MITSUBISHI ELECTRIC

Changes for the Better

MEDIUM VOLTAGE SWITCHGEAR

The *MS-E* conforms to IEC 62271-200 standard and is designed and manufactured utilising Mitsubishi Electric *state-of-the-art* technology, fully taking into account present and future power system requirements.

Mitsubishi Electric has manufactured hundreds of thousands of medium voltage panels over the last almost 70 years.

With this experience, Mitsubishi Electric has gained a reputation of manufacturing *up-to-date* and reliable medium voltage panels, and possesses a supply record that comprises satisfied customers from all across the globe.

MS-E with gas exhaust duct

MS-E with gas screen

40 kA internal arc fault test of MS-E at KEMA's Netherlands laboratory

Type testing of the MS-E was first performed at Mitsubishi Electric's High Power Testing Laboratory in Japan, and then by an independent external testing and certification authority, KEMA, in the Netherlands.


ABS

CERTIFICATE OF
DESIGN ASSESSMENT

This is to Certify that a representative of this Bureau did, at the request of
MITSUBISHI ELECTRIC CORPORATION -
HARUGAME-CITY

MS-E and its installed VCB type VPR have been applied for marine application, especially ABS; American Bureau of Shipping.

CONTENTS

1 FEATURES

HIGH RELIABILITY

- Type testing of the MS-E was performed by an independent external testing and certification authority, KEMA, in the Netherlands.
- MS-E is designed with the benefit of Mitsubishi's vast medium voltage panels production experience of hundreds of thousands of panels over the last almost 70 years.
- All components, such as current transformers, voltage transformers and multi-function relays are made of the highest quality materials.
- Heat stress analysis of the switchgear structure has led to a heat-resistant design in which circuit breakers up to 3150 A are self-cooled (i.e. cooling fans not required).
- The reduced number of parts reduces the chance of failure.

SAFETY

- Partitions between compartments and an automatic shutter system (for withdrawable equipment primary junctions) completely isolate live parts.
- Safe operation and maintenance is ensured with the adoption of comprehensive interlocking mechanisms.
- In the event of an internal arc fault, the MS-E is designed to withstand the huge pressure and burning effect of the arc. (Relief flaps located on top of the panel open to limit pressure.)
- Withdrawable equipments are inserted / withdrawn whilst the front panel door is closed so that any arc proof rating is not compromised (in line with IEC 62271-200 requirements).

EASY INSTALLATION

- Installation and testing duration are considerably reduced as the panel is tested and adjusted in the factory and then delivered as a complete unit.

FLEXIBLE DESIGN

- Panels with main circuit and control cable entry from either the top or bottom are available.

PROTECTION

- Mitsubishi *MP or MELPRO-D* Multiple Protection relays are installed as standard. The *MP or MELPRO-D* relay provides protection, measurement, communications and control functionality.

Figure 1-1 MP Multiple Protection relay

Figure 1-2 MELPRO-D Multiple Protection relay

2 APPLICATIONS

- Mitsubishi MS-E provide control and protection of the power supply to motors, transformers, capacitors and other feeder circuits.
- The MS-E is available at rated voltages of 7.2 to 15 kV, with rated short-circuit breaking capacities from 25 to 40 kA.
- MS-E is designed for indoor use and is particularly suitable for electric power plants, substations, industrial plants, commercial buildings, pumping stations, pipeline stations and transportation systems.
- Front access & front maintenance design realize the package house application.

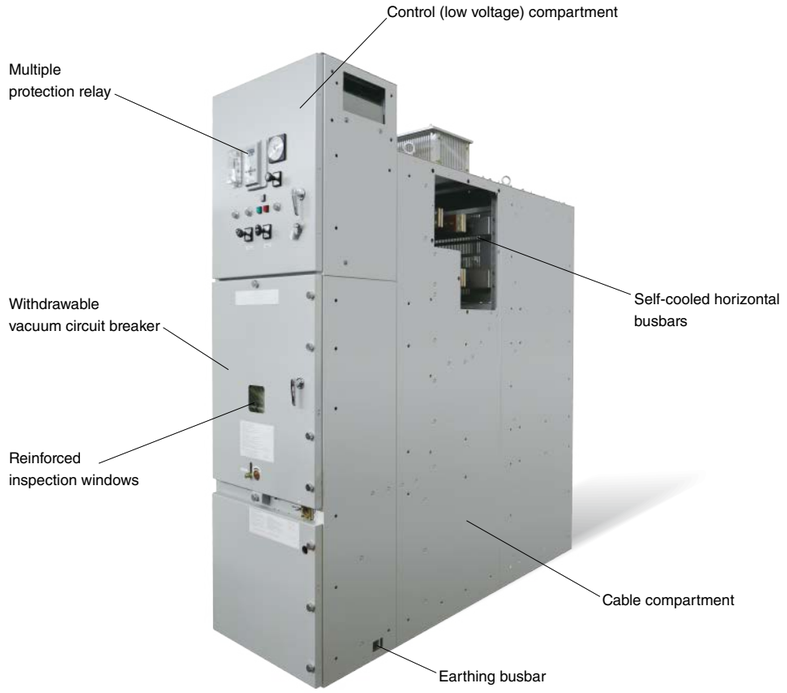


Figure 2-1 MS-E panel

3 STANDARD RATINGS

1. SWITCHGEAR

Ratings					
Type designation		MS-E			
Applied standard		IEC 62271-200*1:2021		IEC 62271-200:2003	
Rated voltage	**[kV, rms]**	U_r	7.2 12	7.2 12	15*2
Rated frequency	**[Hz]**	f_r	50, 60		
Rated insulation level*3					
Short-duration power frequency withstand voltage, 1 min.	**[kV, rms]**	U_d	20 28	20 28	36
Lightning impulse withstand voltage	**[kV, peak]**	U_p	60 75	60 75	95
Rated normal main busbar current	**[A, rms]**	I_r	630, 1250, 2000, 3000	3150	630, 1250, 2000
Rated short-time withstand current , symmetrical	**[kA, rms]**	I_k	25, 31.5, 40		
Rated peak withstand current	**[kA, peak]**	I_p	50 Hz: 2.5 x I_k, 60 Hz: 2.6 × I_k		
Rated duration of short-circuit	**[sec]**	t_k	1, 3		
Loss of Service Continuity category		LSC2B-PM			
Internal Arc Classification*4		*IAC*			
Accessibility type			AFL, AFLR	AFL	AFL, AFLR
Arc test current	**[kA]**		Up to 40	Up to 40	Up to 40
Arc test current duration	**[sec]**		Up to 1.0	Up to 1.0	Up to 1.0
Service Conditions					
Location		Indoor			
Ambient temperature	**[°C]**	-5 ~ 40			
Altitude a.s.l.	**[m]**	1000 max.			
Humidity					
R.H.	**[%]**	95 max.			
Water vapour pressure	**[kPa]**	2.2 average			
Earthquake protection*5					
Horizontal seismic withstand*6	**[m/s²]**	9.80			
Vertical seismic withstand	**[m/s²]**	3.23			
Features					
Type test*7		KEMA (Netherlands)			
Withdrawable equipment*8		position Mid-mount			
Withdrawal / insertion method		External operation (with door closed)			
Maintenance access		Front & rear, Front			

*1. High-voltage switchgear and controlgear-Part 200:
AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV.
*2. North American rating (range I, series II in IEC).
*3. 28 kV rms (75 kV peak) and 36 kV rms (95 kV peak) apply to switchgear.
*4. Optional
*5. General use, class B on the upper floor or roof of building according to JEM-TR 144.
*6. Static acceleration of horizontal is 3.92 m/s² at base of structure.
*7. Internal arc fault test.
*8. Circuit breaker or Fused contactor or Voltage transformer.

2. VACUUM CIRCUIT BREAKER

Manufacturer		Mitsubishi Electric			
Type designation		6/10-VPR-□□C*1			
Applied standard		IEC 62271-100			
Rated voltage	**[kV, rms]**	U_r	7.2	12	15*2
Rated frequency	**[Hz]**	f_r	50, 60		
Rated normal current (self-cooling)	**[A]**	I_r	630, 1250, 2000, 3150*3		
Rated insulation level					
Short-duration power frequency withstand voltage, 1 min.	**[kV, rms]**	U_d	20	28	36
Lightning impulse withstand voltage	**[kV, peak]**	U_p	60	75	95
Rated short-time withstand current	**[kA, rms]**	I_k	25, 31.5, 40		
Rated peak withstand current	**[kA, rms]**	I_p	50 Hz: 2.5 × I_k , 60 Hz: 2.6 × I_k		
Rated duration of short-circuit	**[sec]**	t_k	3		
Rated cable-charging breaking current	**[A, rms]**	I_c	10, 25		
Rated short-circuit breaking current	**[kA, rms]**	I_{sc}	25, 31.5, 40		
Transient Recovery Voltage (TRV)					
Reference voltage	**[kV]**	u_c	12.3	20.6	25.7
Rate of Rise of Recovery Voltage (RRRV)	**[kV/μs]**	u_c/t_3	0.24	0.34	0.34
Rated break time	**[cycles]**	3			
Rated short-circuit making current	**[kA, peak]**	63, 78.8, 100			
Rated control voltage	**[V DC]**	U_a	48, 110, 220		
Rated operating sequence		O–3 min–CO–3 min–CO O–0.3 sec–CO–3 min–CO CO–15 sec–CO			
Closing operation					
Motor current (at 110 V DC)	**[A]**	1.2 (peak 6 A)			
Spring charging time	**[sec]**	Approx. 6 (after closing)			
Closing control current (at 110 V DC)	**[A]**	3.4			
Tripping control current (at 110 V DC)	**[A]**	3.4			
Auxiliary switch (contacts)		5a, 5b			
Weight	**[kg]**	*M*	630, 1250 A: 140 2000 A: 160 3150 A: 210		

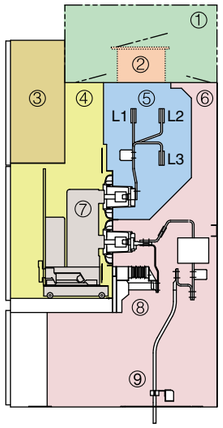
*1. Rated short-circuit breaking current
25 kA ····· 2 5
31.5 kA ····· 3 2
40 kA ····· 4 0
*2. North American rating (range I, series II in IEC).
*3. 3150 A apply to 7.2 kV and 12 kV switchgear.

Figure 3-1 Withdrawable vacuum circuit breaker

4 CONSTRUCTION

1. ENCLOSURE AND PARTITIONS

- The all-metal enclosure is completely earthed. Each compartment (control, withdrawable equipment, busbar and cable) is segregated from other compartments by earthed metal partitions.
- The front of the MS-E is divided into three kinds of compartments. The upper compartment is the control compartment, and the middle one is the withdrawable equipment compartment. The bottom-most compartment can be used for maintenance access. (See Figure 4-1.) The multi-function relay (or meters, protective relays, control switches, etc.) is semi-flush mounted on the door of the control compartment.



① Gas exhaust duct or gas screen (optional)*1
② Ventilator*2
③ Control compartment
④ Withdrawable equipment compartment
⑤ Busbar compartment
⑥ Cable compartment
⑦ Vacuum circuit breaker
⑧ Earthing switch (optional)*3
⑨ Power cable

*1. Gas exhaust duct or gas screen required when Internal Arc Classification selected. Refer to p. 21 for more detail.
*2. When the current within a compartment is 2000 A or greater, a ventilator is required for that compartment. However, not required if gas exhaust duct used.
*3. Earthing truck is applied for 15 kV switchgear with I_K > 25 kA

Figure 4-1 Front compartments of MS-E (switchgear)

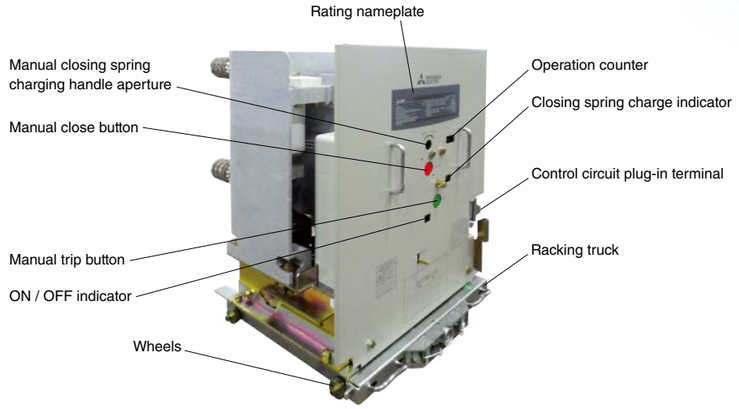
2. BUSBAR

- The main busbar is made of copper conductor.
- MS-E has bare busbars as standard. However, when required, the busbar can be insulated. Also, the main bus joints, such as the busbar joints between adjacent panels, can be shrouded with insulating covers. Other joints, such as those at the cable terminals, are covered with insulating tape. Connecting bars, such as those between busbars and circuit breaker bushings, or circuit breaker bushings and cable terminals, may also be optionally insulated.

Figure 4-2 Main busbars (air-insulated) with tin plating

3. VACUUM CIRCUIT BREAKER (VCB)

- The VCB is easy to operate, with the closing spring charge indicator, the manual close and trip buttons, the operation counter and mechanical ON / OFF indicator all being located on the front of the circuit breaker. (See Figure 4-3.)
- The circuit breaker has two positions, *Service* and *Test / Disconnected*, and may be optionally padlocked at each position. When the VCB is closed, the VCB locks in each position by mechanical interlock. When the VCB is opened, the interlock pin is released.
- The circuit breaker can be easily drawn out or inserted by a simple rotation action. (See Figure 4-3.) This is accomplished with the circuit breaker compartment door closed. Unauthorised racking can be prevented by padlocking the shutter for the draw-out handle aperture.
- The control circuit terminal of the circuit breaker is of manual connection type. The connector (see Figure 4-3) can be only attached when the VCB is in the *Test / Disconnected* position, and has the following mechanical interlocks.
  i. The circuit breaker cannot be inserted to the *Service* position when the control circuit terminals are not connected.
  ii. The control circuit terminals cannot be disconnected when the circuit breaker is in the *Service* position.
- Circuit breakers of different ratings other than specified are mechanically prevented from being inserted into the *Service* position.



Racking

Front face-plate

Figure 4-3 Vacuum circuit breaker details

4. AUTOMATIC SHUTTERS

- Inserting the withdrawable equipment into the *Service* position causes the shutters to automatically open. Drawing the withdrawable equipment out to the *Test*/*Disconnected* position causes the shutters to move and cover the primary junction contacts.

Figure 4-4 Shutters open

Figure 4-5 Shutters closed

- As shown below, the shutters operate on the busbar and cable sides. The shutters for the upper and lower primary junctions can be closed and opened individually, and can be (optionally) padlocked in the closed position.

Figure 4-6 Individual shutter operation

Figure 4-7 Optional padlocking of top and bottom shutters

- The shutters are made of metal and the following labels can be (optionally) provided.
  "BUSBAR" on shutter for busbar (line) side.
  "CABLE" on shutter for cable (load) side.
- The shutters can be (optionally) provided with a manually operated device to keep it in the opening position.
  The function of the device is cancelled by insertion of withdrawable equipment.

5. CABLE COMPARTMENT / CURRENT TRANSFORMERS

- Moulded-type current transformers are installed in the cable compartment.

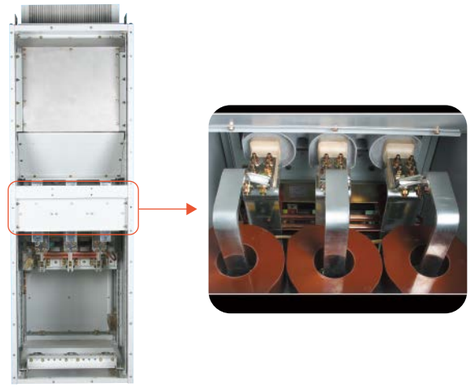


Figure 4-8 Current transformers installed in cable compartment

6. WIRING

- Necessary control equipment such as auxiliary relays, terminal blocks and fuses are located in the control compartment.
- Ducting and bundling ensure that control wiring is systematic and neat.
- External control cable can be terminated to both sides of the compartment.
- Wiring to devices mounted on the door are protected from damage during opening or closing by vinyl tubing.
- IP2x inside the control compartment is satisfied.

Figure 4-9 Control compartment

7. EARTHING BUSBAR

- The earthing busbar is made of copper conductor.
- MS-E has no plating earthing busbar as standard. However, when required, the earthing busbar can be optionally tin-plated.
- An earthing busbar is installed along the full length of the switchgear structure, with provision for earth cable connection at each end.
- The earthing busbar can be easily accessed from the front by removing the cover within the cable compartment.

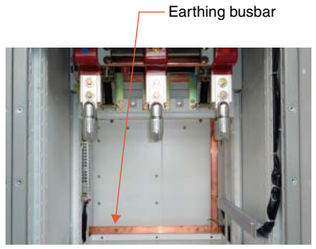
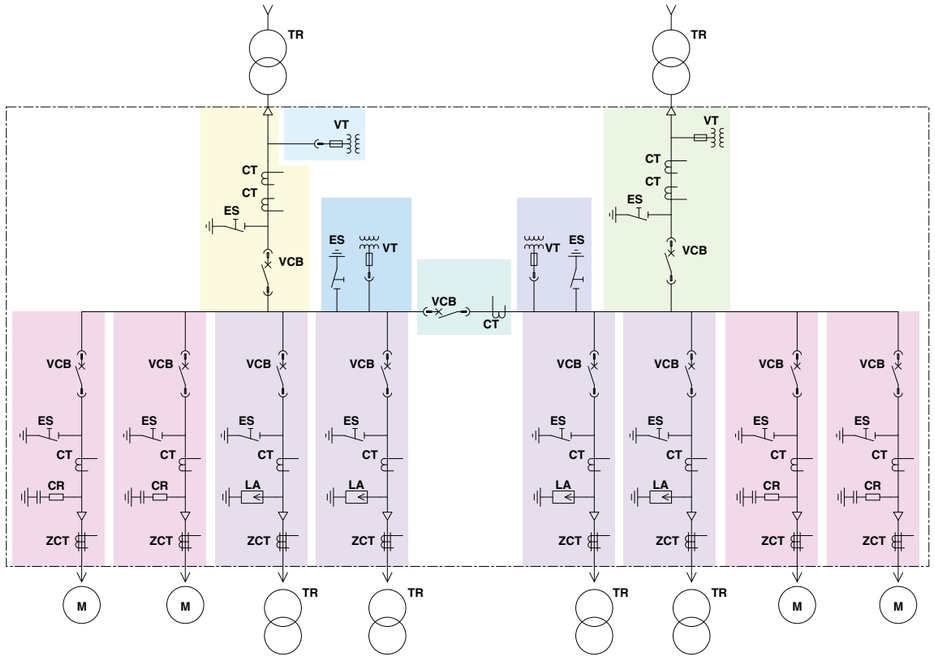


Figure 4-10 Earthing busbar viewed from rear of panel

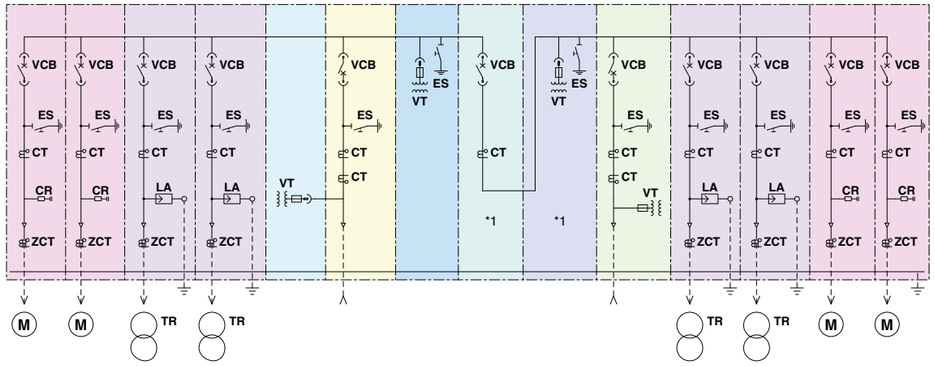
5 SWITCHGEAR ARRANGEMENT

1. EXAMPLE

A. SINGLE-LINE DIAGRAM



B. PANEL LAYOUT

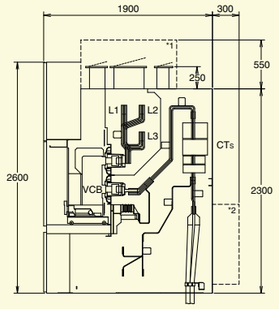
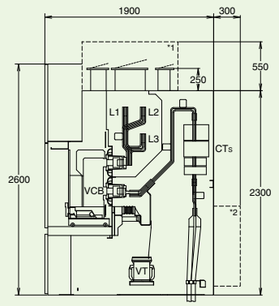


CT: Current Transformer
E. BUS: Earthing Busbar
ES: Earthing Switch
LA: Lightning Arrester
M: Motor
CR: CR suppressor
VCB: Vacuum Circuit Breaker
VT: Voltage Transformer
ZCT: Zero-phase sequence Current Transformer
TR: Transformer

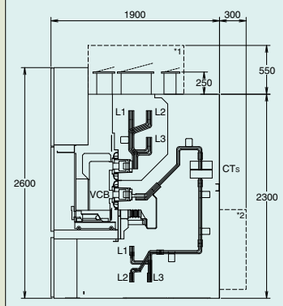
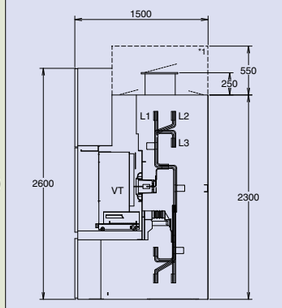
*1. For customer requirements, a fixed VT can be considered on the Bus-Tie panel. Please contact us for further details.

2. STANDARD SECTION VIEW AND DIMENSIONS

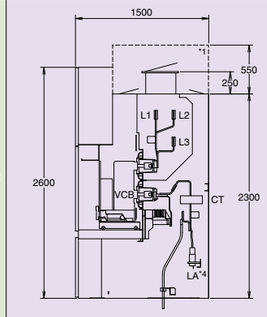
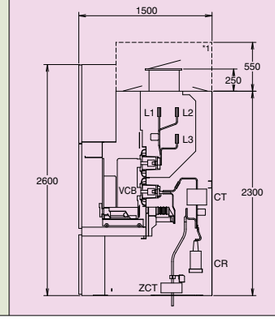
(1) 7.2 / 12 / 15 kV, 25 ~ 40 kA MITSUBISHI MS-E SWITCHGEAR

Panel type	Section view	Rated voltage (kV)	Short-circuit current (kA)	Rated current (A)		Dimensions (mm)			Weight (t)	Heat loss (W)
				Busbar	VCB	Width (W)	Depth*3 (D)	Height*4 (H)		
Incomer		7.2 12	25	630	630	800	1500	2600 (2850)	0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
				3150	3150				1.4	1200
			31.5	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
				3150	3150				1.4	1200
			40	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
				3150	3150				1.4	1200
		15	25	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
			31.5	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
			40	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
Incomer + VT (fixed type)		7.2 12	25	630	630	800	1500	2600 (2850)	1.0	200
				1250	1250				1.1	500
				2000	2000		1900 (2200)		1.3	800
				3150	3150				1.5	1200
			31.5	630	630		1500		1.0	200
				1250	1250				1.1	500
				2000	2000		1900 (2200)		1.3	800
				3150	3150				1.5	1200
			40	630	630		1500		1.0	200
				1250	1250				1.1	500
				2000	2000		1900 (2200)		1.3	800
				3150	3150				1.5	1200
		15	25	630	630		1500		1.0	200
				1250	1250				1.1	500
				2000	2000		1900 (2200)		1.3	800
			31.5	630	630		1500		1.0	200
				1250	1250				1.1	500
				2000	2000		1900 (2200)		1.3	800
			40	630	630		1500		1.0	200
				1250	1250				1.1	500
				2000	2000		1900 (2200)		1.3	800

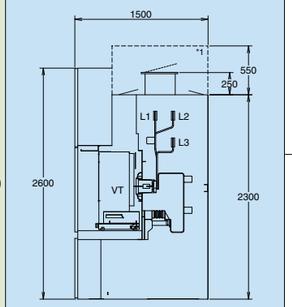
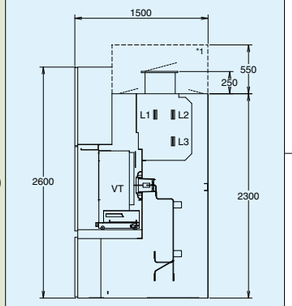
*1. Gas exhaust duct or gas screen (shown dashed) is required when Internal Arc Classification (IAC) be selected.
*2. Arc proof ventilator (shown dashed) is required when AFLR of IAC be selected.
*3. Depth given in parentheses applies when AFLR of IAC be selected.
And if more than 2 cables / phase required, or CT is non-standard, then the depth will increase.
*4. Height given in parentheses applies when IAC be selected.

Panel type	Section view	Rated voltage (kV)	Short-circuit current (kA)	Rated current (A) or VT ratio		Dimensions (mm)			Weight (t)	Heat loss (W)
				Busbar	VCB / VT	Width (W)	Depth*3 (D)	Height*4 (H)		
Bus-tie		7.2 12	25	630	630	800	1500	2600 (2850)	0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
				3150	3150				1.4	1200
			31.5	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
				3150	3150				1.4	1200
			40	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
				3150	3150				1.4	1200
		15	25	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
			31.5	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
			40	630	630		1500		0.9	200
				1250	1250				1.0	500
				2000	2000		1900 (2200)		1.2	800
Bus-Riser + VT (withdrawable)		7.2	25 31.5 40	630 ~ 3150	3 × VT 6600/110 V	800	1500 (1900) (2200)	2600 (2850)	0.8	100
				630 ~ 3150	3 × EVT $\frac{6600}{\sqrt{3}}/\frac{110}{\sqrt{3}}/\frac{190}{3}$ V					
		12	25 31.5 40	630 ~ 3150	3 × VT 11000/110 V					
				630 ~ 3150	3 × EVT $\frac{11000}{\sqrt{3}}/\frac{110}{\sqrt{3}}/\frac{190}{3}$ V					

*1. Gas exhaust duct or gas screen (shown dashed) is required when Internal Arc Classification (IAC) be selected.
*2. Arc proof ventilator (shown dashed) is required when AFLR of IAC be selected.
*3. Depth given in parentheses applies when AFLR of IAC be selected.
And if more than 2 cables / phase required, or CT is non-standard, then the depth will increase.
*4. Height given in parentheses applies when IAC be selected.

Panel type	Section view	Rated voltage (kV)	Short-circuit current (kA)	Rated current (A) or VT ratio		Dimensions (mm)			Weight (t)	Heat loss (W)
				Busbar	VCB / VT	Width (W)	Depth*2 (D)	Height*3 (H)		
Outgoing feeder (transformer)		7.2 12	25	630 ~ 3150	630	800	1500 (1900) (2200)	2600 (2850)	0.9	300
					1250				1.0	600
			31.5	630 ~ 3150	630				0.9	300
					1250				1.0	600
			40	630 ~ 3150	630				0.9	300
					1250				1.0	600
		15	25	630 ~ 2000	630				0.9	300
					1250				1.0	600
			31.5	630 ~ 2000	630				0.9	300
					1250				1.0	600
			40	630 ~ 2000	630				0.9	300
					1250				1.0	600
Outgoing feeder (motor)		7.2 12	25	630 ~ 3150	630	800	1500 (1900) (2200)	2600 (2850)	0.9	300
					1250				1.0	600
			31.5	630 ~ 3150	630				0.9	300
					1250				1.0	600
			40	630 ~ 3150	630				0.9	300
					1250				1.0	600
		15	25	630 ~ 2000	630				0.9	300
					1250				1.0	600
			31.5	630 ~ 2000	630				0.9	300
					1250				1.0	600
			40	630 ~ 2000	630				0.9	300
					1250				1.0	600

*1. Gas exhaust duct or gas screen (shown dashed) is required when Internal Arc Classification (IAC) be selected.
*2. Depth given in parentheses applies, it depends on the busbar configuration and customer requirement specification.
*3. Height given in parentheses applies when IAC be selected.
*4. Required only for dry-type transformers.

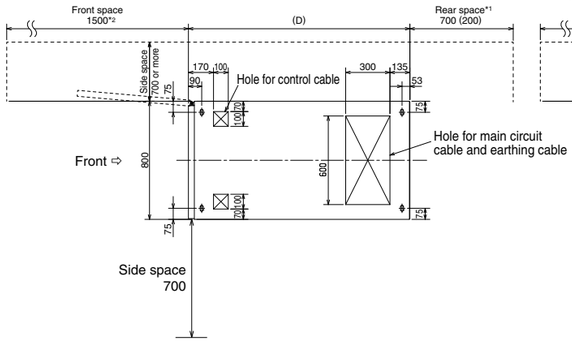
Panel type	Section view	Rated voltage (kV)	Short-circuit current (kA)	Rated current (A) or VT ratio		Dimensions (mm)			Weight (t)	Heat loss (W)
				Busbar	VCB / VT	Width (W)	Depth*2 (D)	Height*3 (H)		
Busbar + VT (withdrawable)		7.2	25 31.5 40	630 ~ 3150	3 × VT 6600/110 V	800	1500 (1900) (2200)	2600 (2850)	0.8	100
				630 ~ 3150	3 × EVT $\frac{6600}{\sqrt{3}}/\frac{110}{\sqrt{3}}/\frac{190}{3}$ V					
		12	25 31.5 40	630 ~ 3150	3 × VT 11000/110 V					
				630 ~ 3150	3 × EVT $\frac{11000}{\sqrt{3}}/\frac{110}{\sqrt{3}}/\frac{190}{3}$ V					
Incoming + VT (withdrawable)		7.2	25 31.5 40	630 ~ 3150	3 × VT 6600/110 V	800	1500 (1900) (2200)	2600 (2850)	0.8	100
				630 ~ 3150	3 × EVT $\frac{6600}{\sqrt{3}}/\frac{110}{\sqrt{3}}/\frac{190}{3}$ V					
		12	25 31.5 40	630 ~ 3150	3 × VT 11000/110 V					
				630 ~ 3150	3 × EVT $\frac{11000}{\sqrt{3}}/\frac{110}{\sqrt{3}}/\frac{190}{3}$ V					

*1. Gas exhaust duct or gas screen (shown dashed) is required when Internal Arc Classification (IAC) be selected.
*2. Depth given in parentheses applies, it depends on the busbar configuration and customer requirement specification.
*3. Height given in parentheses applies when IAC be selected.

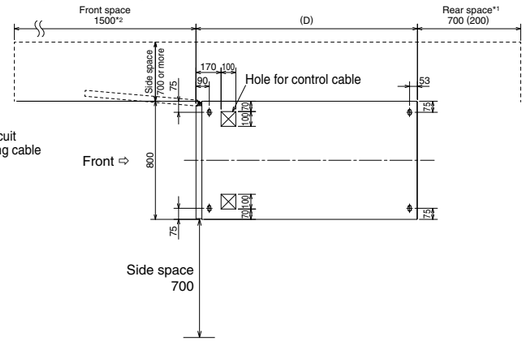
3. FOUNDATION

7.2 / 12 / 15 kV, 25 ~ 40 kA MITSUBISHI MS-E SWITCHGEAR

VCB Panel



VT (withdrawable) Panel



*1. Rear space given in parentheses applies when AFL of IAC be selected.
*2. Front space will be 2000 (mm) in case of rated current 4000A.

6 STANDARD DESIGN

1. ENCLOSURE AND STRUCTURE

● Steel thickness is a minimum of 1.5 mm

- Side cover (both ends of arrangement): 2.0 mm
- Frame: 2.0 mm
- Door: 2.0 mm
- Ceiling plate: 2.0 mm
- Bottom plate: 2.0 mm
- Internal partitions: 1.5 mm
- Mounting plates: 2.0 mm

● Standard front door / rear cover

Position	Structure	Hinge location	Handle location	Handle lock
Front	Hinged doors (×3)	Left	Right	Optional
Rear	Bolted covers (×2)	—	—	—

● Degree of protection
Enclosure: IP2X
Internal partitions: IP2X

2. BUSBAR AND CONNECTING CONDUCTOR

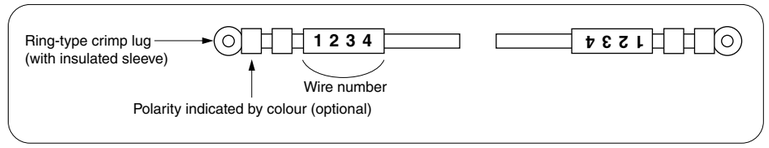
● Conductor material: copper (JIS H3140)
● Surface treatment: tin plating
● Auxiliary apparatus: high voltage insulated wire

3. EARTHING BUSBAR

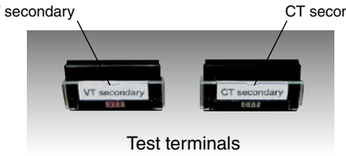
● Conductor material: copper (JIS H3140)
● Surface treatment: none (bare)
● Standard dimensions: 6 mm × 25 mm

4. CONTROL CIRCUIT WIRING

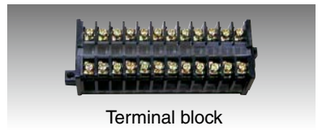
● Wiring system: duct or bundled
● Insulation: 600 V heat-resistant plastic (PVC)
● Size: 1.25 mm²
● Colour: yellow, except for earth wire (green)
● Wire numbering: indicated by "tube" ferrule



The VT / CT test terminals and terminal blocks shown below are adopted as standard.



Test terminals


Terminal block

5. PHASE / POLARITY ARRANGEMENT AND COLOUR CODING

● Main circuit and control circuit arrangements are as follows:

AC ····· 1st phase L1
2nd phase L2
3rd phase L3

(Viewed from front to back, top to bottom, or left to right from front.)

DC ····· 1st wire Positive
2nd wire Negative

(Viewed from front to back, top to bottom, or left to right from front.)

● Main circuit colour identification is achieved with vinyl tape or coloured label at bus end where main cables are connected.

AC ····· L1 Red
L2 Yellow
L3 Blue

Unless specially requested, the control circuit is not colour coded.
(Identifying colour tube markers, with the standard colours shown below, can be optionally installed.)

AC 3-phase ··· L1 Red
L2 Yellow
L3 Blue
Neutral Black

AC 1-phase ··· 1st wire Red
2nd wire Blue
Neutral Black

DC ····· Positive Red
Negative Blue

6. WITHDRAWABLE EQUIPMENT

Apparatus	Main circuit	Control circuit	Earthing circuit (Carriage frame)
Vacuum Circuit Breaker	Automatic connection (self-aligning)	Manual connection	Automatic connection (earthing shoe)
Voltage Transformer			

7. WITHDRAWABLE EQUIPMENT POSITIONS

● The withdrawable equipment has the following two positions:

Service : Main and control circuit – Connected
Test / Disconnected : Main circuit – Disconnected
Control circuit – Connected (manual disconnection possible)

● The front door can be opened / closed when the withdrawable equipment is *Test / Disconnected* position.

8. SAFETY INTERLOCKS

Action	Interlock Condition
Rack VCB (Insert from test position to service Position, Draw-out from service position to test position)	• VCB status OFF • VCB compartment door closed
Operate ES (Earthing Switch)	• VCB (only the same panel) at test position or withdrawn • Cable compartment door Closed
Open VCB compartment door	• VCB at test position
Close VCB compartment door (VCB compartment door cannot be closed when the control circuit connector (VCB secondary junction) isn't connected.)	• Control circuit connector (VCB secondary junction) Connected
Open cable compartment door	• ES (Earthing Switch) ON
Disconnect control circuit connector	• VCB at test position
Close VCB by electrical command	• VCB at service position or at test Position

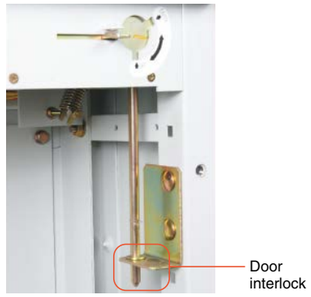


Figure 6-1 Earthing switch*1 and cable compartment door interlock

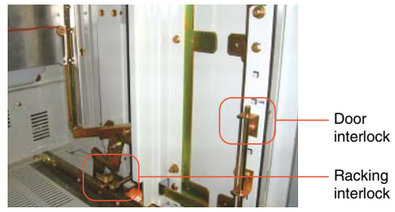


Figure 6-2 VCB position-door interlock (derived from shutter mechanism)

*1. The earthing switch can be optionally provided.
*2. Excludes VT panel.

9. PAINTING AND COLOUR

● External enclosure surfaces
Surfaces are first cleaned and pretreated for rust. Two coats of paint are then applied: first, acrylic epoxy, and finally, melamine enamel.

● Internal enclosure surfaces
As for external except only first coat of acrylic epoxy, or primer, applied.

● Finish colour
Enclosure: light grey (Munsell No. 5Y 7/1).
Frame, meter covers, control devices and protection relay cases: manufacturer's standard.

10. NAMEPLATES

Nameplates are of plastic with black lettering on white background, fastened by plastic rivets, and are the following sizes:

● Panel arrangement name: 63 mm × 315 mm

● Panel section name: 16 mm × 50 mm

11. SURGE (SWITCHING) PROTECTIVE DEVICES

Load	Rotary machine (electric motor & generator)	Dry-type transformer	Oil-immersed transformer
Protection device for switching surge of VCB	CR Suppressor	Lightning Arrester	Not required

7 ACCESSORIES

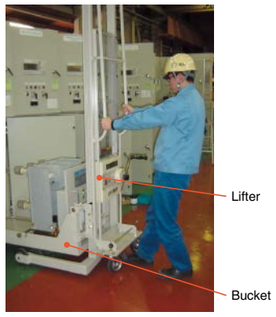
1. STANDARD ACCESSORIES

- Draw-out handle for withdrawable equipment
- Manual charging handle for VCB closing spring
- Test Terminals test plug set for secondary circuit of VT & CT
- Lifter with bucket for withdrawable equipment

Draw-out handle

Manual spring-charging handle

Test plug set

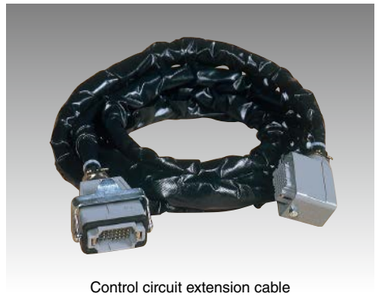


Lifter with bucket

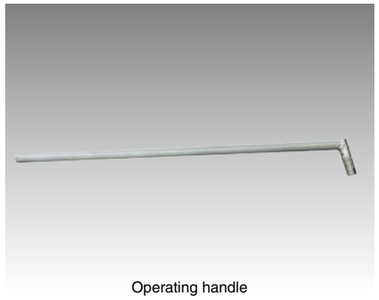
Figure 7-1 Standard accessories

2. OPTIONAL ACCESSORIES

- Control circuit extension cable for withdrawn VCB ON / OFF testing
- Earthing switch operating handle



Control circuit extension cable



Operating handle

Figure 7-2 Optional accessory

3. EARTHING DEVICES

Optional earthing devices are available for safety during cable and busbar maintenance and/or inspection.
The following two types of earthing device can be provided upon request with the MS-E.

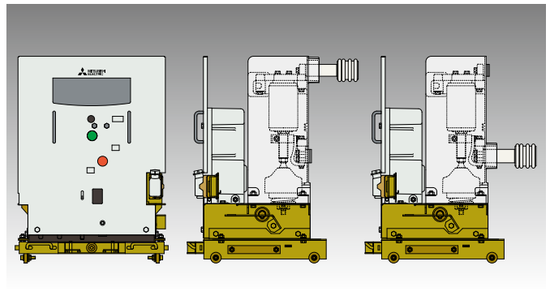


Figure 7-3 Earthing truck

- Earthing truck for switchgear

  An earthing truck with fault-making capability which has the same operating mechanism as the circuit breaker.

- Integral earthing switch

  In the case of cable-side earthing, the earthing switch is integrated within the cable compartment . A mechanical interlock between the earthing switch and Vacuum circuit breaker is provided.

  Bus-side earthing switches are usually integrated within a VT panel, and so employ electrical interlocking with the adjacent panel's circuit breaker.

  The mechanical indicator for the earthing switch's state can be checked from the front of the panel through a small, circular inspection window.

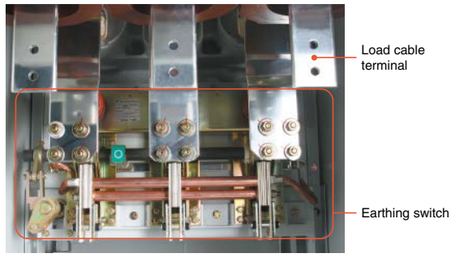


Figure 7-4 Rear view of earthing switch

Figure 7-5 Earthing switch operation

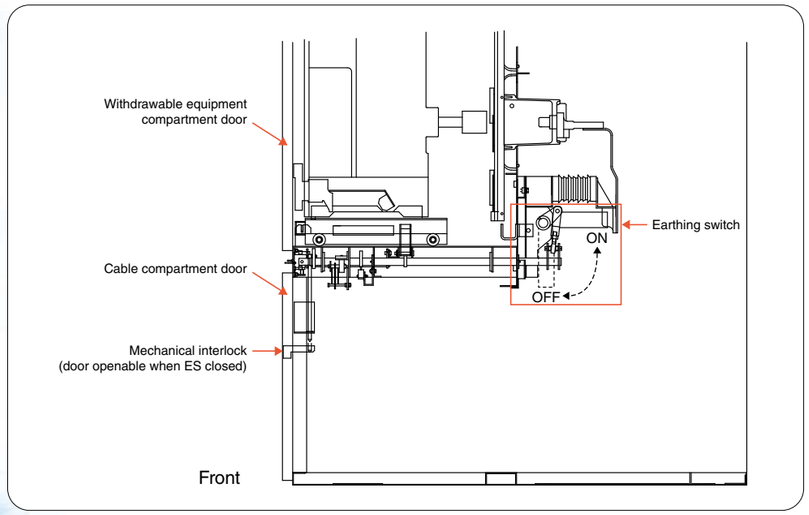


Figure 7-6 Section view of earthing switch

4. GAS EXHAUST DUCT

● For switchgear requiring optional Internal Arc Classification (IAC), the gas exhaust duct must be fitted onto the top of panel. The gas exhaust duct ensure that in the event of an internal arc fault, any hot gases or vapours are channeled away from personnel in the vicinity of the panel.

● The gas exhaust duct may extend to the open air. The straight and maximum two meters design, which is standard, is available. The part of extension duct to reach to the open air will be supplied by others. The design guideline for them will be shown for consumer convenience.

● The gas exhaust duct is dismantled from the panels prior to shipping, and are re-attached on site.

● With gas exhaust duct, the switchgear and controlgear are designed to protect persons in the event of an internal arc fault of up to 40 kA. Thus, in the event of internal arcing, there is no ejection of parts, no expulsion of hot gases (except from the gas exhaust duct) and the enclosure remains earthed. Minimum clearances of 600 mm, 100 mm and 800 mm from the panel to the room's ceiling, side walls and back wall, respectively, are required.

● Classification IAC

AFLR – signifies that the switchgear and controlgear are designed for access from the *F*ront, *L*ateral ends and *R*ear by *A*uthorised personnel only.

AFL – signifies that the switchgear and controlgear are designed for access from the *F*ront and *L*ateral ends by *A*uthorised personnel only.

5. GAS SCREEN

● The gas screen can be selected instead of the gas exhaust duct on condition that ceiling height from floor of electrical room is 4400 mm or over.

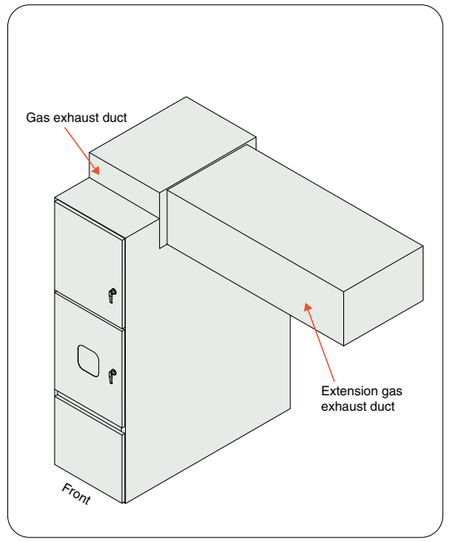


Figure 7-7 Panel section with gas exhaust duct

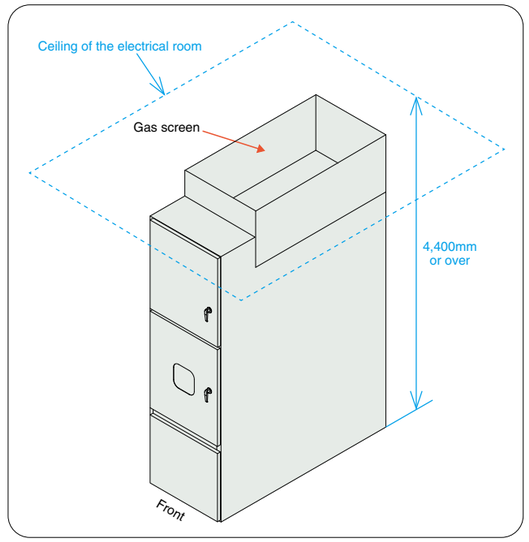


Figure 7-8 Panel section with gas screen (without channel base)

8 OPTIONS

CLASSIFICATION	ITEM	STANDARD DESIGN	SPECIAL SPECIFICATIONS AND/OR OPTIONS
Enclosure	•Degree of protection	IP2X	IP31 IP41
	•Padlocking facility for withdrawable equipment Position Shutters	 — —	 Available Available
	•Internal Arc Classification (IAC) Accessibility type Arc test current Arc test current duration	 — — —	 AFL, AFLR Up to 40 kA Up to 1.0 sec
	•Cable entry Power Control	 Bottom Bottom	 Top Top
Busbars	•Plating	Tin	Silver
	•Insulation	Bare	Epoxy coat
	•Short-time withstand current	25, 31.5, 40 kA rms (1 sec.)	25, 31.5, 40 kA rms (3 sec.)
	•Earthing busbar Plating Size	 — 6 × 25 mm	 Tin 6 × 32, 6 × 40 mm
	•Busbar compartment segregation between panels	No segregation	With segregation
Main circuit	•Cable lugs	Not supplied	Specify type, size
	•Cable glands	Not supplied	Specify type, size
	•Cable termination material	Not supplied	Heat-shrinkable material (Specify size and type)
Control circuit	•Wire type	600 V, PVC, 75°C (*HIV**1)	Please specify
	•Wire size	CT / VT secondary: 2.0 mm^2 other: 1.25 mm^2	Please specify
	•Colour	Yellow	Please specify
	•Terminals	Up to 5.5 mm^2	Please specify
	•Terminal blocks	Screw type (MITSUBISHI: Type TJX)	Please specify (e.g. clip-on)

*1. Tinned copper, heat resistant (JIS C 3316)

CLASSIFICATION	ITEM	STANDARD DESIGN	SPECIAL SPECIFICATIONS AND/OR OPTIONS
Equipment	•Space heater	Not supplied	Please specify power source
	•Thermostat (for space heater)	Not supplied	Please specify power source
	•Interior lighting operated by door position switch	Not supplied	Available
	•Transparent plastic covers (prevention of accidental contact with live parts)	Not supplied	Available (behind door)
	•Integral earthing switch	Not supplied	Available
	•Earthing truck	Not supplied	Available
	•Automatic Transfer System (ATS)	Not supplied	Slow speed
	•Foundation bolts	Not supplied	Available
	•Channel base	Not supplied	Available
CT	•Secondary rating	5 A	1 A
	•Accuracy Measuring Protection for switchgear Protection for controlgear	 Class 1.0 10P20 5P10	Please specify
	•Burden	Min. 5 VA	Please specify
Nameplates	•Material	Acrylic plastic	Laminated plastic Stainless steel
	•Language	English	Please specify
Measurement and Protection	•Relay	MITSUBISHI Multiple Protection Relay	Please specify instruments and protection relays

MEMO

MEMO

MEMO

MITSUBISHI ELECTRIC CORPORATION
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⚠ Safety Precautions

Please read the instruction manual
before using the device.

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Specifications are subject to change without notice.

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