for a greener tomorrow

Eco Changes is the Mitsubishi Electric Group's environmental statement, and expresses the Group's stance on environmental management. Through a wide range of businesses, we are helping contribute to the realization of a sustainable society.

MITSUBISHI ELECTRIC CORPORATION
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⚠ Safety Precautions

Please read the instruction manual before using the device.

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New Publication, effective Sep. 2012.
Specifications are subject to change without notice.

MITSUBISHI ELECTRIC

Changes for the Better

GAS-INSULATED SWITCHGEAR

MODELS

HG-VA & HG-VG

72kV 72kV/84kV

Advanced environmentally friendly switchgear

for a greener tomorrow

Advanced environmentally friendly switchgear

Mitsubishi Electric has an impressive record of achievements in designing and manufacturing high-quality switchgear for customers worldwide.
Drawing on this vast experience, we are proud to present the HG-VA & HG-VG models, the next generation of advanced, safe and environmentally friendly switchgear.

Flexible Design – Well-matched to a Range of Applications

Switchgear that provides some of the greatest system flexibility in the market, designed to allow freedom when configuring the layout for cable lead-in and power/control cable terminals.

Space saving – Effective,flexible layout

The functional modular structure of the switchboard contributes to ensuring an efficient layout capable of fitting easily into the installation space.
The busbars are installed in two busbar sections, allowing the freedom to create a layout appropriate for the electrical room.

JP Pat No.4519076
Others, five patents in Japan and four patents in four different countries (KR, DE, US, CN).

Laborsaving – Reduction of manpower

The optional condition-based maintenance (CBM) unit detects abnormalities in operating devices and other components. This helps prevent failures and realizes efficient maintenance, leading to shorter inspection times and reducing lifecycle costs.
Solid insulation can be added to the busbar connectors as an option to allow future system expansion between switchgear. This option not only reduces the gas processing work, but also contributes to reduced installation work when expanding the system.

JP Pat No.4488995

Energy Saving – Reduced Operating Costs

An electro-magnetic vacuum circuit breaker (VCB) operating mechanism has been adopted, reducing operating energy by approximately 70% compared to conventional motor-spring operating mechanisms.
Optimal equipment placement and the shortest possible main-circuit conductor enables a reduction in power loss (heat value) of up to 60% by minimizing electrical resistance compared to its previous model.

High reliability – Long-term, Trouble free Operation

Electro-magnetic VCB operating mechanisms have been adopted, realizing an ever higher level of reliability. The reduced number of parts†1 also translates into a lower chance of failure.

†1 HG-VA & HG-VG models have 30% fewer parts compared to our conventional motor-spring VCB operating mechanisms.

Safe Design – Ensures operator's safety

Busbars and other main-circuit components are fitted inside strong, grounded, metal containers to secure safety.
Tests have been carried out to confirm that insulation performance can withstand system voltage even if the gas pressure drops to atmospheric pressure.†2

†2 If the gas pressure drops below the gas-pressure alarm level, restore the rated gas pressure and contact a Mitsubishi Electric Co. representative.

Minimal Maintenance – Reduced Maintenance Costs

The high-tech electro-magnetic VCB operating mechanisms provide maintenance-free use for a period of over 15 years.†3 The secret to this amazingly low maintenance requirement is placing the VCB and disconnecting / earthing switch in a hermetically sealed vessel and applying an original anti-oxidation grease to the moving parts of the disconnecting / earthing switch.

†3 Under normal operating conditions as specified in IEC standards.

Environmentally friendly – SF_6-free

Mitsubishi Electric Co. is a global leader in dry compressed-air insulation technologies, which has been developed through extensive experience in designing and developing SF_6 switchgear. Under dry, clean and compressed conditions, air has good insulation properties, making it an ideal solution for switchgear insulation (dry-air insulation is only available for HG-VA).

CONTENTS

HG-VA & HG-VG

72kV 72kV/84kV

Ratings

Model			HG-VA(dry-air)	HG-VG(SF_6)

GENERAL

Standard			JEC†1 2350 (2005)	
Rated voltage		kV	72	72 / 84
Rated frequency		Hz	50 / 60	
Rated normal current of main busbars		A	800 / 1200	
Rated insulation levels	LIWV	kV (peak)	350	350 / 400
	AC (1min)	kV (rms)	140	140 / 160
Rated short-time withstand current		kA	25 / 31.5	
Rated duration of short-time current		sec	2	
Insulation medium			Dry air	SF_6
Rated gas pressure		MPa-abs	Dry air : 0.25	SF_6 : 0.15
Alarm gas pressure		MPa-abs	Dry air : 0.23	SF_6 : 0.13

†1 Japanese Electrotechnical Committee.

VACUUM CIRCUIT BREAKER (VCB)

Standard		JEC 2300 (1998)	
Rated voltage	kV	72	72 / 84
Type of circuit breaker		Vacuum	
Rated short-circuit breaking current	kA	25 / 31.5	
Rated short-circuit making current	kA	63 / 80	
Break time	cycles	3	
Rated operating sequence		O-1min-CO-3min-CO, CO-15sec-CO	
Type of operating mechanism		Electro-magnetic	

DISCONNECTING / EARTHING SWITCH (DS / ES)

Standard		JEC 2310 (2003)
Rated normal current (disconnecting switch)	A	800 / 1200
Rated short-time withstand current	kA	25 / 31.5
Operating mechanism (disconnecting switch)		Manual†2
Operating mechanism (earthing switch)		Manual†2

†2 Motor operation is an option.

CURRENT TRANSFORMER (CT)

Standard		JEC 1201 (1996)
CT ratio	A	As required (min. ratio 100 / 5)
Burden	VA	15†3
Accuracy class		1P / 3P†3

†3 For other burden and / or accuracy class, Please contact a Mitsubishi Electric representative.

EARTHED VOLTAGE TRANSFORMER (EVT)

Standard		JEC 1201 (1996)		
Rated primary voltage	kV	66 / √3	66 / √3	77 / √3
Rated secondary voltage	V	110 / √3		
Rated tertiary voltage†4	V	110 / 3		
Burden (secondary / tertiary)†4	VA	100 / 100		
Accuracy class		1P / 3G		

†4 Tertiary winding is an option.

LIGHTNING ARRESTOR (LA)

Standard		JEC 2373 (1998)	
Type		Zinc oxide	
Rated voltage	kV	84	84 / 98
Normal discharge current	kA	10	

Features

HG-VA(dry-air)

Technology of dry air insulation with low gas pressure

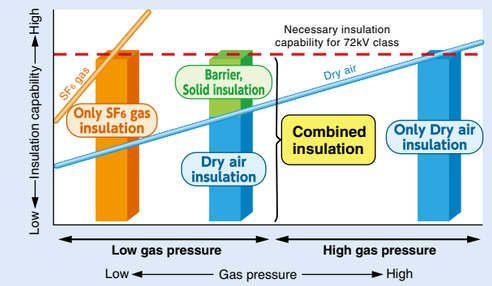
Although dry air insulation is required high gas pressure to keep the same performance as SF_6, low gas pressure is realized by using combined insulation (dry air, barrier, solid insulation).

JP Pat No.4545362
Others, five patents in Japan.

Global warming potential (GWP)

Insulation medium	GWP
Dry air	0
CO_2	1
SF_6	23900

●Conceptual diagram of insulation effect with combined insulation

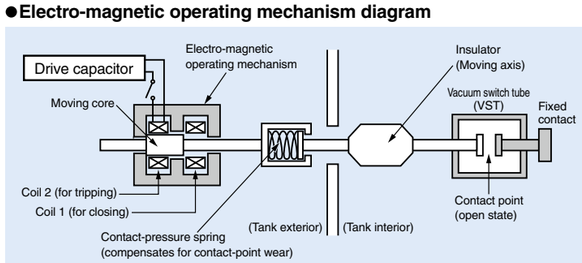


Electro-magnetic VCB Operating Principles

The elimination of consumable parts, such as the latch lever required for the conventional motor-spring operating mechanism, has realized a 30% reduction in the number of parts compared to our previous product. A fewer number of parts enables a significant reduction in the maintenance of circuit breaker operational mechanisms under general indoor operating environments†1 (i.e., drive capacitor and operation control board require replacement every 15 years).

†1 Simulation: accelerated deterioration testing confirmed that continuous operation for a period of 30 years without performing maintenance is possible.

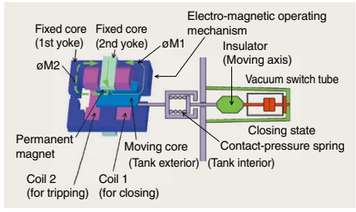
●Electro-magnetic operating mechanism diagram

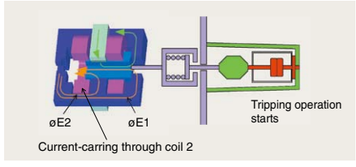


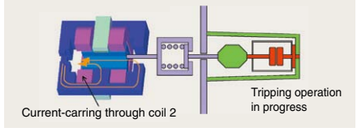
Mitsubishi Electric's original double-yoke†2 electro-magnetic operating mechanism has been adopted. Switching operation is performed via the electro-magnetic force of the coil, while the open / close status is maintained via the electro-magnetic force of the permanent magnet. Using the double-yoke system, the magnetic paths of the permanent magnet (maintaining open/closed states) and coil excitation (switching operation) are isolated. This prevents reverse excitation of the permanent magnet and realizes highly efficient switching operation.

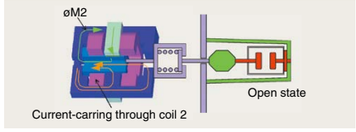
JP Pat No.4230246
Others, six patents in Japan and twenty-three patents in eight different countries (CN, HK, TW, KR, SG, DE, FR, US).

†2 Yoke (fixed core)









Maintain closing state
(contact pressure < retention force)

1. Closing state

The moving core is adsorbed / maintained on the closing side of the fixed core via the magnetic flux (øM1) of the permanent magnet (øM2 magnetic flux of the permanent magnet is also generated, but it is extremely small compared to øM1 because there is a large air-gap in the magnetic circuit).

Current-carring through tripping coil

Drive starts via contact-pressure spring force + electro-magnetic force

2. Tripping operation

(1) Based on the tripping command, Current is carried through the tripping coil (coil 2). Two magnetic fluxes are generated that initiate movement of the moving core to the open side: øE1, which moves in a direction to negate the magnetic flux of the permanent magnet (øM1), and øE2, which sucks the moving core to the open side.

Move to open side

(2) The moving core is separated from the fixed core, and an air-gap is created in the øM1 magnetic circuit. As a result, øM1 drops dramatically.

Maintain open state

Current-carring through coil 1 will result in an closing state via reverse operation.

3. Opening state

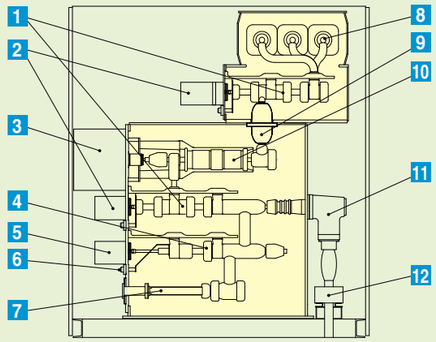
When the moving core reaches the open side of the fixed core, the øM2 magnetic flux from the permanent magnet increases sharply. Even after the Current-carring to coil 2 is stopped, the moving core will be adsorbed to and maintained at the open side.

Components

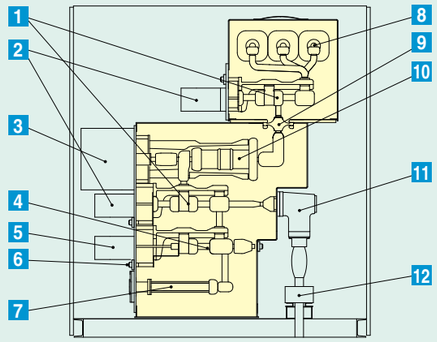
Cross-sectional diagram (indoor incoming panel)

1 DS / ES
2 DS / ES operating mechanism
3 VCB operating mechanism
4 ES
5 ES operating mechanism
6 Earthing terminal
7 LA
8 Main bus
9 Insulator (gas barrier)
10 VCB
11 Cable sealing end (slip-on type)
12 CT

HG-VA (dry-air)



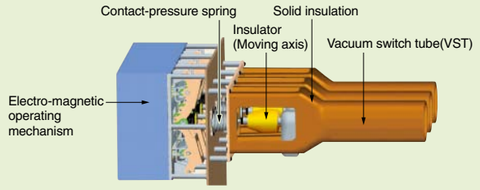
HG-VG (SF_6)



Vacuum Circuit Breaker (VCB)

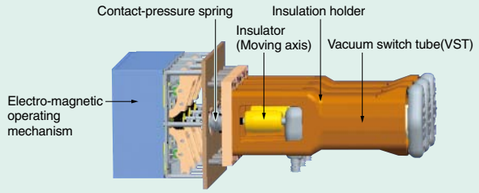
VCB are adopted as the circuit breaking mechanism. The magnetic circuit used for switching operations and to maintain the open / closed state is isolated, reducing power consumption during switching operation. Additionally, the latch mechanism is eliminated, realizing a simple structure with an even higher level of reliability.

HG-VA (dry-air)



VST are built in to solid insulation.

HG-VG (SF_6)

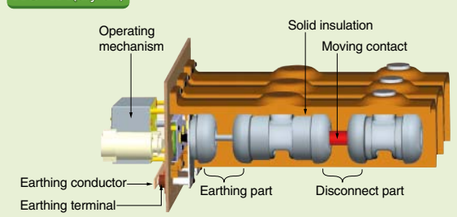


VST are inserted into insulation holder.

Disconnecting / Earthing Switch (DS / ES) for maintenance

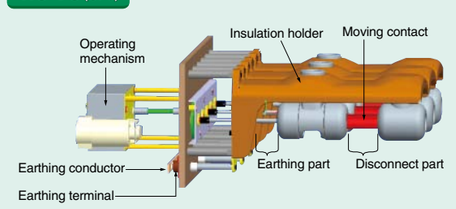
The disconnecting / earthing switch for maintenance has a compact structure with a linear drive system that moves the moving contact in a straight line. The disconnecting / earthing switch for maintenance are operated manually as standard, with the option of motor operation for the disconnector. The earthing terminal of the earthing switch functions to be drawn out and earth each phase individually outside the tank.

HG-VA (dry-air)



DS / ES are built in to solid insulation.

HG-VG (SF_6)

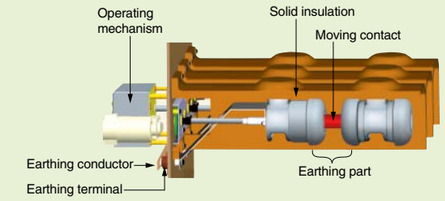


DS / ES are fixed on insulation holder.

Earthing Switch (ES) for line

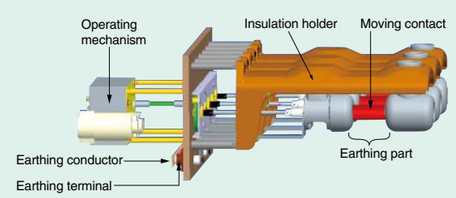
As is the case with the disconnecting / earthing switch for maintenance, the line earthing switch has a linear drive system that moves the moving contact in a straight line. Manual or motor (optional) operation is possible. The earthing terminal functions to be drawn out and earth each individual phase outside the tank. It is possible to apply a DC voltage (10kV DC) for testing on the power cable, remove the earthing conductor from the earthing terminal at the front of the tank.

HG-VA (dry-air)



ES are built in to solid insulation.

HG-VG (SF_6)



ES are fixed on insulation holder.

Earthed Voltage Transformer (EVT)

Using molded insulation, instrument voltage transformers are covered with a conductive layer that grounds the exterior. When disconnected, gas processing is not required.
There is no need to disconnect the transformer from the main circuit when conducting onsite AC withstand voltage testing.
The voltage transformer has molded insulation. It can be detached from the circuit for AC withstand voltage testing.

HG-VA (dry-air)

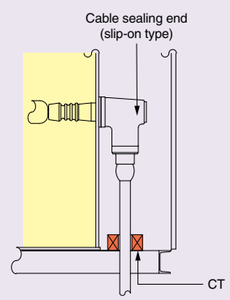
HG-VG (SF_6)

EVT are built in to SF_6 gas tank.

Current Transformer (CT)

The instrument current transtormers of divided type can be installed in the cable compartment.

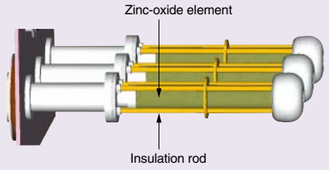
Common



Lightning Arrester (LA)

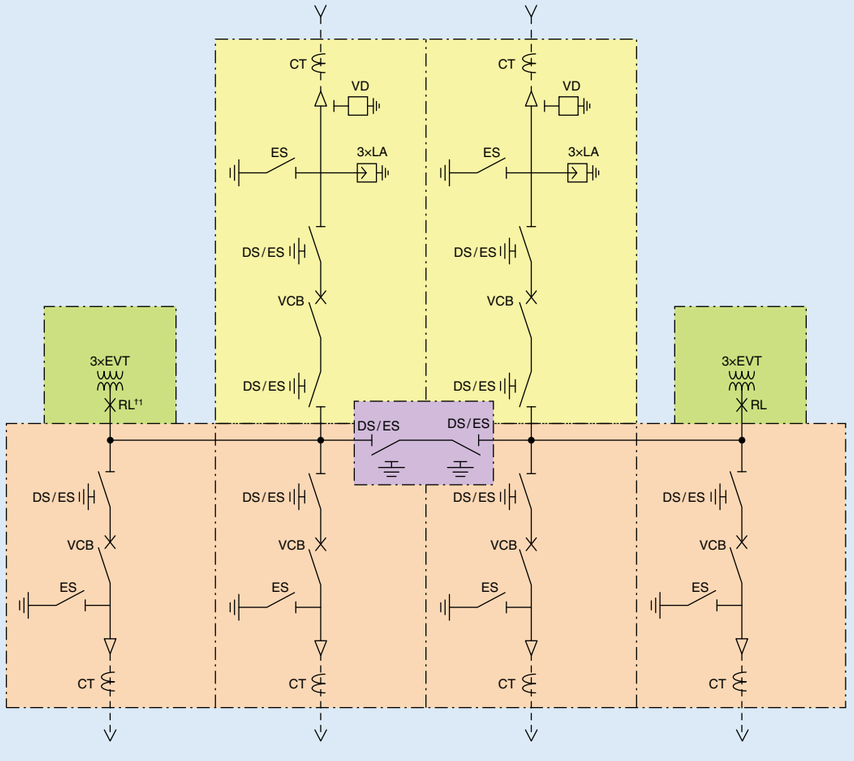
Mitsubishi Electric zinc-oxide lightning arresters have a simple structure consisting of insulation rods for each phase that support the zinc-oxide element. Very easy to disconnect from the circuit for withstand voltage testing.

Common



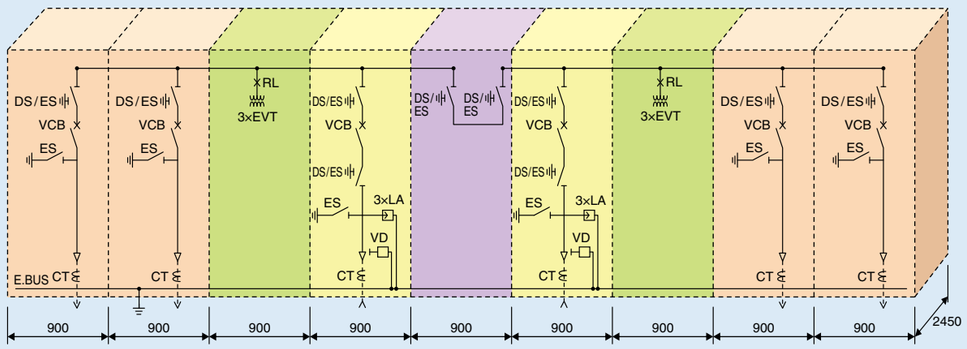
Switchgear arrangement

Typical single-line diagram



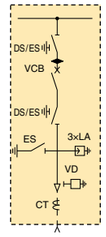
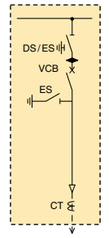
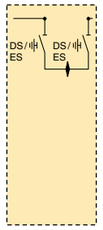
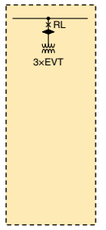
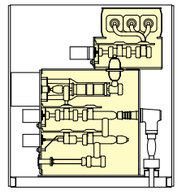
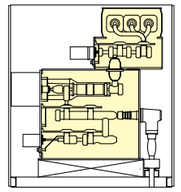
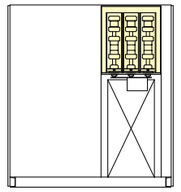
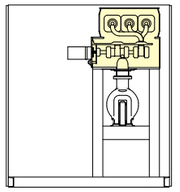
†1 Removable link

Panel layout of above single-line diagram

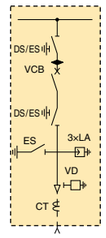
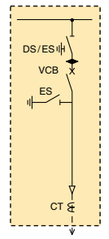
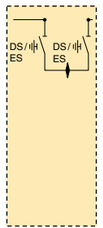
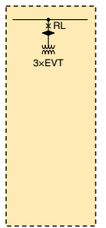
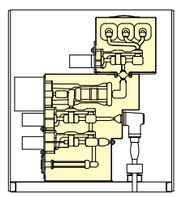
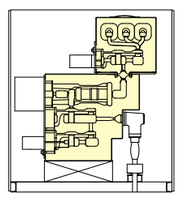
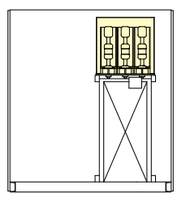
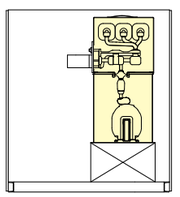


Typical key single-line schematic & cross-sectional diagrams

HG-VA(dry-air)

		Incoming panel	Outgoing panel	Bus section panel	Bus EVT panel
Typical key single-line schematic					
Cross-section					
72kV	Width (mm)	900	900	900	900
	Depth (mm)	2450	2450	2450	2450
	Height (mm)	2700	2700	2700	2700
	Weight (t)	4.5	3.8	2.3	1.9
	Heat value (J/S)	310	250	150	50
Note	▮◆: Insulator (gas barrier) ▮ Heat values indicated are for 800A. ▮ For outdoor panels, the height is increased by 200mm. ▮ For other type configrations, please contact a Mitsubishi Electric representative.				

HG-VG(SF_6)

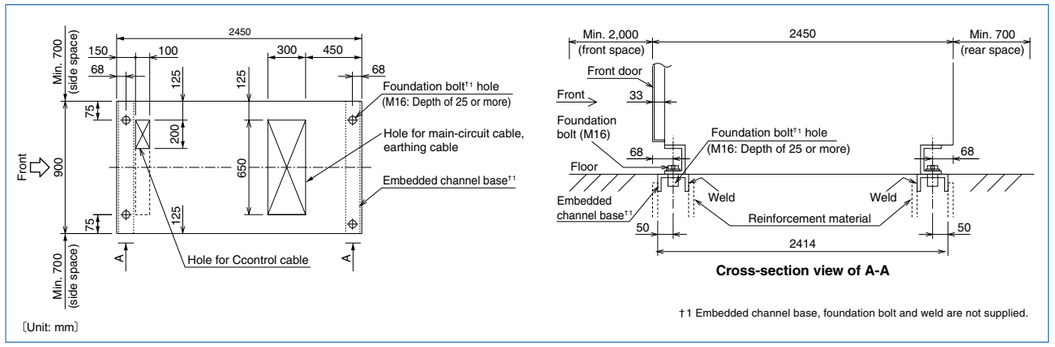
		Incoming panel	Outgoing panel	Bus section panel	Bus EVT panel
Typical key single-line schematic					
Cross-section					
72 / 84kV	Width (mm)	900	900	900	900
	Depth (mm)	2450	2450	2450	2450
	Height (mm)	2700	2700	2700	2700
	Weight (t)	3.5	3.0	1.8	2.5
	Heat value (J/S)	360	300	170	50
Note	▮◆: Insulator (gas barrier) ▮ Heat values indicated are for 800A. ▮ For outdoor panels, the height is increased by 200mm. ▮ For other type configrations, please contact a Mitsubishi Electric representative.				

Standard Specifications

Common

Item				Specifications	
Installation location				indoor	outdoor
General specifications	Applicable standards			JIS, JEM, JEC	
	Operating circuits, auxiliary circuits (including remote control signals)			Control: 100VDC (100VDC ±10% at terminal block into panel), space heater (outdoor only): 200 / 220VAC	
	Panel installation entrance and path			Max. of 2 panels transported together (confirm entrance / path for installation)	
	Earthquake protection			3.92m/s² (JEM-TR144; horizontal)	
	Panel type			JEM1425-CX	
Main circuit	Conductor	Tank interior	Material / Plating	Material: Copper or aluminum / Plating: Silver (partial plating)	
		Earthing busbar	Material / Plating/Size	Material: Copper / Plating : None / Size: 6 × 32mm	
	Earthing cable			Lightning arrester and earthing switch: EM (black, both ends green) 38mm², Unit / Other equipment: HIV (green) 5.5mm² or larger	
	Phase	According to JEM standards		Phase 1 (red); Phase 2 (white); Phase 3 (blue)	
		Indicator materials		Sticker	
	Exterior cable connections	Cable connection method		Cable terminal connection box: Cable sealing end (female)	
		Permissible cable size		400mm² or smaller	
		Overhead cable connection method (bushing)	Salt deposit density	Indoor: 0.03mg/cm² or less; Outdoor: 0.06mg/cm² or less	
			No. of connection holes	No. of connection holes: 2; Compression terminal: Not supplied	
		Opening cover, fixing bracket		Cover: Aluminum (no hole, no rubber sheet, no coating); Bracket: Not supplied	
Control wires	Wires	CT / EVT secondary, tertiary		HIV (yellow) 2mm²	
		Other (excluding dedicated cables, inside the unit)		HIV (yellow) 1.25mm² or larger (for instrument circuits: HIV [yellow] 1.25mm² twisted)	
		Earthing cables		CT / EVT secondary, tertiary: HIV (green) 5.5mm²; Other: HIV (green) 2mm²	
	Wiring No. indicators (excluding interior circuits such as CB, DS)			Marker attached at both ends of wire (excluding connector, relay terminal inside panel)	
	Cable connections between panels/across doors			Connector (2mm² or smaller); Terminal block (other than connector)	
	Cable hole cover			Aluminum (no hole, no rubber sheet, no coating)	
Painting	Panel exterior			Color: 5Y7/1, half-gloss	Color: 5Y7/1, full-gloss
Enclosure	Structure	Service conditions (altitude, Ambient temperature, relative humidity)		1,000m or less; -5~40°C; 45~85% RH no condensation	1,000m or less; -25~40°C
	Doors	Handle		TAKIGEN A-140-1 with key (No. 200)	
	Panel thickness			Basic structural materials: 2.3mm or thicker; Interior cover / Mounting plate for instruments: 1.6mm or thicker	
	Interior lighting, space heater			None	Applied
Panel nameplate (front only)				Acrylic, black letters on white background, 63 × 315mm	
Accessories	Standard accessories			Manual generator device for VCB operation × 1; DS / ES operating handle × 1; Auxiliary gas set (adapter × 1, nylon hose × 1(5m)); Accessory box × 1	
	Options			Insulation gas for restoration; Pressure reduction valve; Adapter for pressure reduction valve	

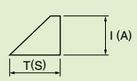
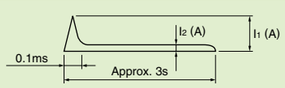
Standard Base Diagram



†1 Embedded channel base, foundation bolt and weld are not supplied.

Cautions Installation space depends on the type of skeleton structure; please contact a Mitsubishi Electric representative for details.

Auxiliary Power Capacity (110VDC)

Equipment		Capacity	
VCB Electrical-magnet operation	Capacitor charging current		110VDC For opening: I=8.5A, T=3s For closing: I=8.5A, T=13s
DS (For motor operation)	Control power	110VDC 0.5A	
	Motor operation current		110VDC Current: I₁=30A, I₂=2A
Manual operation for DS / ES	Only during shutter open	110VDC 0.2A	

Devices Disconnected During Power Cable DC Withstand Voltage Testing

The switchgear main circuit and cables are constructed so that they can be disconnected without gas processing. When the power cable DC withstand voltage test is performed, this allows DC voltage to be applied to the power cables and cable sealing end only (power-receiving part is standard and other parts are optional).

- Fig. (a) shows the state during normal operation.
- Fig. (b) shows the state of the lightning arrester disconnected when the switchgear main unit AC withstand voltage test is conducted.
- Fig. (c) shows the state of the switchgear main unit, lightning arrester and cable disconnected when the power cable DC withstand voltage test is conducted. The voltage necessary for the DC withstand voltage test can be applied by connecting the cable for testing to the applied voltage opening on the cable sealing end.
- HG-VA and HG-VG are operated in the same way.

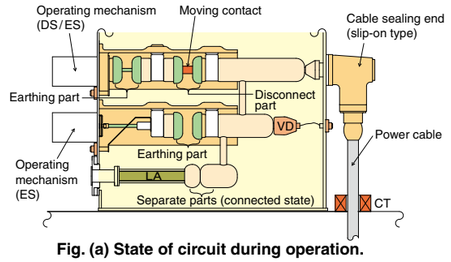


Fig. (a) State of circuit during operation.

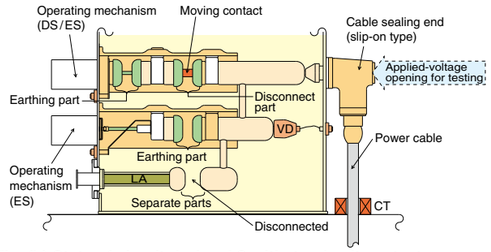


Fig. (b) State of circuit during AC withstand voltage test.

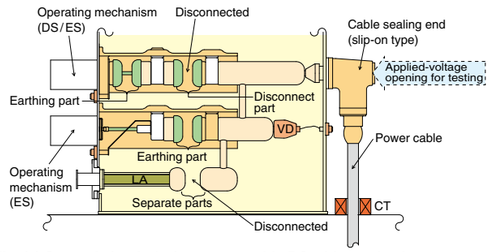


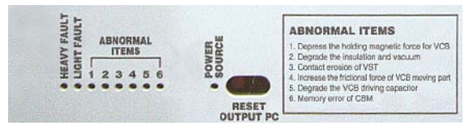
Fig. (c) State of circuit during power cable DC withstand voltage test.

Option

CBM (Condition Based Maintenance) System

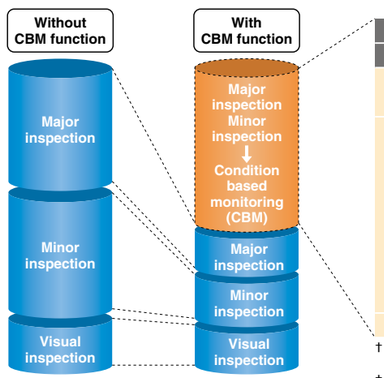
CBM system is the maintenance system based on the equipment condition. It has two advanced points compared to Time Based Maintenance system requires periodical maintenance.

1. Prevention of accidents by early detection of malfunction
2. Reduction of life cycle cost



CBM function unit

Example of maintenance Item



Main periodical inspection item		Items automatically monitored by CBM
Class	Part	
Switchgear	Insulation, gas pressure†2	• Partial discharge monitoring†1
VCB	Vacuum interrupter (contact erosion,degree of vacuum)	• Analysis of driving current • Partial discharge monitoring†1
	Electro-magnetic operating mechanism	• Analysis of driving current
	Controller	• Charge voltage of capacitor
	Control circuit for drive	• Analysis of driving current
	Control P.C.B.	• CPU fault self-monitoring
	Driving capacitor	• Time properties of discharging
DS	Operating mechanism	• Operating monitoring

†1 There are cases when partial discharge monitoring cannot be applies, in some cases of noise level from outside system of panel.
†2 Gas pressure is monitored with gas densimeter.

Regarding periodical maintenance

For conditions not monitored by the CBM function, periodical inspections equivalent to those conducted conventionally, including field, minor and major inspections, are required.

JP Pat No.4682046
Others, two patents in Japan and thirteen patents in seven different countries (CN, HK, TW, KR, US, TH, DE).