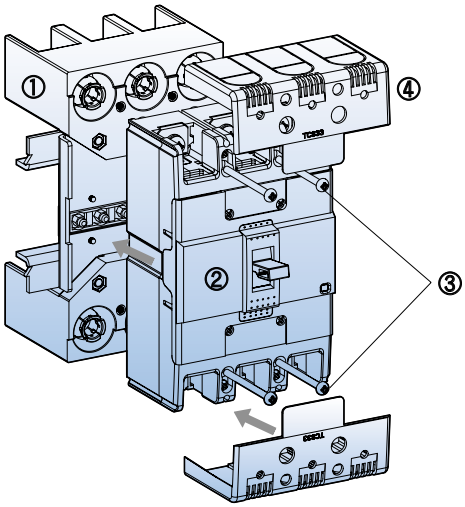
ABE100c



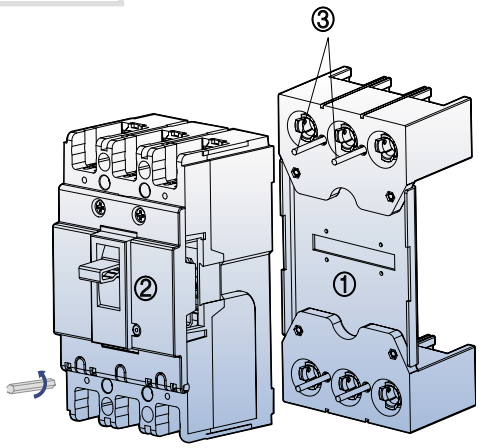
ABH125c



ABH250c



400 ~ 800AF

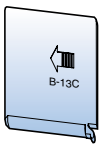
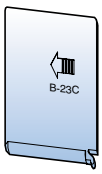
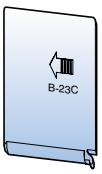
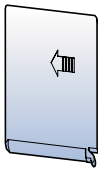
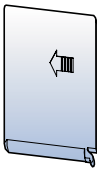


E

11. Standard accessories by type of product

Below are standard accessories for installing Metasol series Circuit Breakers which will be packed and provided with the circuit breaker.

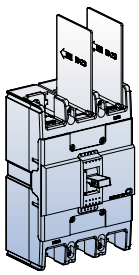
* For additional accessories, please see Metasol Circuit Breaker catalogue by our company.

Items	ABN100c	ABH125c	ABH250c	400AF	630/800AF
Fixing bolt					
	2pole : 2pcs (M4×60) 3pole : 2pcs (M4×60) 4pole : 4pcs (M4×60)	2pole : 2pcs (M4×60) 3pole : 2pcs (M4×60) 4pole : 4pcs (M4×60)	2pole : 2pcs (M4×55) 3pole : 4pcs (M4×55) 4pole : 4pcs (M4×55)	2pole : 2pcs (M6×100) 3pole : 4pcs (M6×100) 4pole : 4pcs (M6×100)	2pole : 2pcs (M6×100) 3pole : 4pcs (M6×100) 4pole : 4pcs (M6×100)
Terminal bolt					
	3~30A 2pole : 4pcs (M5×14) 3pole : 6pcs (M5×14) 4pole : 8pcs (M5×14) **40~100A** 2pole : 4pcs (M8×14) 3pole: 6pcs (M8×14) 4pole : 8pcs (M8×14)	2pole : 4pcs (M8×14) 3pole : 6pcs (M8×14) 4pole : 8pcs (M8×14)	2pole : 4pcs (M8×20) 3pole : 6pcs (M8×20) 4pole : 8pcs (M8×20)	2pole : 4pcs (M10×30) 3pole : 6pcs (M10×30) 4pole : 8pcs (M10×30)	2pole : 2pcs (M12×35) 3pole : 6pcs (M12×35) 4pole : 8pcs (M12×35)
Insulation barrier					
	2pole : 1pcs 3pole : 2pcs 4pole : 3pcs	2pole : 1pcs 3pole : 2pcs 4pole : 3pcs	2pole : 1pcs 3pole : 2pcs 4pole : 3pcs	2pole : 1pcs 3pole : 2pcs 4pole : 3pcs	2pole : 1pcs 3pole : 2pcs 4pole : 3pcs

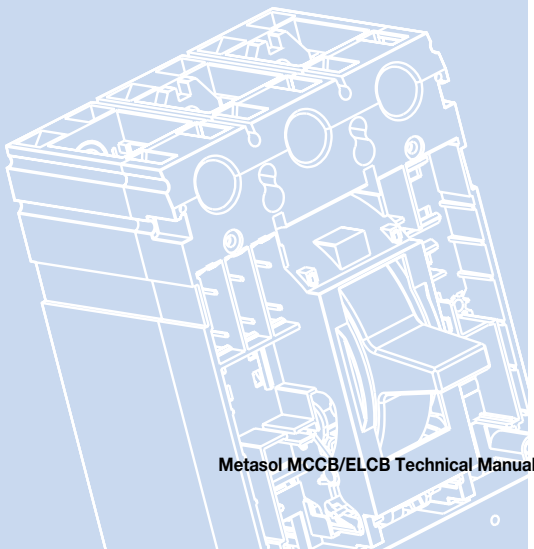
Attachable insulation barrier

The standard insulation barrier will be provided and insulation efficiency can be improved between phases by installing them on notches between each terminal. Even if the circuit breaker is installed already, you can easily assemble them together. When there are two circuit breakers installed next to each other, you can also assemble it between them.
*Insulation barrier can not be used together with the terminal cover.

You can insert insulation barrier into the circuit breaker's insulation barrier installation notch as shown in the Fig.



F. Accessories



1. Internal accessories

Internal accessories of Metasol series circuit breakers are used commonly for 30~250AF products.

Auxiliary switch (AX)

Auxiliary switch (AX) is a device which is used to indicate the circuit breaker's ON and OFF state exernally. One AX is composed with the C contact so when the one contact becomes ON, another becomes OFF. *see contact operating state

Alarm switch (AL)

Alarm switch (AL) is a device which is used to indicate the circuit breaker's TRIP state.
When circuit breaker is tripped by overload and short circuit, or shunt trip and undervoltage trip, it indicates this externally.
It operates when the circuit breaker trips automatically or the trip test button is pressed but it does not operate when circuit breaker is switched (ON/OFF) manually.
One AL is composed with C the contact so when the one contact switches ON, another switches OFF. *see contact operating state

Undervoltage Trip (UVT)

Undervoltage Trip (UVT) is designed to trip the circuit breaker automatically when the line voltage goes down to 20~70% of rating. Tripping occurs instantaneously without time delay and if the voltage recovers up to 85% of rating, the circuit breaker does not reclose(Reset and ON).
To reclose the circuit breaker, first, keep maintaining the voltage supplied to UVT above 85% of rating, then reset the circuit breaker and close(ON)
- Trip condition : voltage drop to 20~70% of rating
- Reset/Reclosing condition : Voltage recovery over 85% of rating
- Applied Frequency : 45~65Hz

Shunt Trip (SHT)

Shunt Trip (SHT) is designed to trip the circuit breaker when a certain voltage is applied(trip signal) to the SHT from outside. Tripping occurs instantaneously without time delay and once the circuit breaker trips, the trip signal will disappear automatically.
- Operating(trip signal) Condition : Apply 70~110% of rated voltage
- Applied Frequency : 45~65Hz

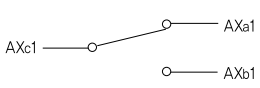
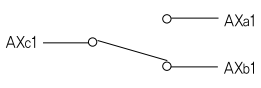
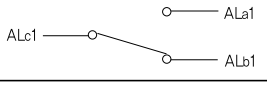
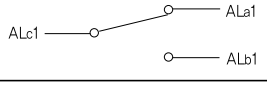
Shunt Trip (SHT)

Position	Accessories	ABN100c		ABH125c		ABH250c	EBN100c	EBH125c	EBH250c
		2P	3/4P	2P	3/4P	2/3/4P	2/3/4P	3/4P	2/3/4P
Handle left (R phase)	AX	–	1	–	1	1	1	1	1
	AL	–	1	–	1	1	1	1	1
	AX+AL	–	1	–	1	1	1	1	1
Handle right (T phase) note)	AX	1	1	1	1	1	–	–	–
	AL	1	1	1	1	1	–	–	–
	AX+AL	1	1	1	1	1	–	–	–
	SHT/UVT	1	1	1	1	1	–	–	–

Position	Accessories	MCCB (400~800AF)	ELCB (400~800AF)
Handle left (R phase)	AX	2	2
	AL	2	2
	SHT/UVT	1	1
Handle right (T phase)	AX	2	–
	AL	2	–
	SHT/UVT	1	–

note 1) AX/AL and SHT/UVT can't be installed at the same time on the T phase.

Switch (AX, AL) operating state

MCCB	ON	OFF	TRIP
AX operating			
AL operating			

Rating of switch (AX, AL)

Current flow, Ith		5A			
Rated current by voltage(Ie)		Rated voltage(Ue)	Rated current(Ie)		Applied MCCB/ELCB
			Resistance load	Coil Load	
	AC 50/60Hz	125V	5	3	Metasol MCCB/ELCB
		250V	3	2	
		500V	-	-	
	DC	30V	4	3	
		125V	0.4	0.4	
		250V	0.2	0.2	

Rating of under voltage trip (UVT) 30~250AF

Rated voltage and consumption power	Rated voltage(Vn)	Consumption power			Applied MCCB/ELCB
		AC(VA)	DC(W)	mA	
	AC/DC 24V	0.64	0 .65	27	Metasol MCCB 30~250AF
	AC/DC 48V	1.09	1.1	23	
	AC/DC 100~110V	0.73	0 .75	5.8	
	AC/DC 200~220V	1.21	1 .35	5.4	
	AC 380~440V	1.67	-	3.8	
	AC 440~480V	1.68	-	3.5	
Operating (Opening) time		50ms(max.)			
Terminal tightening torque		8.2 kgf · cm			
Operating voltage	Circuit breaker trip	20~70% Vn			
	Circuit breaker	≥ 0.85Vn			

Rating of under voltage trip (UVT) 400~800AF

Rated voltage(Ue)	Trip voltage	Reset/closing voltage	Time rating
AC/DC 48	· AC: 85~1.1Vn · DC: 85~1.25Vn	· AC: 0.2~0.7Vn · DC: 0.2~0.7Vn	Continuous
AC/DC 100~125			
AC/DC 200~240			
AC 380~440			
AC 440~480			

Rating of shunt trip (SHT) 30~250AF

Rated voltage and consumption power	Rated voltage(Vn)	Consumption power			Applied MCCB/ELCB
		AC(VA)	DC(W)	mA	
	AC/DC 12V	0.35	0.36	30	Metasol MCCB 30~250AF
	AC/DC 24V	0.64	0.65	27	
	AC/DC 48V	1.09	1.1	23	
	AC/DC 60V	1.2	1.22	20	
	AC/DC 100~130V	0.73	0.75	5.8	
	AC/DC 200~250V	1.21	1.35	5.4	
	AC 380~450V	1.67	–	3.8	
	AC 440~500V	1.68	–	3.5	
Operating (Opening) time		50ms(max.)			
Terminal tightening torque		8.2 kgf · cm			

Rating of shunt trip (SHT) 400~800AF

Rated voltage(Ue)
AC/DC 24~48
AC 100~125/DC 100~110
AC 200~240/DC 200~220
AC 380~460
AC 480~550

Note: Range of operational voltage
AC: 0.85 ~ 1.1Vn
DC: 0.75 ~ 1.25Vn

(W)Power consumption			(W)Power consumption		
V	mA	W	V	mA	W
AC 24	14	0.3	AC 220	6.8	1.5
DC 24	15.4	0.4	DC 200	7.6	1.5
AC 48	14	0.7	AC 440	4.3	1.9
DC 48	16	0.8	AC 480	4.4	3.3
AC 110	6	0.7	AC 550	4.6	2.4
DC 110	6.6	0.7			

1. Internal accessories

Precautions for Safe Use of Auxiliary switch (AX) / Alarm switch (AL)

(1) Before installing and using the Auxiliary switch(AX) and Alarm switch(AL), please be sure to read the user manual.
(2) Please let qualified people install and repair them. Do not install anything other than authorized devices.
(3) Before handling, wiring work, operating, repair and inspecting, please read precautions for safety reasons and danger prevention then use the product as directed.

⚠ Danger : If you violate these instructions, it may result in death or serious injury.
⚠ Warning : If you violate these instructions, it may result in light injury or material damage.

⚠ Danger

1. Before you install accessories, please make sure to turn the circuit breaker off. There is a danger of electric shock during installation.

⚠ Warning

1. Before installing the product, please read precautions and install it according to instructions.
2. Please give this user manual to the end user or the person in charge of repairs.
3. If you apply excessive strength to each hook unit during assembly, it's easy for them to be damaged.

Precautions for Safe Use of Undervoltage Trip (UVT) / Shunt Trip (SHT)

(1) Before installing and using the Undervoltage Trip(UVT) and Shunt Trip(SHT), please make sure to read the user manual.
(2) Please let qualified people install and repair them. Do not install anything other than authorized devices.
(3) Before handling, wiring work, operating, repair and inspecting, please read precautions for safety reasons and danger prevention then use the product as directed.
(4) Please make sure to follow these instructions because they are very important details about safety.

⚠ Danger : If you violate this instruction, it results in death or serious injury.
⚠ Warning : If you violate this instruction, it results in light injury or material damage.

⚠ Danger

1. Before you install accessories, please make sure to turn the above circuit breaker off.

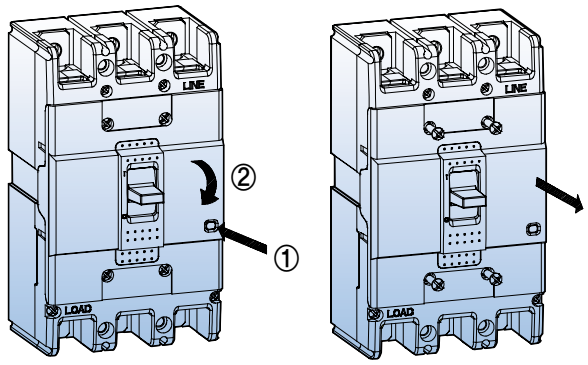
⚠ Warning

1. Before you assemble accessories, please thoroughly check the circuit breaker.
2. If you apply excessive strength to any hook unit during assembling, it's easy to damage them.
3. Please do not operate the handle when the power isn't applied to undervoltage trip device.

Installation method of internal accessories

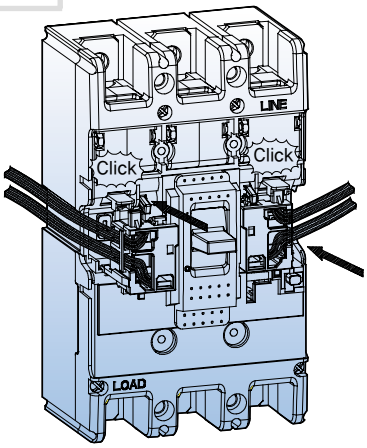
(1) Before you install an auxiliary / alarm switch, please check if the handle of Metasol MCCB is set on the trip position. Please press trip button to the tripped position(see Fig.1).
(2) Please remove the 4 screws and open the auxiliary cover.
(3) As shown on Fig. 2-1, press accessories into installation location which is on the right or left side of Metasol MCCB until you here click sound.
(4) When it's a block type, assemble it on the side of the main device as shown in Fig. 2-2 then tighten the designated electric wire to the terminal with a gauge of 1.13Nm(12kgf.cm)
*The electric wire is connected to the accessories on wire type of auxiliary switch(AX) / alarm switch(AL).
(5) Close the auxiliary cover and tighten the screws. Please tighten ABE100c model with gauge of 0.83Nm(8.2kgf.cm), ABH125c and ABH250c models with gauge of 1.13Nm(12kgf.cm).
(6) Before you use, please ensure smooth operation.
*AX/AL and SHT/UVT can't be installed at the same time on the T phase.
*SHT and UVT can not be used at the same time.

1



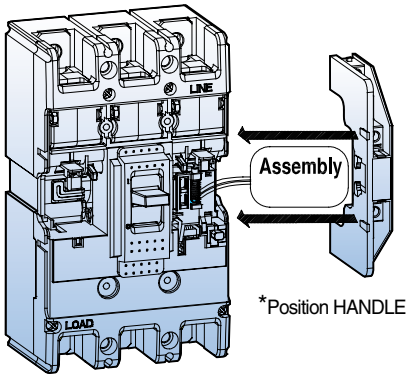
Open the Aux Cover

2-1 AX, AL



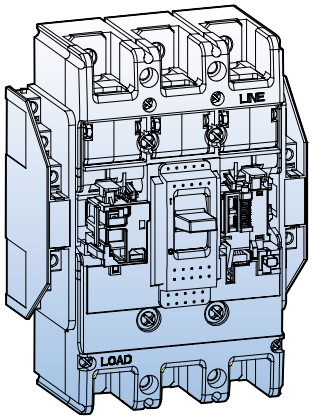
2-2 SHT/UVT

*Caution : Damage on line when Assembling

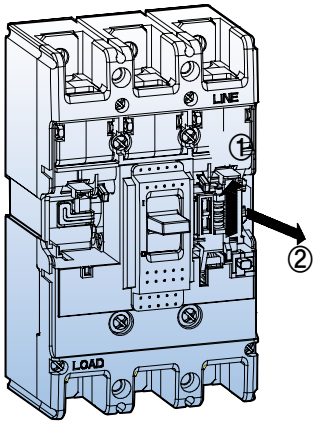


*Position HANDLE to 'ON' when mounting SHT/UVT

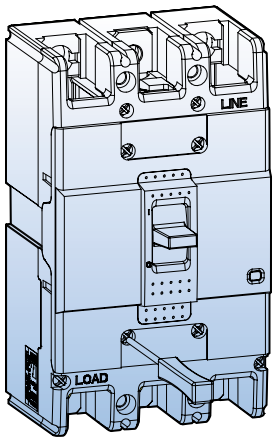
TERMINAL BLOCK



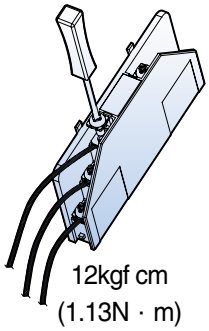
3 *Removing



4



15kgf cm
(1.48N · m)



12kgf cm
(1.13N · m)

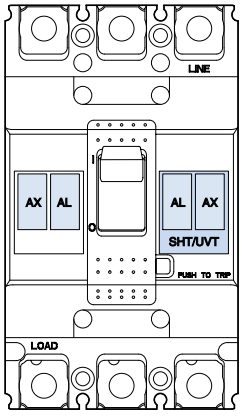
F

1. Internal accessories

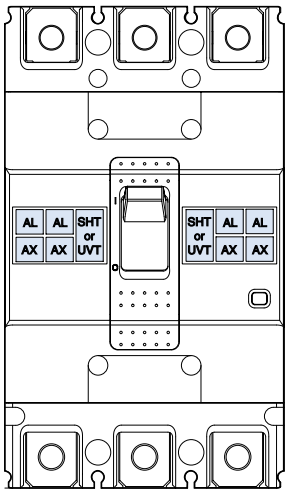
Mounting position

MCCB

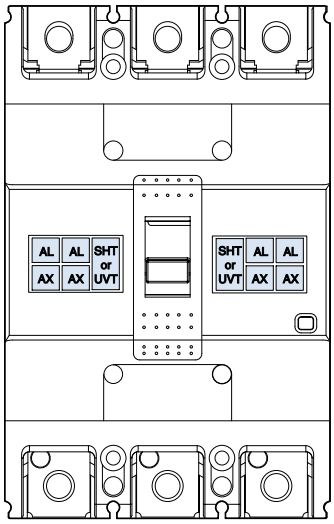
30 ~ 250AF



400AF



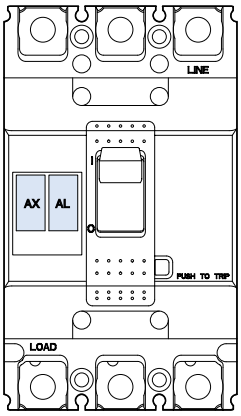
600 ~ 800AF



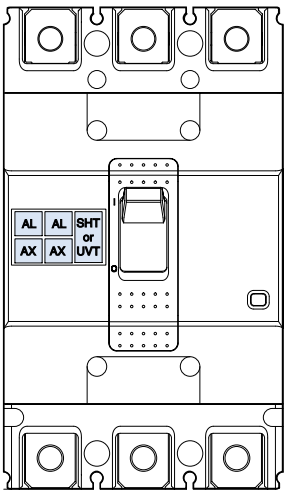
note) The AX/AL and SHT/UVT can't be installed at the same time.

ELCB

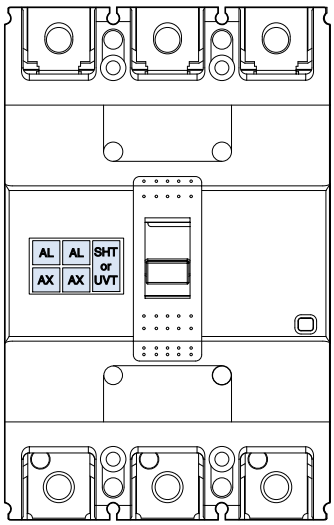
30 ~ 250AF



400AF



600 ~ 800AF



F

2. Rotary handle

Rotary handle

A rotary handle is a device which can check a circuit breaker's position(ON, OFF, TRIP) and operates even when the panel door is closed. They are categorized by the location where the handle is attached.

1. Direct Rotary Handle(D-Handle): Attached directly to circuit breaker.
2. Extended Rotary Handle(E-Handle): The length between the circuit breaker and panel door is long enough to install the handle on the panel door.

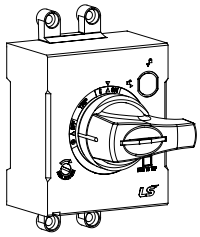
Basically, an external lock is installed on the loop of handle so it can't be locked to ON or OFF. And for a direct rotary handle, a built-in key lock type is available separately.

Handles by type of product

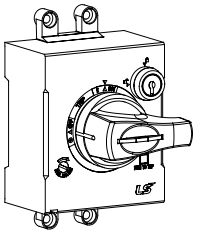
Direct type	Direct type (Key lock)	Extended type	Breaker type	
			MCCB	ELCB
DH100	DHK100	EH100	ABN50c/60c/100c ABS30c/50c/60c	EBN50c/60c/100c EBS30c/50c/60c
DH125	DHK125	EH125	ABS125c ABH50c/125c	EBS125c EBH50c/125c
DH250	DHK250	EH250	ABN250c, ABS250c ABH250c	EBN250c, EBS250c EBH250
N-70	-	E-70U	ABN/S/H/L400c	EBN/S/H/L400c
N-80	-	E-80U	ABN/S/L630c/800c	EBN/S/L630c/800c

The shape of direct rotary handles and components

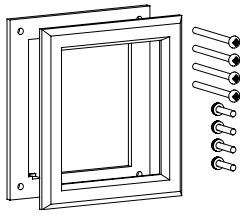
DH-Type



DHK-Type

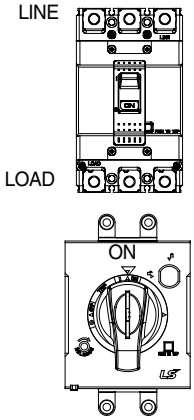


Additional accessories

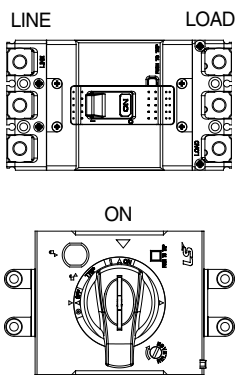


Types of direct rotary handles by Metasol MCCB's installation form

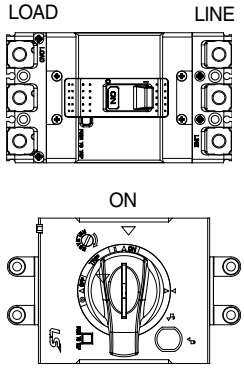
S-Type



L-Type



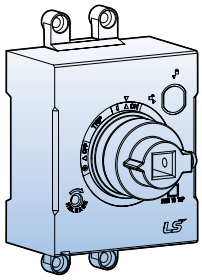
R-Type

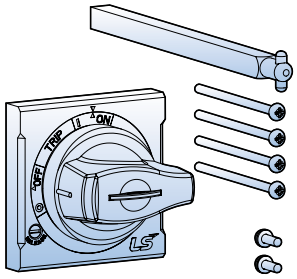


F

2. Rotary handle

The Shape of an extended rotary handle(E-Handle) and its components





Degree of protection of attaching rotary handle (IP degree)

Type	Degree of protection	IP degree
Circuit breaker with direct rotary handle (Cover frame attached)	The probe with a 0.1mm diameter cannot pass through.	IP 40
Circuit breaker with extended rotary handle (Cover frame attached)	Dust and water cannot penetrate from any direction.	IP 65

Precautions for safe use of rotary handle

(1) Before installing and using, please make sure to read user manual..
(2) Please give the product user manual to the end user or person in charge of repair.
(3) Before handling, wiring work, operating, repair and inspecting, please read the precautions for safety reasons and danger prevention then use the product as directed.
(4) Please make sure to follow these rules because they are very important details to ensure safety.

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

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

⚠ Danger

1. Before you install accessories, please make sure to turn the above circuit breaker off. There is a danger of electric shock during installation.

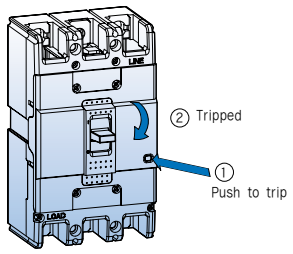
⚠ Warning

1. Please prohibit from using damaged and transformed products.
2. Please let a qualified person with technical knowledge do the installation, repair and inspection work.
3. Please prohibit from using in extreme conditions with high temperature, high humidity, dust, corrosive gas, excessive vibration and impact etc. It can cause fire or faulty operation.
4. Please attach according to the manual. If it's attached incorrectly, there is a possibility of injury from obstacles to functioning or unforeseen accident.
5. Please tighten screws with the designated torque.
6. During installation please do not let foreign substances like concrete, iron content etc. penetrate into the circuit breaker.
7. Please do not make unauthorized alterations.
8. Please handle this as industrial waste for disposal of this product.

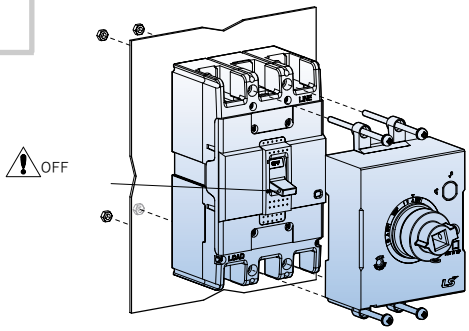
Installation method of rotary handle

(1) Press the trip button as shown in Fig. 1 to trip the circuit breaker.
(2) Turn the circuit breaker OFF as shown in Fig. 2 and attach the rotary handle using 4 screws.
(3) Install the vertical bar as shown in Fig. 3, then attach the rotary handle on panel using assembly screws.

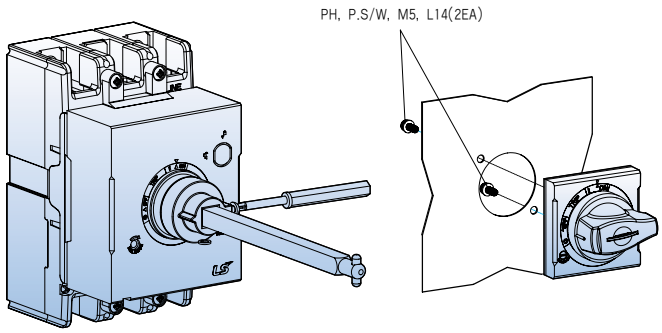
1



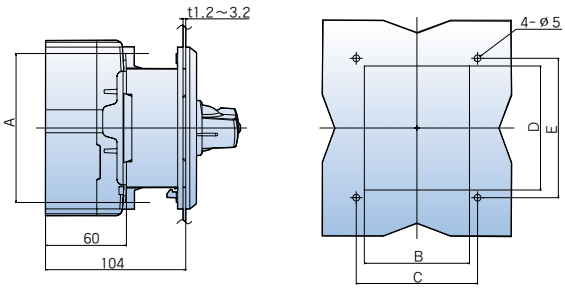
2



3



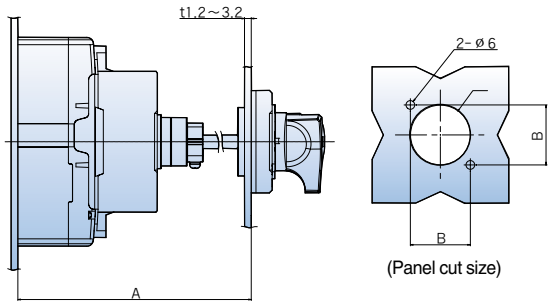
Dimension of 30 ~ 250AF type direct rotary handle (D-Handle)



(Panel cut size)

D-Handle	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
DH100	110.5	78	90	92	103.4
DH125	132	94	105	108	120
DH250	126	108	121	110	122

Dimension of 30 ~ 250AF type extended rotary handle (E-Handle)



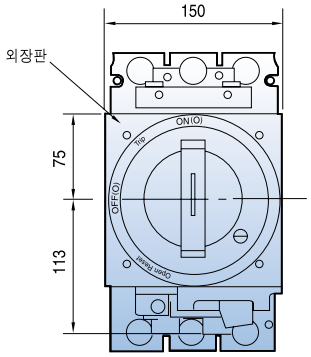
(Panel cut size)

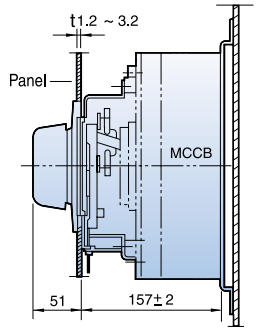
E-Handle	A (mm)	B (mm)	C (mm)
EH100	min 150, max 573.5 (SHAFT469mm)	47	Ø 53
EH125	min 150, max 573.5 (SHAFT469mm)	47	Ø 53
EH250	min 150, max 571.5 (SHAFT469mm)	47	Ø 53

F

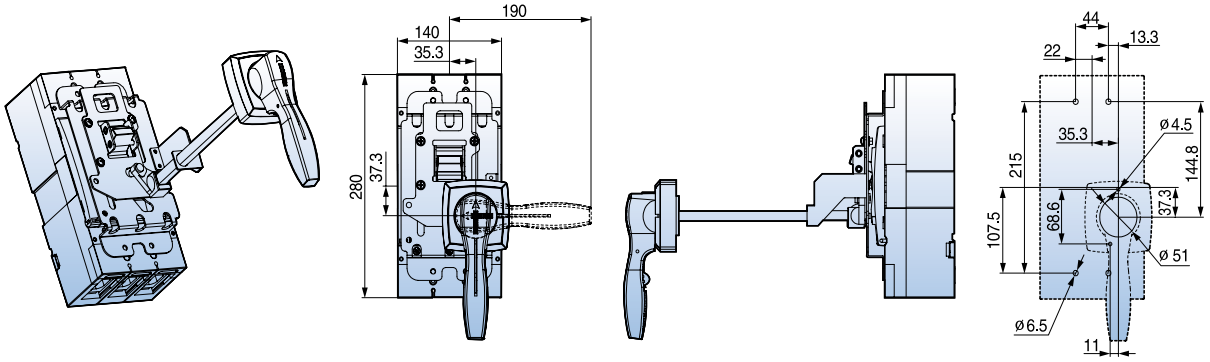
2. Rotary handle

Dimension of 400 ~ 800AF type direct rotary handle (N-Handle)

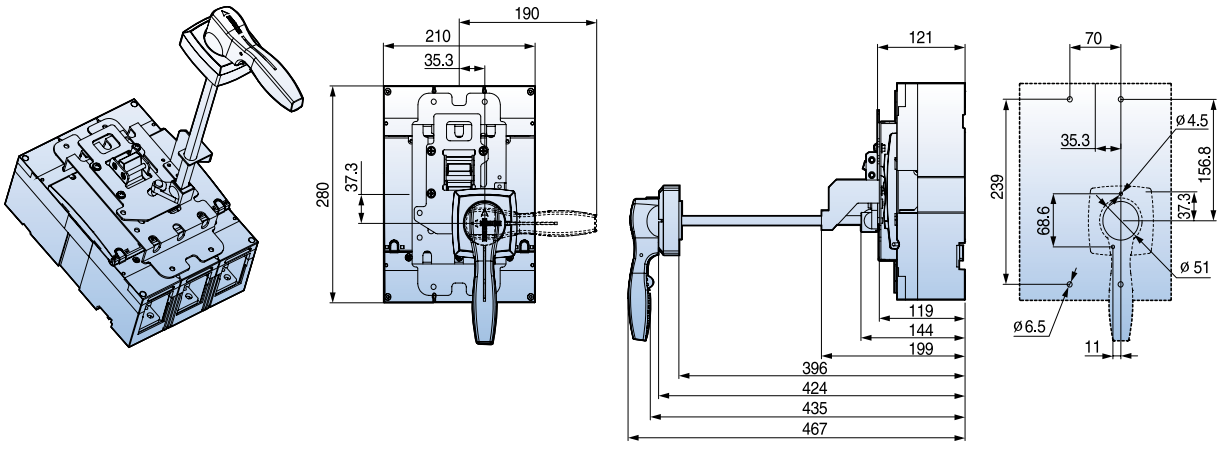




Dimension of 400AF type extended rotary handle



Dimension of 800AF type extended rotary handle



F

3. Terminal covers

Types of terminal covers

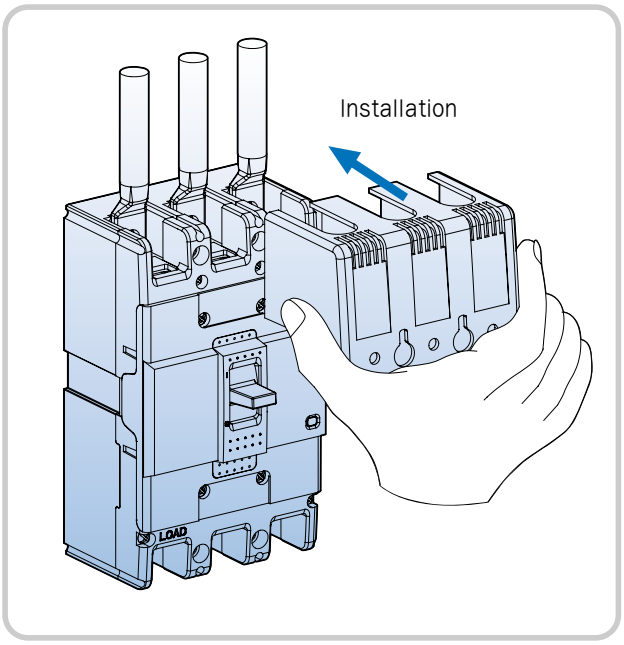
Terminal covers insulate the circuit breaker's power and load side from outside(degree of protection IP40). So they prevent electric shock and short circuit faults which can be caused by the direct contact of human hand or a screwdriver etc. with current flow units(terminal and wire connecting units).

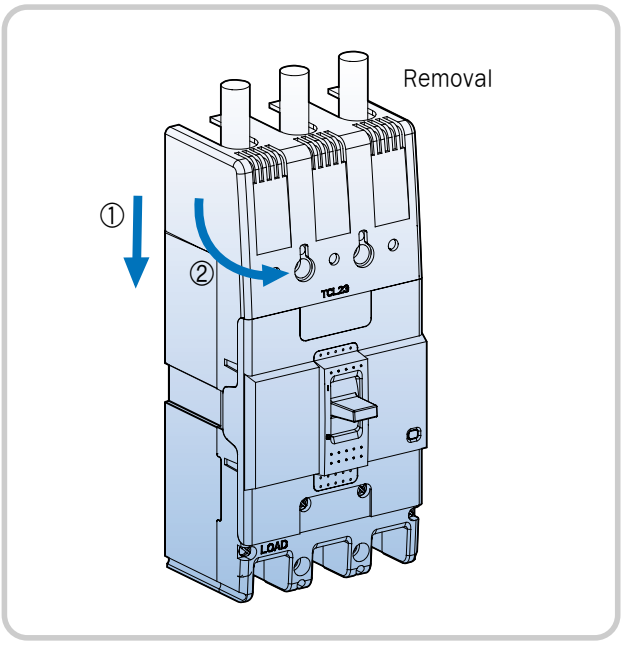
There are long type and short types of covers depending on circuit breaker's connection method.

Type		Pole	Breaker	
Long Type	Short Type		MCCB	ELCB
TCS12	TCL12	2P	ABN50c/60c/100c ABS30c/50c/60c	EBN50c/60c/100c EBS30c/50c/60c
TCS13	TCL13	3P		
TCS14L	TCL14L	4P Line		
TCS14R	TCL14R	4P Load		
TCS22	TCL22	2P	ABS125c ABH50c/125c	EBS125c EBH50c/125c
TCS23	TCL23	3P		
TCS24L	TCL24L	4P Line		
TCS24R	TCL24R	4P Load		
TCS33	TCL33	2/3P	ABN250c, ABS250c ABH250c	EBN250c, EBS250c EBH250c
TCS34L	TCL34L	4P Line		
TCS34R	TCL34R	4P Load		
T1-43A	-	2, 3P	ABN/S/H/L400c	EBN/S/H/L400c
T1-44A	-	4P		
T1-63A	-	2, 3P	ABN/S/L630c/800c	EBN/S/L630c/800c
T1-64A	-	4P		

Under 250AF type terminal cover attaching and detaching method

1. As seen in the Fig, please align with circuit breaker's installation notches and insert in the direction of the arrow .
2. To separate the terminal cover, as in the Fig. below, push the bottom of it in the direction of ① and push up in the direction of ②
3. There are two terminal covers in one package.



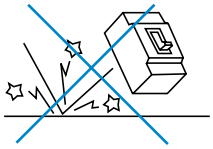


F

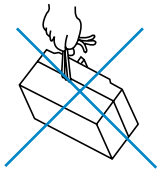
G. Handling and maintenance

1. Conditions for transport and Storage

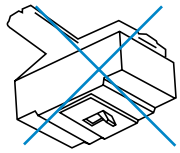
Precautions for transport



Do not drop the package.

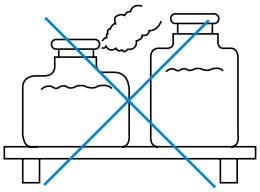


Do not carry it by holding any of its wires.

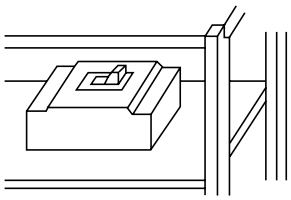


Do not hold circuit breaker up side down and do not move after installing DIN rail.

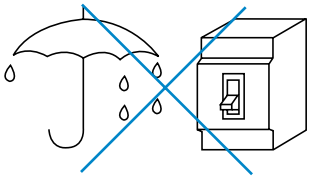
Precautions for storage



Avoid corrosive gas.

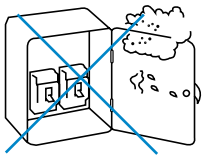


Store circuit breaker in the Off or Trip position.

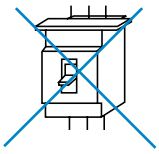


Avoid humid air.
Relative humidity: should not exceed 85%

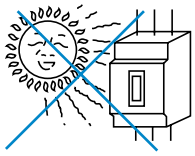
Precautions for installation



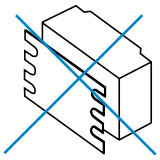
Avoid direct exposure to rain,oil, dust and electric power etc.



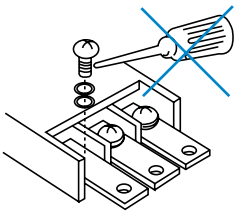
Do not block up the exhaust port.



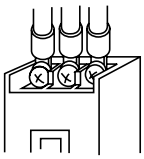
Avoid direct sunlight.



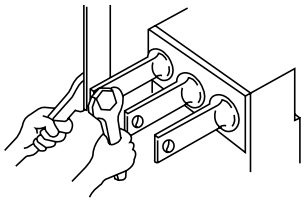
Do not separate the insulation plate at the back of circuit breaker.



Avoid lubricating oil.



Keep condenser's poles parallel with each other.



Do not change the bolt.
Fix the back connection type condenser without changing the bolt.

G

2. Maintenance and inspection

Because there is a danger of electric shock from repair and inspection, it needs to be done by an expert and before repair and inspection, it is necessary to check that there is no current flowing on the line by breaking the main circuit beaker.

Early inspection

After installing the MCCB, the below checklists need to be run through before current flow.

Common	ON	OFF	TRIP
Type	1. There should be no conductive materials such as screws, airborne	Remove totally.	
	materials, cut parts from the wire etc. around the terminal.	No crack or damage.	
	2. No cracks or damage on the cover or case.	No condensation.	
	3. No condensation on the cover or case terminal unit.	Over 5MΩ	
	4. Check insulation resistance with a 500V resistance meter.	Designated tightening	
	5. Be sure to tighten the conductive connection unit.	torque.	
ELCB	1. Rated voltage and circuit voltage of ELCB should be same.	Same.	See note (2)
	2. Test operation by applying voltage and pressing test button..	Trip ELCB.	

Precautions

(1) Withstanding voltage test : standard of withstanding voltage test is as below.

[Unit : V]

Main circuit		Auxiliary circuit or control circuit	
Rated insulation voltage[Ui]	Test voltage(AC RMS value)	Rated insulation voltage of manipulated vircuit	Test voltage(AC RMS value)
300＜Ui≤690	2500	Ui≤60	1000
690＜Ui≤800	3000	60＜Ui≤600	2Uis+1000(min. 1500)

(note) 1. Don't test withstanding voltage between the terminal for motor protective circuit breaker.
2. Withstanding voltage of leakage relay between internal contact points should be 1000V.
3. This test voltage is based on standards of K60947-4-1 9.3.3.4.3.

(2) Insulation resistance measurement and withstanding voltage test(for ELCB)

- Insulation Resistance Measurement
  As seen in table 1, insulation resistance of △ will not break down with a 500V resistance meter but if a 1000V is applied, it will.
- Withstanding Voltage Test
  For insulation resistance and withstand voltage measurement test, do not apply voltage on indicating X.

Table 1. Insulation resistance and withstanding voltage measurement test

Applied circuit breaker / Applied circuit breaker		Insulation resistance measurement		Withstanding voltage test	
Handle Position		On	Off	On	Off
Charging unit - Between ground		O	O	O	O
R phase - S phase, S phase - Tphase, between R-T	Power side	△	△	×	O
	Load side	△	△	×	×
Between power - load terminals		-	O	-	O

Periodical inspection

To prevent accidents and maintain the circuit breaker longer, it needs to be inspected once before or after one month of use, then record inspections regularly and according to this table.

Environment	Inspection Cycle
1. clean and dry environment	once in 2~3 years
2. environment with dust, corrosive gas, steam, salinity etc.	once in 1 year
3. more extreme environment than 1 and 2	once in 6 months

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

Inspection after breaking

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

Size of breaking current	Damage level of circuit breaker	Usage result
Operating within the range of time-delay trip operation. (over current, 10 times below than rated current)	no other faults than exhaust hole	50 times of breaking is possible(below 100A) on overload current of 6 times more than rated current.
small short circuit current which current value is relatively low.	carbonization around exhaust hole is seen.	possible to reuse
↕	↕	↕
large short circuit current close to rated breaking capacity	carbonization around handle carbonization around exhaust hole metal fusion material attached to inside of circuit breaker	replacement with new product

1) If you can't guess the size of fault current, you need to remove circuit breaker and measure insulation resistance.
2) If insulation resistance value is lower than 5MΩ , please test dielectric strength.
3) If insulation resistance and dielectric strength is sufficient, it can be reused. But please check carefully if there is any temperature increase in the short term.

2. Maintenance and inspection

The Solution for Circuit Breaker's(MCCB,ELCB) Abnormal Conditions

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

Solution for accessories' abnormal operation

Type		Abnormal condition	Cause	Solution
Internal Accessories	SHT	Trip inactive	• Operating voltage drop • Incorrect commercial voltage selection	• Power improvement
			• Coil burn out	• Request after service
	UVT	Closing impossible	• Applied frequency or voltage fault	• Power improvement
	AL AX	Fault operation	• Loose attachment screw	• Readjustment
Motor switch		Remote control impossible	• Fault product installation	• Check motor switch and installation and tightening of circuit breaker
			• Power not applied	• Inspect if there is any problem on power circuit.
			• Manual/automatic lever fault setting	• Change manual/automatic setting lever to automatic.
			• Inactive operation by operating switch	• Use the switch which is applicable for product's operating current.
			• Damage of internal circuit • Fault connection • Withstand voltage test above standard • Insulation resistance test	• Product exchange
		Continuous operation	• Apply ON/OFF signal at the same time	• Use interlock device on switch

Solution for ELCB's abnormal leakage breaking

Type	Abnormal condition	Cause	Solution
Abnormal operation	Leakage indicator button pops up at same time as ELCB is closed(in the case of leakage device operation)	• Beacause wires are long, ground electrostatic capacity becomes bigger and a leakage current flows	• Rated sensibility current adjustment • Install ELCB close to the load
		• Connect the ELCB in parallel • Neutral line fault connection	• Confirm connection
	Operation during usage	• Excessive surge penetration	• Install surge absorber to circuit
		• Inductive noise penetrates from nearby large current	• Remove noisy element

Replacement cycle (product life)

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

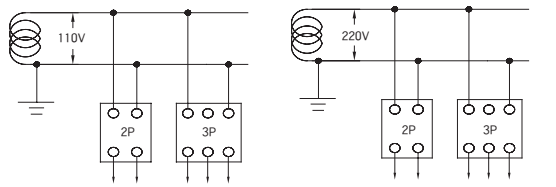
Type	Environment	Location	Cycle(years)
Standard usage condition	Clean and dry place	Dustproof and air-filtered switchboard	Approx. 10~15
	Place with dust but no corrosive gas	Private switchboard without dustproof or air filter	Approx. 7~10
Extreme condition	Sulfuric acid, hydrogen sulfide, salinity,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

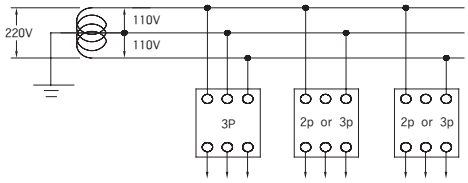
3. Precautions for ELCB's circuit connecting

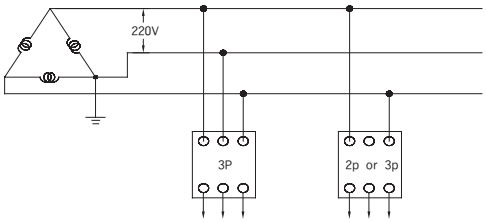
Precautions for circuit connection

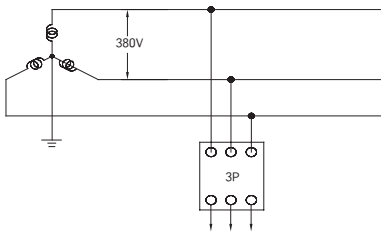
1.Examples by type of circuit connection

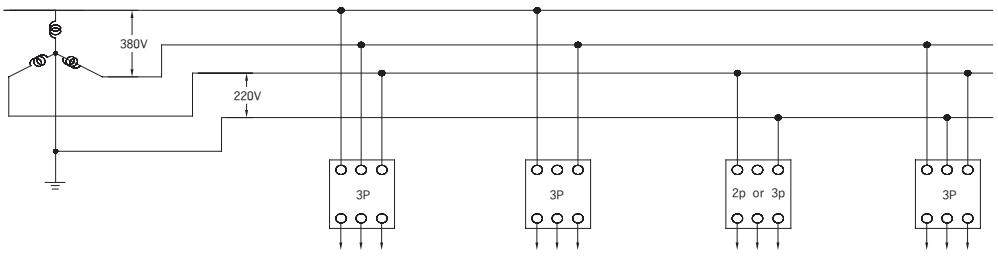
1Ø 2W, 1Ø 3W, 3Ø 3W, 3Ø 4W' s each circuit connection example is as in the table below.

<table>
<tr><td>Circuit type</td><td>① Single phase two line(1Ø 2W) 110V or 220V circuit</td><td>② Single phase 3 line(1Ø 3W) 110V or 220V circuit</td></tr>
<tr><td>Connection Fig.</td><td> 

• 110 / 220V Multi-purpose type
• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type</td><td> 

• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type
• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type
• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type</td></tr>
<tr><td colspan="3">General singe phase circuits supplied by KEPCO 220V multi-purpose type can be used regardless of circuit voltage and circuit type</td></tr>
<tr><td>Circuit type</td><td>③ 3 phase 3 line(3Ø 3W) 220V circuit(△Connection)</td><td>④ 3phase 3 line(3Ø 3W) 380V circuit (Y connection)</td></tr>
<tr><td>Connection Fig.</td><td> 

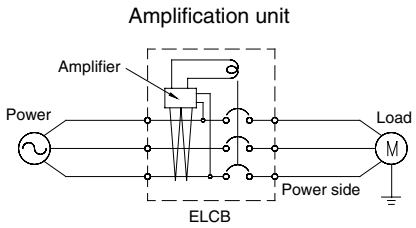
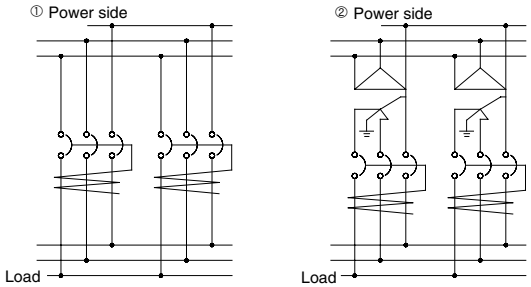
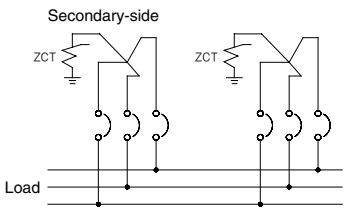
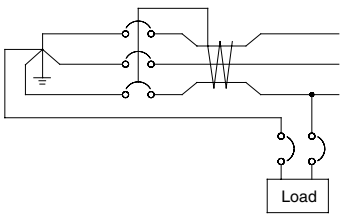
• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type
• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type</td><td> 

• 220 / 460V Multi-purpose type</td></tr>
<tr><td colspan="3">On generally low voltage, three phase, three line type circuits supplied by KEPCO 220/460V multi-purpose type can be used regardless of circuit type</td></tr>
<tr><td>Circuit type</td><td colspan="2">⑤ 3 phase 4 line(3Ø 4W) 380V circuit (Y connection)</td></tr>
<tr><td>C
onnection Fig.</td><td colspan="2"> 

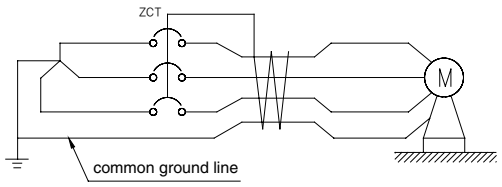
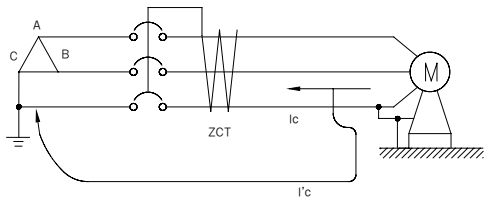
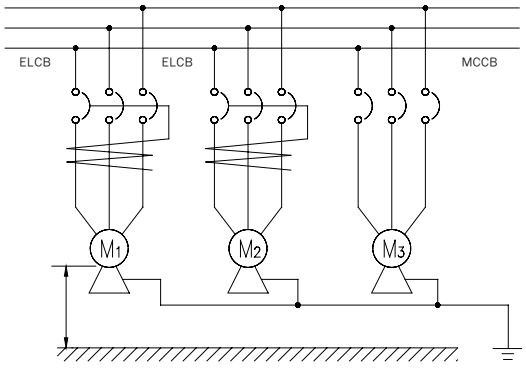
• 220 / 460V Multi-purpose type
• 220 / 460V Multi-purpose type
• 220 / 460V Multi-purpose type
• 110 / 220V Multi-purpose type
• 220V type
• 220 / 460V Multi-purpose type</td></tr>
<tr><td colspan="3">On generally low voltage, three phase, three line type circuits supplied by KEPCO 220/460V multi-purpose type can be used regardless of circuit type</td></tr>
</table>

Example of fault connections

If the ELCB is not connected correctly, it can cause inactive operation fault operation, internal damage, etc., so having a correct connection is important. In the table below examples of common connection mistakes are shown.
[Examples of Typical Connection Mistakes]

Item	Fault connection circuit Fig.	Resulting problem
(1) Reversing connection of switch side and load side is impossible		If there is a reverse connection, even though ELCB is tripped, the voltage stays connected to the amplification unit so the internal thyristor doesn't switch off and a continuous tripping signal comes out and damages the trip coil.
(2) Impossible to apply on parallel circuit		If you close(make) one ELCB and then close a second ELCB in the same way on a simple parallel circuit as in Fig.① or a circuit like transformer parallel operation as in Fig.② , it will be tripped. Also after closing one, if you press the test button of a second ELCB, even after it's tripped, the power will be sent to the load side continually so the trip coil will be damaged.
(3) Impossible to install ZCT on neutral point of parallel circuit to detect ground current.		If you install a ZCT on earth wire of neutral point and connect load in parallel, it becomes as shown on item (2) and detects load unbalance as ground current.
(4) If you use a 3 pole product on a 3 ø 4W circuit, it's impossible to connect the load between neutral lines on the load unit.		Because the current of a single phase load flows through a neutral line which did not flow through the ZCT, it is detected as ground current and the ELCB will be tripped.

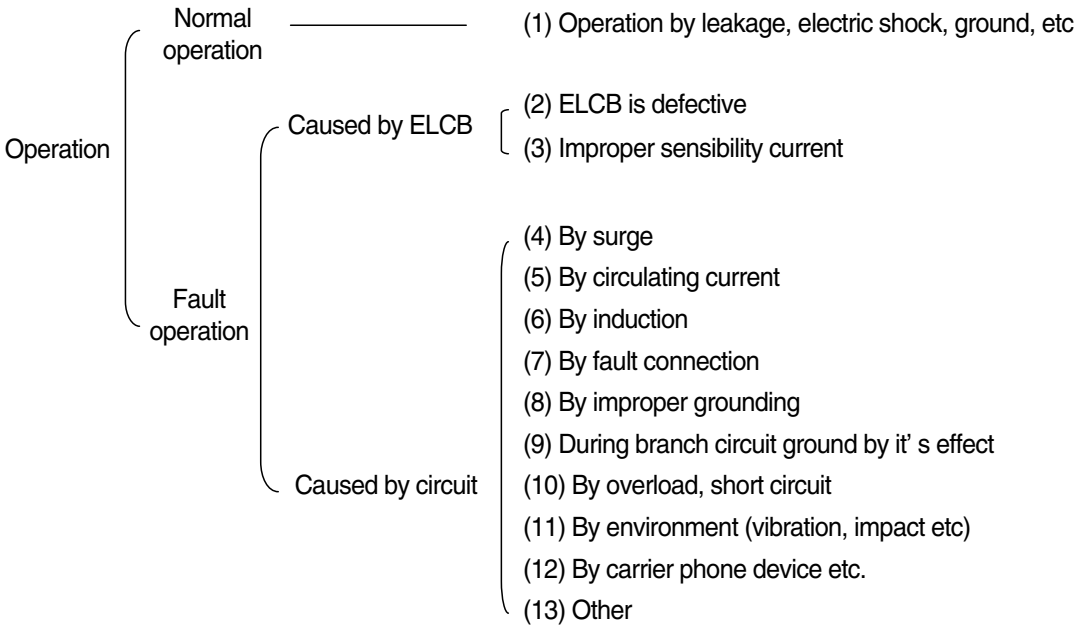
3. Precautions for ELCB's circuit connecting

Item	Fault connection circuit Fig.	Resulting problem
(5) Impossible to connect common ground wire to the ELCB.		Even if there is a leak on the motor load M, leakage current will flow through the common ground wire which is connected to ELCB and it can't be detected on the ZCT, so the ELCB will not operate. This can not be checked by inspection with test button.
(6)Impossible to take neutral line ground on load side of ELCB.		Through ground point, because part of load current like I'c can be separated by ground, it can cause an ELCB fault operation. Also if there is a leak on load M, it might cause an inactive operation as item (5).
(7)The ground of the circuit which contains an ELCB can not share the ground connection with the circuit without one.		If the device frame is connected to a common ground wire, even though there is leak on the load device of the circuit which does not contain the ELCB, the circuit will not be broken. So even the device frame which contains ELCB can have fault voltage and it can be dangerous. It is necessary to ground it separately or install an ELCB on all the circuits.

About faulty operation

When an ELCB operates correctly against leakage, electric shock and ground etc, it's called normal operation but if it operates without any faults like leakage because of improper selection, environmental conditions or an unsuitable circuit condition etc., it's called faulty operation.
On the other hand, if it does not operate even with an earth leakage fault from the wrong selection of ELCB, an unsuitable ground wiring or internal fault of ELCB etc., it's called fault inactive operation.
To prevent fault operation or fault inactive operation by ELCB internal fault, we are doing 100% testing in the middle of manufacturing and for the finished product. But an ELCB is a machine to guarantee safety so operation inspection needs to be done by pressing test button once a month.
Recently installation and usage of ELCB is increasing but some users think that an ELCB operates even when there is no fault. So we would like describe interpretation of fault operation's cause by category and correct selection of ELCB.

1. ELCB's operational types



3. Precautions for ELCB's circuit connecting

2. Contents of Operation

(1) Normal Operation

It is an ELCB operation according to its installation purpose and main operating reasons are as below.

1. Insulation deterioration of machinery ··· Things which use water like washing machine etc. or having big impact like a press etc.
2. Insulation deterioration of wiring ··· temporary line's connecting unit or terminal
3. Careless construction ··· ground by cable damage during construction or breaking of wire etc.
4. Careless handling ··· electric shock ground by flooding or ground by damage etc.

(2) Fault of ELCB

- **There could be a fault by components' fire corrosion but fault by leakage detecting unit is very small.**
- **There is a case of closing fault from a worn out trip coil unit or switch unit.**
- **Besides the fault, if the balance characteristic is bad(low), it can be operated by the motor starting current**

When the characteristic of the ZCT used for the ELCB is bad or the magnetic shield effect of the ZCT is not good, the ZCT balance characteristic gets lower from the effect of residual current. So as grounding occurs when a motor's starting current(arrangement of full load current) flows, there could be a fault operation from an electromotive force on a ZCT's secondary winding. The effect of residual current gets bigger when the bus current is bigger, so it's necessary to be careful on the circuit where the load current is big. The ZCT residual characteristic changes depending on the insulation material, conductor arranging position, winding etc. but with a regular circuit, this should not cause the fault operation. Using a bad quality ZCT core or not having enough ZCT shield effect can cause a fault operation so the ZCT core material of the LS circuit breaker is Permalloy, which uses nickel as its main element and its residual current characteristic is great.

So the effect of the residual current is very small and even with a 1000A current, there is no fault operation.

In the case of load from an unbalanced current, theoretically the ELCB does not operate but if a ZCT with a bad residual current characteristic is used, it could cause a fault operation.

If there is a fault operation when the motor starts or there is unbalanced load, it can be assumed that this happens because the ZCT balance characteristic from residual current characteristic is bad. So it is necessary to use the product with a trustworthy brand name.

(3) Unsuitable sensibility current

It operates when the sensibility current of ELCB is more sensitive than the firm leakage current of the circuit. So this is a selection problem. The leakage current of the circuit is mostly from the ground electrostatic capacity of the wire but an electric furnace or heater's insulation resistance decreases under high temperature, so it can be difficult to find the reason oof an ELCB's operation.

Also the reason why its important to be careful with leakage current of circuit is that not only firm leakage current during normal condition but also excessive ground leakage current during switching or starting, can operate the ELCB as well.

Because the electric potential range of winding is different during starting and operating, excessive leakage current during starting can occur through electrostatic capacity for the winding frame.

If electrostatic capacity for the ground of a ground of load device or distribution line is big, even under normal conditions, a big zero phase-sequence component current flows. And this can exceed the ELCB's rated inactive operation current then cause the operation. This happens generally when one ELCB protects with many combined brand circuit against ground.

Also if the electrostatic capacity gets bigger, it's easy to have a fault operation during load circuit switching, so to prevent electric shock of low voltage circuit, it's recommended to install an ELCB on each branch circuit.

(4) By surge

Regarding surge by distribution line's inductive lightening; we test lightening impulse inactive operation according to KSC 4613, so surge resistance efficiency can be guaranteed.

If there is an effect from an inductive lightening surge, high voltage will be applied to the power distributor through electric line.

In this case, electric circuit of the ELCB will operate incorrectly then it will be tripped or destroy electric device, and it will cause the break down of operation impossibility.

ELCB for service entrance etc. can be affected by this easily so its important to be careful.

The size and frequency of a surge by inductive lightening are very different depending on the area but statistically most of it is below 5kV though sometimes it reaches a maximum of 6~7kV.

The LS ELCB uses a surge absorption element which can resist this surge to the electron circuit unit so there are no concerns about fault operation.

When you make and break an inductive load device, there is an instant make and switching surge.

Because there is electrostatic capacity in the distribution line or load device against grounding, the leakage current which flows through the ground electrostatic capacity increases instantly during switching, then if it exceeds rated inactive current value, the ELCB will operate.

The current can have an electrostatic capacity against ground with a difference in quantity but if the capacity of each phase is same, there will be no zero-phase-sequence component current on a single phase, 3 line circuit or 3 phase, Y connection circuit etc.

But if there is switching switching surge by contact point chattering etc., not only will the voltage phase fall down but also it will have high frequency voltage, so impedance by ground electrostatic capacity becomes small and excessive charging current will flow.

As a result, because the ELCB can be operated from electromotive force on secondary winding of ZCT, LS ELCB's electron circuit is composed with ZCT secondary filter circuit not to operate by short period of ZCT secondary generation power from surge voltage, and surge bypass circuit to protect ELCB exclusive IC against over current or excessive ground current. are no concerns about fault operation on a general circuit.

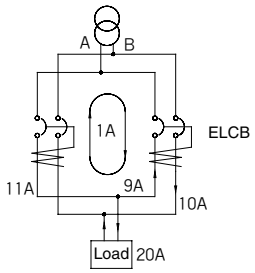


Fig. G-1

(5) By circulating current

As shown on Fig. G-1, on the circuit where load side is coupled in parallel, left and right branch divided current on each phase can't be the same for sure, for example, if A phase flows divided by 11A and 10A, then there is 1A of current difference which circulates on this loop of parallel circuit. In the ELCB, this circulating current will be detected as a ground current so parallel use of the ELCB should not be allowed.

1) By induction

As shown on Fig. G-1, primary winding of the ZCT is composing the loop in parallel circuit, so an inductive current can occur easily not only from circulating current but also from the magnetic field of a surrounding large current bus.

This inductive current flows along the same path of the circulating current so it causes fault operation of the ELCB.

2) By faulty connection

Like the example of a faulty connection, seven detailed faulty connections can cause the faulty operation of an

3. Precautions for ELCB's circuit connecting

3) By Improper ground

In the load(electronic calculator or NC machine tools etc.) which uses electron circuit, line filter can be installed to prevent electron circuit unit's noise.

In this case, firm leakage current will flow through line filter's ground, and the ELCB will operate.

To prevent this, you can install an insulation transformer on the power unit.

Also, ground for lightning arrester etc. should be installed on the power side of the ELCB. If arrester is installed on load side of ELCB, lightning current can flow to the earth through the ELCB and it could make the ELCB operate from this current.

4) Sound circuit's operation during branch circuit ground as shown in Fig. G-2, if there is a ground at one point of a branch circuit, the ground current can flow on a closed sound branch circuit through ground electrostatic capacity. In this case, the ELCB of the sound circuit could possibly be operated so to prevent this, the sensibility current needs to be selected. d regarding of ground electrostatic capacity.

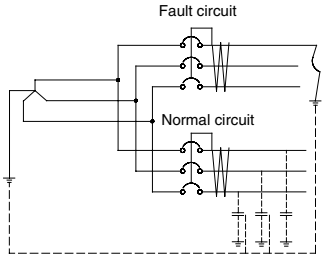


Fig. G-2 Sound circuit operation through ground electrostatic capacity

(6) Operation by overload or short circuit

is natural for an ELCB which has an overload and short circuit operating element to operate by overload, short circuit etc. but because of the name, ELCB, this fact is sometimes overlooked.

Also in an ELCB exclusively for ground protection, its balance characteristic has a limit. If excessive current flows, it will operate so you need to be careful.

(7) Environments of vibration, impact, high temperature

The resistance against environmental conditions is almost same as LS Molded Case circuit breaker(MCCB) but because there is an electron circuit, you have to be more careful of high temperatures.

(8) By carrier phone device

If you install an ELCB on an electric line with a carrier phone that makes phone conversation possible, there will be a fault operation.

As shown on Fig. G-3, carrier phone device applies a high frequency signal(normally 50kHz ~ 400kHz) between the power line and ground by force, so the ELCB detects this high frequency signal as ground

Operating faultily or not is decided by scale of the high frequency signal, the ELCB high frequency characteristic and rated sensibility current scale.

To prevent this, you need to consider the scale of high frequency signal as firm leakage current while and choosing the sensibility current of the ELCB.

(9) Other

To protect electric line or load devices against surges, as shown on Fig. G-4, there can be a surge absorption circuit. In this case, if surge current flows through a surge absorption circuit, the ELCB will naturally operate. To prevent this, you can install surge absorption circuit to power side of ELCB (surge absorber, varistor) regarding of ground electrostatic capacity.

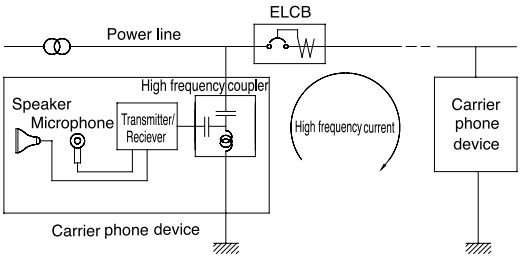


Fig. G-3. Example of carry phone device installation

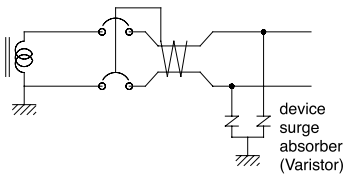


Fig. G-4. Example of surgy absorber installation

Applying to a high frequency circuit

1. ELCB's frequency characteristic

ELCB's operation against its frequency of is as shown on Fig. G-5.

In this graph, the reason why an ELCB operation sensibility becomes slower over 60Hz is because of the high frequency filter circuit's characteristic for noise prevention on the ZCT secondary side. And when the characteristic is below 40Hz it is from the ZCT output characteristic.

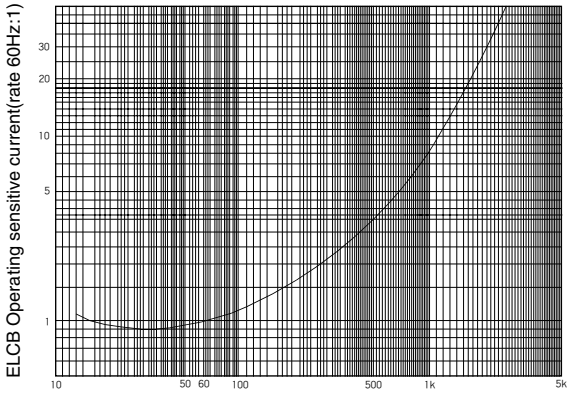


Fig. G-5. Characteristic of ELCB frequency

LS ELCB's frequency characteristic is also considering the frequency characteristic of human body electric shock. In the case of human body electric shock, 50mA.second, the limit of dangerous current adopted worldwide to decide ELCB's operation characteristic is general but is a value within the common frequency of 50Hz to 60Hz.

When we decide an ELCB's operation characteristic, there was no standard for safety of the human body which considered high frequency range as well, but the dangerous limit of human body electric shock from frequency is stated on IEC 60479-2(Effects of current passing through the human body. Part2 : Special aspects).

Fig. G-6 indicates the dangerous range for the human body stated on IEC 60479-2, LS ELCB operation sensibility characteristic and the regular inverter's firm leakage current range by frequency. As you can see in Fig. G-6, the LS ELCB is designed to prevent fault operation from high frequency firm leakage current(by ground electrostatic capacity) of inverter etc., and maintain safety against human body electric shock at the same time.

High frequency elements are becoming more and more common in electric power systems so at this point this is a very important characteristic.

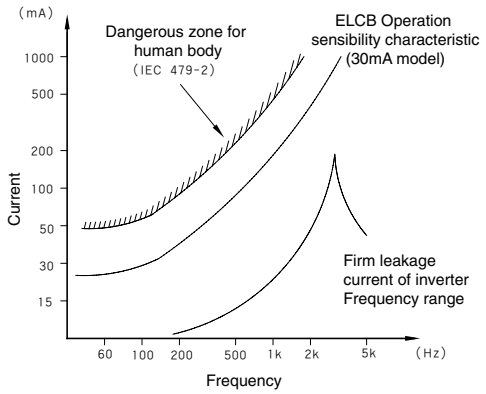


Fig. G-6. How to determine the characteristic of ELCB frequency

3. Precautions for ELCB's circuit connecting

2. Applying an ELCB on an inverter circuit

Recently electric motor's variable speed controls by inverter have been very successful.

In the purpose of use, originally only energy saving was considered. But these days with big improvements of functions like minute position control for processing level improvement or air cleaners for pleasant conditions etc., when we apply it, we have to be careful about faulty operation.

(1) In an inverter circuit, the inverter which is generating the principle of high frequency leakage current converts voltage of common frequency(60Hz) to direct voltage.
Then through a high speed switching circuit, it converts to high frequency voltage. Because this voltage is composed of pulse form square waves, it contains harmonics of high frequency.
This inverter output voltage generates high frequency leakage current through the load side cable and motor's ground electrostatic capacity. In Fig. G-7, it shows a diagram in which an ELCB and an inverter are connected.
High frequency leakage current can flow through the load side cable and motor's ground electrostatic capacity in here, moreover it can have an effect on different adjacent circuits according to the cable installation method.

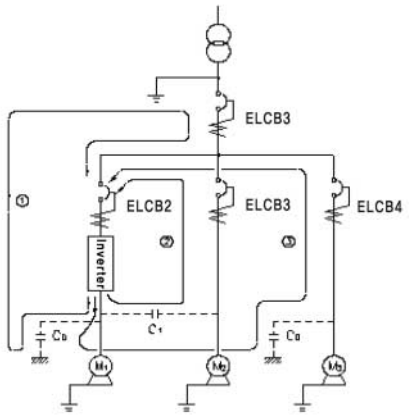


Fig. G-7. Circuit Model with Inverter Installed

It is explained as below about leakage current of three different paths indicated in Fig. G-7.

- It is a high frequency leakage current path only for the circuit using an inverter and generally this happens the most commonly. It effects ELCB1 and ELCB2.
- The circuit using an inverter, has a high frequency leakage path which effects on this circuit and it indicates the case of high frequency leakage flow with electrostatic capacity between cables of the circuit using an inverter and the one without inverter. It affects ELCB2 and ELCB3. If both cables are wired over a long distance adjacently, the electrostatic capacity between cables is very big, so on this path, you need to be careful of leakage current.
- It is when high frequency leakage current flows ground electrostatic capacity (C0) of both cables between the circuit using an inverter and the one without an inverter and it effects ELCB2 and ELCB4.
  As mentioned above, it even effects circuits which do not use an inverter so to examine the reason of ELCB operation from this effect, you need to check cable installation method and path by distribution in the Fig.

(2) Selection of sensibility current of an ELCB on the circuit with an applied inverter
Choosing the sensibility current of ELCB should prevent faulty operation from firm leakage current by high frequency voltage.
To do this, you need to calculate the ground leakage current from the cable length on the load side an ELCB and other very difficult works like measuring and checking ground leakage current of load devices etc. need to be done. Also, it gets much harder when you examine everything while considering the relationship of the leakage current frequency characteristic of ELCB.
To be ready for this, we summarized sensibility current selection of the LS ELCB under inverter circuit condition on next page, 84 and table 1.

Table 1. Circuit sensibility current selection table inverter

(a) AC 200 ~ 220V 3 Phase Inductive Motor

Motor Output (kW)	Load Current (A)	Inverter Capacity (kVA)	Connection Wire (㎟)	Load Wire Length and Applicable Sensibility Current					
				10m	30m	50m	100m	200m	300m
1.5	6.5	3	2 ~ 14	30mA	30mA	30mA	100mA	100mA	200mA
2.2	9.2	3	2 ~ 14	30mA	30mA	30mA	100mA	100mA	200mA
3.7	15	5	3.5 ~ 14	30mA	30mA	30mA	100mA	100mA	200mA
5.5	22	8	5.5 ~ 14	30mA	30mA	30mA	100mA	100mA	200mA
7.5	29	10	8 ~ 38	30mA	30mA	100mA	100mA	100mA	200mA
11	42	15	14 ~ 38	30mA	30mA	100mA	100mA	100mA	200mA
15	55	20	22 ~ 60	30mA	30mA	100mA	100mA	200mA	200mA
18.5	67	24	30 ~ 60	30mA	30mA	100mA	100mA	200mA	200mA
22	78	30	38 ~ 60	30mA	30mA	100mA	100mA	200mA	200mA
30	106	37	60 ~ 125	30mA	30mA	100mA	100mA	200mA	500mA
37	132	47	80 ~ 125	30mA	100mA	100mA	100mA	200mA	500mA
45	160	57	~ 325	30mA	100mA	100mA	200mA	200mA	500mA
55	198	70	~ 325	30mA	100mA	100mA	200mA	200mA	500mA

(b) AC 400 ~ 440V 3 Phase Inductive Motor

Motor Output (kW)	Load Current (A)	Inverter Capacity (kVA)	Connection Wire (㎟)	Load Wire Length and Applicable Sensibility Current					
				10m	30m	50m	100m	200m	300m
5.5	11	10	3.5 ~ 14	30mA	30mA	100mA	100mA	200mA	500mA
7.5	15	10	3.5 ~ 14	30mA	30mA	100mA	100mA	200mA	500mA
11	21	24	5.5 ~ 14	30mA	30mA	100mA	100mA	200mA	500mA
15	28	24	8 ~ 38	30mA	100mA	100mA	100mA	200mA	500mA
18	34	24	14 ~ 38	30mA	100mA	100mA	200mA	200mA	500mA
22	39	47	14 ~ 38	30mA	100mA	100mA	200mA	200mA	500mA
30	53	47	22 ~ 60	30mA	100mA	100mA	200mA	500mA	500mA
37	66	47	30 ~ 60	30mA	100mA	100mA	200mA	500mA	500mA
45	80	70	38 ~ 60	30mA	100mA	100mA	200mA	500mA	500mA
55	99	70	60 ~ 125	100mA	100mA	100mA	200mA	500mA	500mA
75	135	95	80 ~ 125	100mA	100mA	100mA	200mA	500mA	
90	160	140	~ 325	100mA	100mA	200mA	200mA	500mA	
110	192	140	~ 325	100mA	100mA	200mA	500mA	500mA	

(note)

1. Wire length indicates the total distance from the inverter to the motor, so if there are multiple motors connected to one inverter, it should be a total of branch current.
2. We calculated the wire cable IV line (600V) based on the electrostatic capacity so if you use the cable which has a smaller ground electrostatic capacity you need to make the wire length longer.
3. We calculated this based on ground adjacent metallic conduit so if it' s wired with an installation method with a smaller electrostatic capacity, you need to make the wire length longer.

Memo

Products Type Overview

MCCB

MCCB

Type	
N	N-Type
S	S-Type
H	H-Type
L	L-Type

Ampere Frame	
3	30AF
5	50AF
6	60AF
10	100/125AF
20	225/250AF
40	400AF
80	800AF

Pole	
2	2-pole
3	3-pole
4	4-pole

Series	
-	Conventional
a	Hi-MEC
b	Meta-MEC
c	Metasol

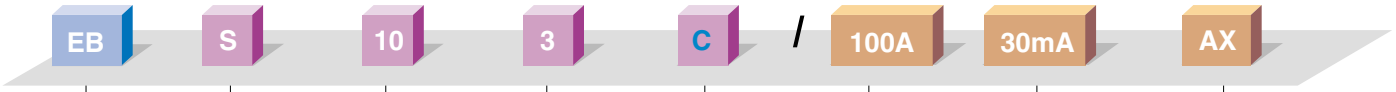
Application	
-	General purpose
M	Motor protection

Rated current	
3A	150A
5A	175A
10A	200A
15A	225A
20A	250A
30A	300A
40A	350A
50A	400A
60A	500A
75A	630A
100A	700A
125A	800A

Accessory	
AX	Auxiliary Switch
AL	Alarm Switch
SHT	Shunt Trip
UVT	Undervoltage trip
DH	Rotary handle (Direct)
EH	Rotary handle (Extended)
RTR RTB	Rear terminal

Control voltage of accessory
SHT
AC/DC 12V
AC/DC 24V
AC/DC 48V
AC/DC 60V
AC/DC 100V~130V
AC/DC 200V~250V
AC 380V~450V
AC 440V~500V
UVT
AC/DC 24V
AC/DC 48V
AC/DC 100V~110V
AC/DC 200V~220V
AC 380V~440V
AC 440V~480V

ELCB



ELCB

Type	
N	N-Type
S	S-Type
H	H-Type
L	L-Type

Ampere Frame	
3	30AF
5	50AF
6	60AF
10	100/125AF
20	225/250AF
40	400AF
80	800AF

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3	3-pole
4	4-pole

Series	
-	Conventional
a	Hi-MEC
b	Meta-MEC
c	Metasol

Rated current	
3A	150A
5A	175A
10A	200A
15A	225A
20A	250A
30A	300A
40A	350A
50A	400A
60A	500A
75A	630A
100A	700A
125A	800A

Rated residual current
30mA
100/200/500mA

Accessory	
AX	Auxiliary Switch
AL	Alarm Switch
DH	Rotary handle (Direct)
EH	Rotary handle (Extended)
RTR RTB	Rear terminal

Name of Document : Metasol MCCB/ELCB Technical Manual (Installation and Handling)
Number of Document : Technology MCCB - 005
Written by : LSIS Production & Technology Group Low Voltage Solution Design Team
Issued by : LSIS Production & Technology Group Technology Management Team
Issue date : 2009. 9

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- For your safety, please read user's manual thoroughly before operating.
- Contact the nearest authorized service facility for examination, repair, or adjustment.
- Please contact a qualified service technician when you need maintenance.
  Do not disassemble or repair by yourself!
- Any maintenance and inspection shall be performed by the personnel having expertise concerned.

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2009. 09

Low voltage circuit breakers (E) 2008. 10/(02) 2009. 09 Printed in Korea STAFF