for a greener tomorrow

MITSUBISHI ELECTRIC

Changes for the Better

Low Voltage
Motor Control Center Type-D

LV MCC Type-D (MCC-D)

GLOBAL IMPACT OF MITSUBISHI ELECTRIC

Through Mitsubishi Electric's vision, "Changes for the Better" are possible for a brighter future.

Changes for the Better

We bring together the best minds to create the best technologies. At Mitsubishi Electric, we understand that technology is the driving force of change in our lives. By bringing greater comfort to daily life, maximizing the efficiency of businesses and keeping things running across society, we integrate technology and innovation to bring changes for the better.

Mitsubishi Electric is involved in many areas including the following

Energy and Electric Systems
A wide range of power and electrical products from generators to large-scale displays.

Electronic Devices
A wide portfolio of cutting-edge semiconductor devices for systems and products.

Home Appliance
Dependable consumer products like air conditioners and home entertainment systems.

Information and Communication Systems
Commercial and consumer-centric equipment, products and systems.

Industrial Automation Systems
Maximizing productivity and efficiency with cutting-edge automation technology.

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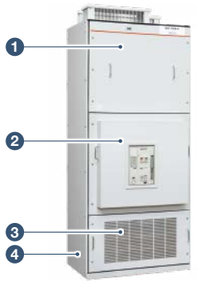
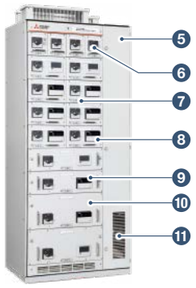
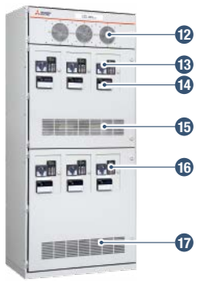
†1: EMC-B: Electronic Multi-function Motor Controller Type-B.

1 Outline of Low-Voltage Motor Control Center Type-D (MCC-D)

With a solid reputation as a pioneer of motor switchgear, Mitsubishi Electric leverages its cutting-edge technology to propose a new concept.

■ System overview

Low-Voltage Switchgear	Controlgear	Inverter Panelboard
<Scope> Controls and protects devices for power generation, power transmission, power distribution and electrical energy conversion, as well as devices that consume electrical energy. ■ **Function** • Incomer • Outgoing feeder • Coupler (bus tie, bus riser)	**<Scope>** Controls and protects motors and resisters connected to low-voltage electric circuits. ■ **Function** • Power feeder • Motor starter (Non-reversible, Reversible, Star/Delta)	**<Scope>** Freely changes the motor's power frequency and intricately controls motor RPM. ■ **Function** • Motor starter (Non-reversible)
<Features> ■ Rated busbar current (Horizontal) • Incomer: 690V, 4000A, 85kA/1s ■ Air circuit breaker (ACB) max ratings • Incomer & Bus tie: 690V, 4000A, 85kA • Outgoing feeder: 690V, 2000A, 65kA ■ ACB main circuit and control circuit • Automatic connection type ■ Form of internal separation: up to Form 4b†1 ■ Internal arc withstand current: 690V, 85kA / 0.3s ■ Arcing class classification: Arcing class B†4	**<Features>** ■ Rated busbar current (Horizontal) • Incomer: 690V, 4000A, 85kA/1s ■ MCC unit max ratings • Power feeder: 480V, 400A, 65kA, (85kA†6) • Motor starter: 480V, 200kW, 65kA, (480V, 132kW, 85kA†6) ■ Unit main circuit and control circuit • Automatic connection type and fixed type ■ Form of internal separation: up to Form 4b†2 ■ Internal arc withstand current: 480V, 65kA / 0.3s, (85kA / 0.3s†6) ■ Arcing class classification: arcing class B†4 ■ Communication • Modbus®-RTU†5 & CDL Transmission	**<Features>** ■ Rated busbar current (Horizontal) • Incomer: 690V, 4000A, 85kA/1s ■ Inverter unit max ratings • Motor starter: 500V, 280kW ■ Form of internal separation: Form 2b †3 ■ Transmission system • Frequency control • Measurement value monitoring • Motor operation control • Parameter settings ■ Communication • CDL Transmission
		
<Main Assembly> ❶ Front top cover ❷ ACB cover ❸ Bottom cover ❹ Side cover	**<Main Assembly>** ❺ Cable compartment ❻ 1/4 Unit ❼ MCCB ❽ 1/2 Unit ❾ EMC-B ❿ 1/1 Unit ⓫ Ventilation	**<Main Assembly>** ⓬ Fan ⓭ MCCB ⓮ EMC-B ⓯ Ventilation ⓰ Parameter unit ⓱ Ventilation

†1: Form 4b: Standard feature. For details, please see P19 (2) Form of internal separation.
†2: Form 4b: Standard feature. For details, please see P17 (9) Form of internal separation.
†3: Form 2b: Standard feature. For details, please see P23 (2) Form of internal separation.
†4: Arcing class B: Optional. For details, please see P21 †1 Arcing class B evaluation criteria.
†5: Modbus®-RTU is a registered trademark of Schneider Automation Incorporated.
†6: To be released later.

■ Field applications (examples)

MCC-Ds are being utilized as power distribution equipment for various plants depending on control schemes desired in various fields.

Chemical plants

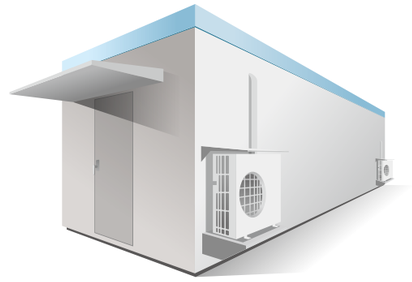
Steel plants

Power plants

Public utility

Supporting one-sided installation for package house-type electrical rooms,†7 which are increasingly being used at overseas plants.

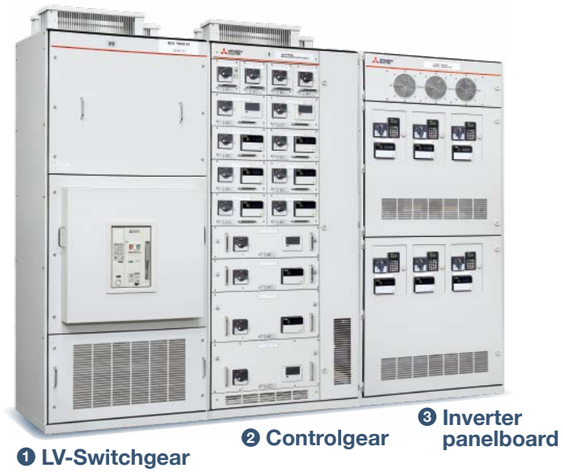
Package house



†7: A container-type electrical room transport-ready and installation–ready with electrical devices mounted inside modular-type housing.

2 MCC-D Features

IEC61439-1/2-compliant, space-saving and advanced utility and usability to meet the needs of the times.



■ Front Operation/Maintenance

- Enabling operation and maintenance from the front through revised part layout and installation method.
- Front operation/maintenance is possible, making this product optimal for wall mounting in general power rooms and package house-type power rooms †1.
  (see page 9 2.3 (1) for details)
- The withdrawable unit is equipped with an auto-connect function for the main circuit and control circuit.
  ❶ LV- Switchgear
  ❷ Controlgear

■ Space-saving

- By using the same frame for individual housings ❶ through ❸, we have reduced the footprint compared to our conventional products with identical specifications. Footprint has been reduced by 45%.
  (see page10 2.3 (2) for details)

■ High-capacity storage

- Each panel stores up to 40 of the newly-developed compact units.
  ❷ Controlgear
- Busbar energizing current has been improved by 2-fold due to a new one-sided structure, and up to 6 units can be stored on each panel.
  ❸ Inverter panelboard

❶ LV-switchgear ACB

❷ Controlgear withdrawable unit

❸ Inverter unit

■ Flexibility

- Also responds flexibly to changes in unit rating on the shop floor.
  ❷ Controlgear (Withdrawable unit)
  ❸ Inverter panelboard (1/6 (DL6), 1/4 (DL4), 1/2 (DL2) unit)

†1: Needs to be at least 50mm from the wall.

■ Safety

- Complies with internal separation Form 4b †2 of IEC 61439-1/2
  ❶ LV- Switchgear, ❷ Controlgear
- Complies with internal separation Form 2b †3 of IEC 61439-1/2
  ❸ Inverter panelboard
- Supports IEC TR61641 Internal Arc Fault (Option)
  Arcing class classification: Arcing class B †4
  ❶ LV- Switchgear
  ❷ Controlgear

■ Operation/maintenance/motor deterioration diagnosis support

- EMC Type-B (EMC-B) not only enables direct operations and collection of operation-related information, but also features a transmission system making it possible to control the operations of devices and equipment remotely and collect information thereof. (Complies with the latest IEC61439-1)
- EMC Type-B (EMC-BA-PRO) can perform diagnosis to determine the level of deterioration of a motor's mechanical components (bearing faults, etc.) and electrical components (layer short faults).
- Communication (Option)
  ❷ Controlgear ⇒ CDL transmission system, Modbus®-RTU transmission system
  ❸ Inverter panelboard ⇒ CDL transmission system

EMC-B

Secure

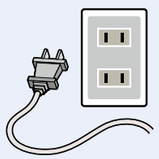
- Equipped with the latest security mechanisms

Easy Operation

- Simple to use
- Quick learning process

Energy-saving

- Features LCD "Normally OFF" mode
- Measures electrical energy
- Features 0-1mA DC current output
- Uses a low-capacity regulating transformer



Expanded User Support

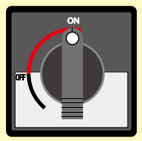
- Provides 3-mode restart function after instantaneous voltage drops
- Provides running time/count-based alarms
- Permits setting of target current
- Ample test functions

■ Universal design

- The visibility of the MCCB operation panel and color tone/writing on LED displays has been improved, making it possible to visually confirm operating status even from a distance.

Japanese Patent No.4932009
Japanese Patent No.5008729

MCCB



EMC-B

†2: Form 4b: For details, please see P17 (9) Form of internal separation and P19 (2) Form of internal separation.
†3: Form 2b: For details, please see P23 (2) Form of internal separation.
†4: Arcing class B: Optional. For details, please see P21 †1 Arcing class B evaluation criteria.

2 MCC-D Features

2.1 Specifications

■ Panel Specifications

Items		Rated		
		Switchgear	Controlgear	Inverter panelboard
Applied standard		IEC61439-1/2		
Motor control center construction		Front access		
Rated insulation voltage		1000V		
Rated busbar current (Horizontal)		800A, 1000A, 1200A, 1600A, 2000A, 2500A, 3200A, 4000A		
Rated voltage		Up to 690V		
Bus System		3ø3W / 3ø4W		
Rated short-time withstand current (Horizontal busbar, Vertical busbar)		Up to 85kA / 1sec		
Form of internal separation		4b (†2)	4b	2b
Rated frequency		50/60 Hz		
Degree of protection		Up to IP43		Up to IP41
Unit Connection method	Main circuit	Automatic type	Automatic type/Fixed type	Fixed type
	Control circuit			
Insulated busbar (†1)		Horizontal busbar	Horizontal busbar/Vertical busbar	Horizontal busbar
Earth busbar		Horizontal	Horizontal/Vertical (†3)	Horizontal
Internal arc withstand current (†1) (†4)		85kA/0.3sec at 690V	65kA/0.3sec, (85kA/0.3sec (†8)) at 480V	———
Arcing class classification (†1) (†4)		Arcing class B		———
Unit capacity		By the unit capacity of the following		
Location		Indoor		
Height (†5)		2370mm	2370mm	2200mm
Depth (†5)		600mm	600mm	600mm
Width (†5)		800 to 1300mm	1000mm	1000mm

■ Unit Capacity

(Unit rating / Breaking current)

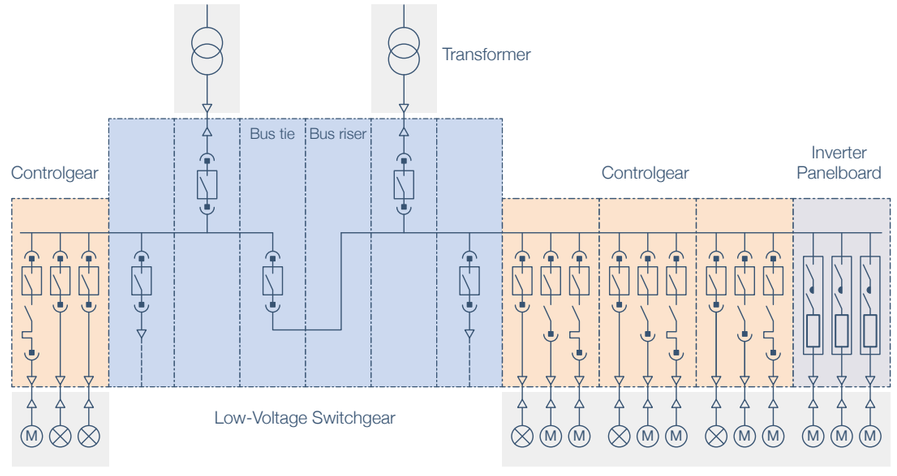
Short-circuit protection device		ACB (†6)	MCCB			Inverter
Rated voltage		Up to 690V	Up to 460V	Up to 480V		Up to 480V
Coordination for protective devices		———	Type 1 (†7)	Type 1 (†7)	Type 2 (†7)(†8)	———
Automatic connection unit	• Incomer • Bus tie • Bus riser	Up to 4000A/ 85kA	———	———	———	———
	• Outgoing feeder	Up to 2000A/ 65kA	———	———	———	———
	• Power feeder unit	———	Up to 400A/ 50kA	Up to 400A/ 65kA	Up to 400A/ 85kA	———
	• Motor starter unit	———	Up to 200kW/ 50kA	Up to 200kW/ 65kA	Up to 132kW/ 85kA	———
Fixed unit	• Power feeder unit	———	Over 400A to 2000A/50kA	Over 400A to 2000A/65kA	Over 400A to 2000A/85kA	———
	• Motor starter unit	———	Over 200kW to 300kW/50kA	Over 200kW to 300kW/65kA	Over 132kW to 300kW/85kA	up to 280kW/ 65kA

(†1): Option
(†2): The standard (Form 4b) applies to "Incomer", "Outgoing feeder" and "Bus tie" (includes Bus riser).
(†3): Only Vertical Earth busbar is optional. Horizontal Earth busbar is a standard feature.
(†4): Applied standard: IEC TR61641
(†5): Please refer to P10 (2) Space-saving structure installation dimensions.
(†6): Applied standard: IEC60947-2
(†7): The short circuit protection device and starter degrees of damage (coordination) stipulated in IEC60947-4-1 are defined as Type 1 and Type 2.
Type 1: A short circuit on the device must not result in personal or property damage. However, the device does not have to be capable of ongoing usage without first conducting part repairs or replacement.
Type 2: A short circuit on the device must not result in personal or property damage. In addition, it must be possible to continue using the device.
(†8): To be released later.

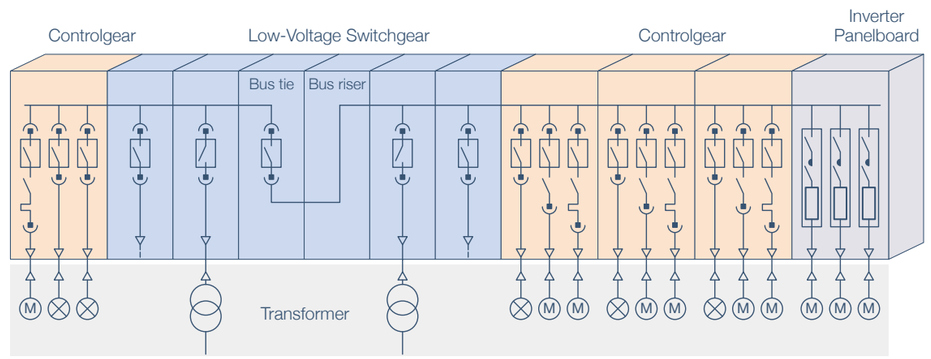
2.2 Arrangement

■ MCC-D Arrangement

Single-Line Diagram (example)



Panel Layout (example)



2.3 Installation

(1) Package House-Type Electrical Room Storage

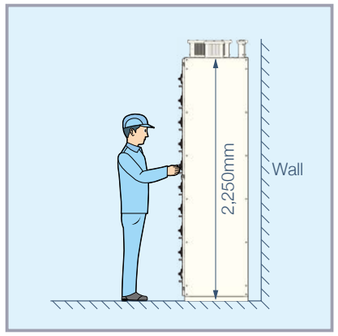
Enables installation in compact, space-restricted electrical rooms and package houses (located on panel rear wall)

■ Package House-Type Electrical Room

- Can be transported "as is" with electrical devices already mounted
- Electrical room with a container-shaped structure in which the electrical devices are mounted on a wall, realizing the use of a single surface (face)
- All tasks, operations and maintenance can be performed from the front, simplifying operation and maintenance

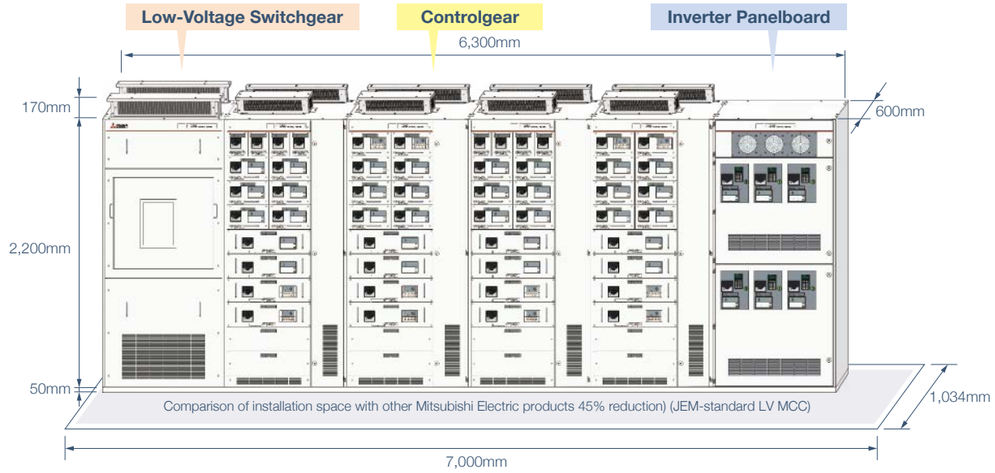
Package house-type electrical room interior

Front access/maintenance



Package House-Type Electrical Room

(2) Space-saving Structure



(3) MCC-D Installation Space (example)

6-panel arrangement †1 offers 45% reduction compared to a conventional model with the identical number of units and unit size.

■ Low-Voltage Switchgear Structure

- For the MCC-D the rear dead space and busbar conversion panel size have been reduced through integration and making the depth dimension and busbar structure the same cabinet height as the conventional product. Effectively utilizing the space in the direction of depth reduces installation space requirements to 20% less than that required for conventional models.

■ Controlgear Structure

- Efficient unit storage has been achieved through the development of compact controlgear (1/4 unit, 1/2 unit, 1unit), and installation space has been reduced by 10% compared to conventional models.
  (10% reduction of 5 panels ⇒ 4 panels)
- Maximum storage of the 1/4 unit (power feed: 30A×40 units) has been improved to 40 units/panel using the conventional cabinet width.

■ Inverter Panelboard Structure

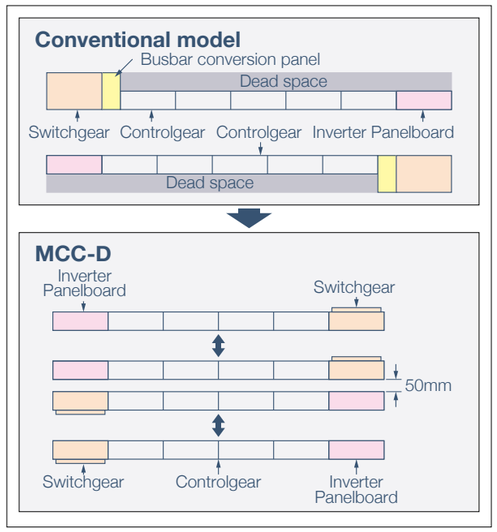
A new cabinet shape has been introduced to achieve a one-sided design enabling operation and maintenance to be performed from the front side.
The rated busbar current has been increased from the conventional 2000 A to 4000 A, therefore up to 6 1/6 (DL6) units (7.5kW) can be stored per panel.

†1: 6-panel arrangement (table on right)
- Low-Voltage Switchgear (1 panel)
- Control Gear (4 panels) (refer to unit specifications)
- Inverter Panelboard (1 panel) (refer to unit specifications)

†2: 1/1 Unit is Full-width unit.

MCC-D (6-panel arrangement) unit specifications

Unit name	Q'ty	Type name	Rated value
ACB	1	————	4000A
Motor starter unit	24	1/2 Unit	5.5kW
	4	1/1 Unit †2	37kW
	4	1/1 Unit †2	55kW
Power feeder unit	8	1/4 Unit	30AT
	4	1/2 Unit	50AT
	4	1/1 Unit †2	100AT
	4	1/1 Unit †2	225AT
Inverter unit	6	1/6 Unit	7.5kW



2.4 Structure

(1) Casing Construction

■ Thin, one-side structure (panel depth: 600mm)

- The back is of a panel structure and space has been saved in the electrical room by installing the panel's rear face alongside the wall. Maintenance can be performed from the front of the panel.

  † Rear panel must be positioned at least 50mm from the wall to prevent condensation.

■ Safe, compartment-like structure

- Between units and between busbar compartment and unit, there is a dividing metal. People and device protection grade complies with IEC 60529.(LV-Switchgear and Controlgear comply with IEC standard Form 4b)
- Unit chamber and wiring duct chamber are separated, therefore wiring tasks can be performed safely and easily.

  † The Controlgear's compartment is used for explanatory purposes

■ Easy installation

- Cabinet panels can be transported one at a time.
- The cables of the main circuit and control circuit can be routed either at the top or bottom.
- The horizontal busbar/earth busbar connection can be made from the front of the cable compartment.

(2) Busbar Construction

■ Horizontal Busbars

- Busbar current rating: 1000A - 4000A
- Horizontal busbars can be arranged vertically
- Horizontal busbars are plate.
  1) Tin-plated : Standard
  2) Silver-plated : Option

  † The Controlgear's busbar structure is used for explanatory purposes

■ Busbar support

- Busbars are secured with unsaturated polyester resin molded supports having excellent arc-resistance and tracking resistance.

  † The Controlgear's support is used for explanatory purposes

■ Horizontal busbar/Earth busbar connection

- Press-fit type press nuts and nut plates are used on the busbar therefore it is possible to connect the conductor simply by securing with bolts applying the appropriate torque from the front of the machine.
  1) Horizontal busbar : press nut and nut plate
  2) Earth busbar : press nut

■ Earth busbar

- Grounding of the housing, compartment and devices are ensured with the horizontal earth busbar (cross-section: 300mm^2)

  † The Controlgear's vertical earth busbar is used for explanatory purposes

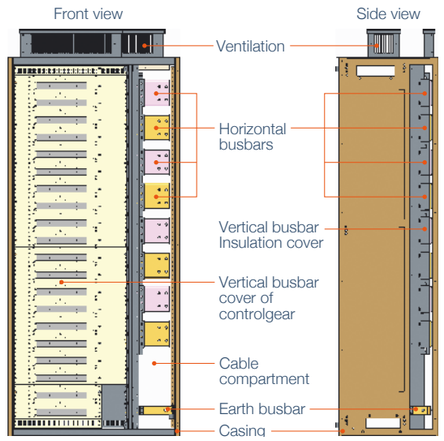
Option

1) Horizontal insulated busbar

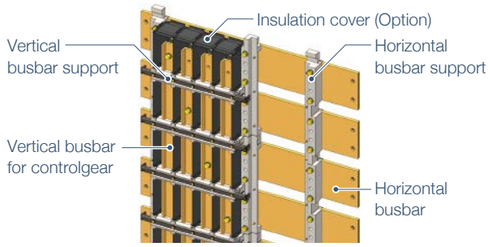
Japan production	Epoxy resin coating (FBC) and or PVC insulated tubing
Overseas production	PVC insulated tubing

2) Vertical insulated busbar: Resin-molded case

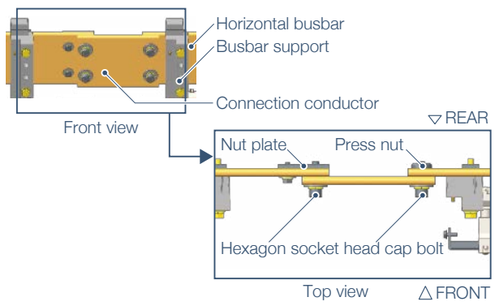
†1: Option



Horizontal/vertical busbar connection



Horizontal busbar connection detailed view



Earth busbar detailed view of Controlgear

Front view Side view

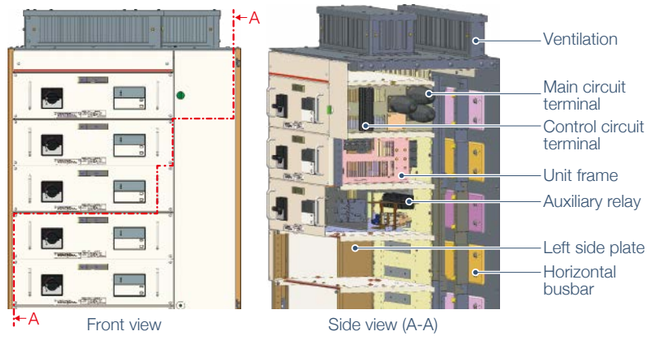
❶ Horizontal Earth busbar
❷ Vertical Earth busbar †1

2.5 Features of Controlgear

(1) Controlgear Construction

■ Housing structure and functions

- The metal housing, compartment and unit frame are grounded to the earth busbar.
- The compartment comprises of the unit, main circuit and cable.
- The compartment complies Form 4b †2 of IEC-61439-2.
- The compartment can be drawn out during operation by cutting power to the relevant feeder unit, with no need for a busbar power stop, as per IEC-61439-2.
- Inspections, setting changes and tests can be performed on a stand-alone unit.
- Unit arrangement and capacity are adjustable.



Front view Side view (A-A)

■ Simple planning

- Unit layout can be planned and changed freely in height increments of 100mm.

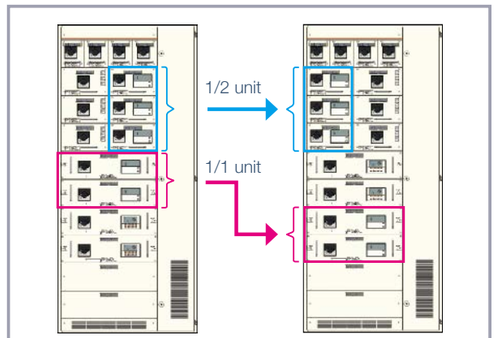
  † See the Unit Selection tables (P59-60) for unit sizes.

Unit Specifications (Controlgear)

		1/4 Unit		1/2 Unit		1/1 Unit	
Unit type							
		Power feeder	Motor starter	Power feeder	Motor starter	Power feeder	Motor starter
Dimensions (Height)	200mm	Up to 30A	———	Up to 63A	Up to 22kW	Up to 225A	Up to 55kW
	300mm	———	———	———	———	Up to 225A	Up to 90kW
	400mm	———	———	———	———	———	Up to 90kW
	600mm	———	———	———	———	Up to 400A	Up to 132kW
	1000mm	———	———	———	———	———	Up to 200kW

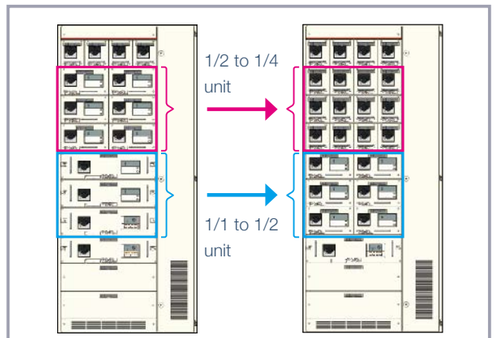
■ Flexible unit arrangement †3

- Arrangement of each rating unit can be changed without interrupting busbar power. (1/4, 1/2, 1/1 Unit)



■ Flexible unit capacity †3

- Load capacity can be changed through junction connection of the distributor and busbar. (1/4, 1/2, 1/1 unit)



†2: Form 4b: For details, please refer to P17 (9) Form of internal separation.

†3 CAUTION Before changing the layout and unit capacity, it is necessary to confirm compatibility between MCC's panel and unit.
(1)Rated and specifications (2)Main and control circuit details.

2.5 Features of Controlgear

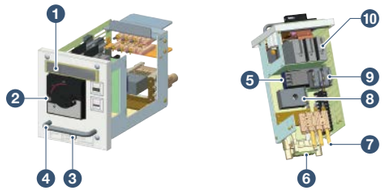
(2) Unit Detail

- ■ A circuit-breaker (MCCB) and EMC-B operating device are equipped on the front of the unit.
- ■ A main circuit junction and control circuit connector are equipped on the rear of the unit.
- ■ An electromagnetic contactor, control transformer, ZCT, auxiliary relay, leakage relay, fuse, etc. are equipped inside the unit.

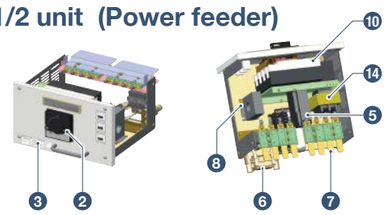
< Names of parts >

❶ Unit nameplate
❷ MCCB operating handle
❸ Center latch
❹ Unit handle
❺ Leakage relay
❻ Control connector
❼ Main circuit junction
❽ ZCT
❾ Fuse
❿ MCCB
⓫ CT
⓬ EMC-B
⓭ Electromagnetic contactor
⓮ Control transformer
⓯ Side latch
⓰ Operation handle port
⓱ Auxiliary relay

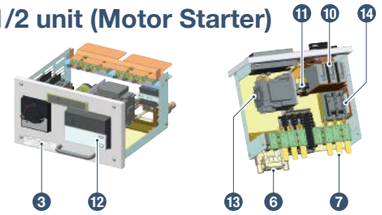
■ 1/4 unit (Power feeder)



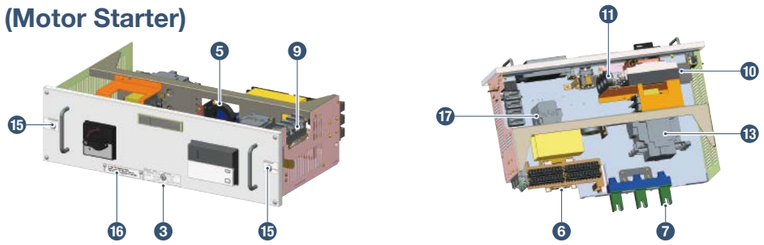
■ 1/2 unit (Power feeder)



■ 1/2 unit (Motor Starter)



■ 1/1 Unit (Motor Starter)

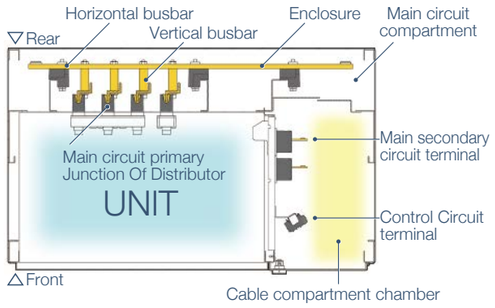


(3) Vertical busbars (tin-plated, Z-shaped busbar)

- Busbar current rating: 1000A
- The distributor's main circuit junction is connected to the vertical busbar.

Vertical busbar support detailed view

Top view of control gear (Horizontal sectional view)



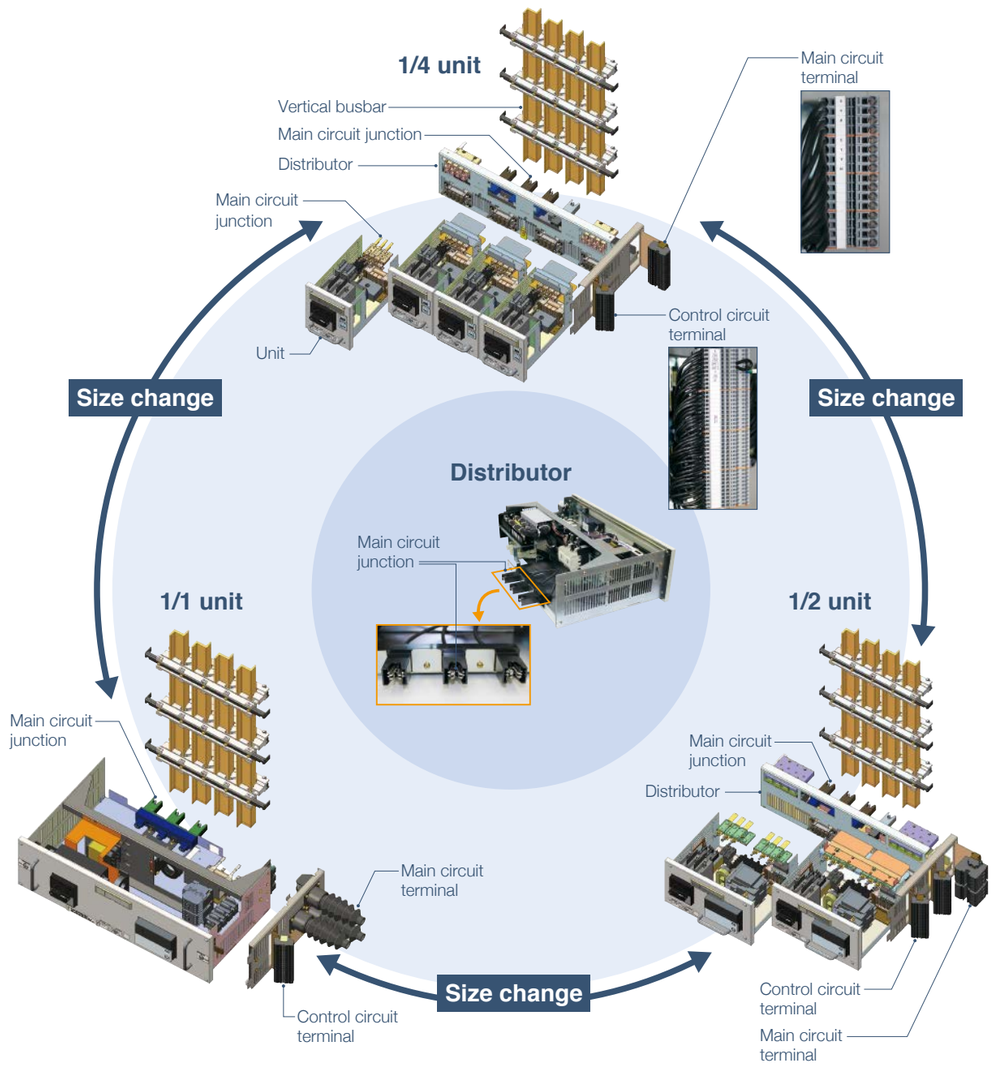
(4) Unit Size Alteration

- ■ Connection between the power source side and load side.
  The 1/1 Unit module is connected to the power source side in a different way than the 1/4 and 1/2 unit modules.
- In the case of 1/4 and 1/2 units, the unit junctions connect with the vertical busbar through a distributor.
- In the case of the 1/1 Unit module, the unit junctions connect directly on the vertical busbar.
  For all units, the load side (main circuit/control circuit) uses an external cable to the distributor terminal.

- ■ Changing Unit Size.
  A different-sized unit can be used by replacing the distributor between the vertical busbar and unit.

  Size changes: 1/4 unit ⇔ 1/2 unit ⇔ 1/1 Unit

  Junctions are used to connect the distributor to the power source side, therefore no troublesome positioning adjustment is required upon replacement – simply connect.



2.5 Features of Controlgear

(5) Unit Insert / Withdraw Mechanism

The unit main circuit junction and control connector automatically attaches and detaches when conducting unit attachment and detachment operations.

❶ Connected position:

This is when the main circuit and control circuit are electrically connected.

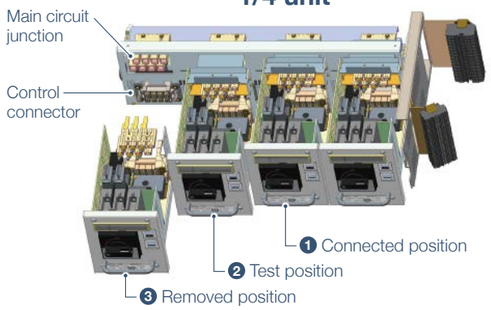
❷ Test position:

This is when only the control circuit is electrically connected.

❸ Removed position:

Both the main and control circuits are electrically disconnected and the unit can be removed from the cabinet.

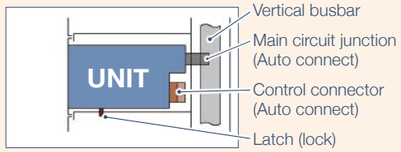
1/4 unit



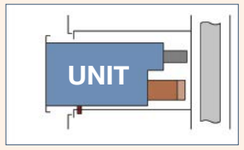
Main circuit junction/control connector connection status (automatic)

Unit position	Main circuit junction	Control connector
Connected	Connected	Connected
Test	open	
Removed		open

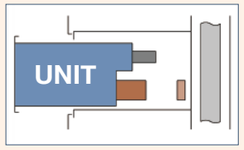
❶ Connected position



❷ Test position



❸ Removed position



A latch (lock) at the bottom of MCC unit is provided to secure the unit in connected position and test position.

Short-circuit protection devices can be switched on/off when the unit is set in connected, test or removed position (cannot when in-between either of these positions).

* Short-circuit protection devices
- MCCB

(6) Insert / Withdraw Latch Operation

The unit has a latch mechanism with a connected position, test position and removed position.

Unit Specifications (Controlgear)

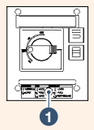
Latch positions	Operation contents
LOCK	• Locks in connected position • Locks in test position
INSERTION	• Test position ⇒ Connected position • Removed position ⇒ Connected position
PULL	• Connected position ⇔ Test position
WITHDRAW	• Moves between connected position and Removed position

❶ Center attachment latch mechanism †1

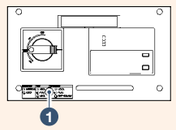
❷ Side attachment latch mechanism †2

Arrow

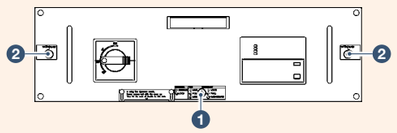
1/4 unit



1/2 unit



1/1 unit

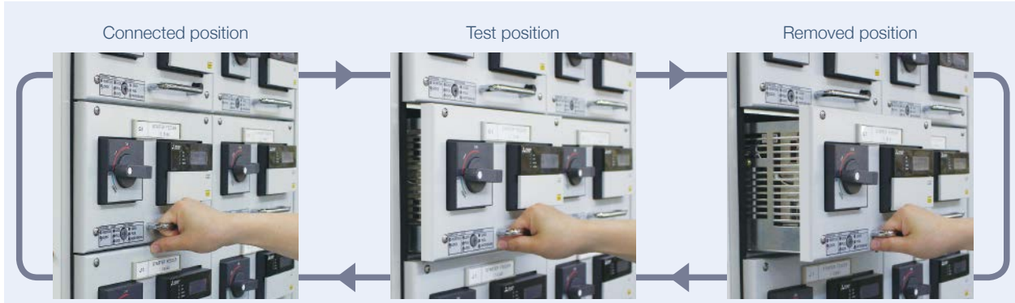


†1: The center latch mechanism is a standard feature.
†2: The side latch mechanism is only installed if the unit frame is 1/1 unit/Type D4 or higher, the protection grade is IP41 or higher and there is a internal arc fault measure.

(7) Unit Insert / Withdraw Operation

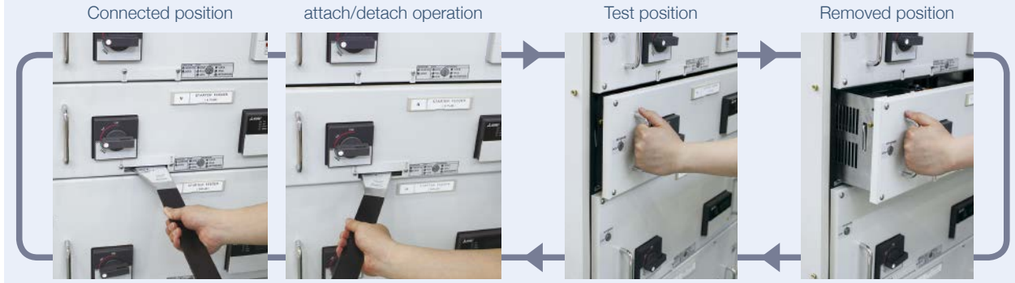
■ Insert/Withdraw for 1/4 and 1/2 units

These small units can be easily changed between connected position and test or removed positions by manual operation.



■ Insert / Withdraw operation of 1/1 Unit

A handle is used to release the unit from connected position, after which it can easily be changed to test or removed positions by manual operation. The same handle will be used to put the unit back to connected position.



Unit attach/detach operation

■ Operation handle for inserting/withdrawing unit

Two types of operation handles for inserting/withdrawing the unit have been prepared to match the operating force. Handle operation is easy thanks to the inclusion of a horizontal shaft.

Operation Handle for inserting/withdrawing unit (up to 225A)

Operation Handle for inserting/withdrawing unit (400A)

2.5 Features of Controlgear

(8) Ingress Protection

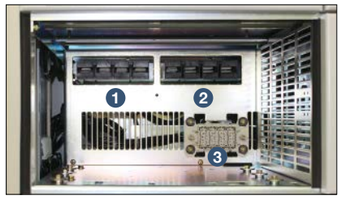
IP2XXB level protection is possible against random contact with energized portions of the main circuit when the 1/4 and 1/2 units are withdrawn from the panel

❶ Vertical bus junction
❷ Outgoing junction
❸ Control connector

Controlgear compartments for withdrawable units

1/4 unit

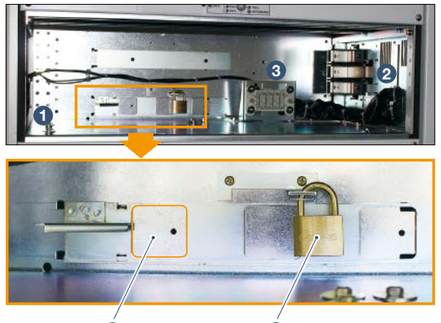
1/2 unit



In order to maintain the protection level for large-capacity 1/1 Unit module's compartment when unit is withdrawn from the panel, an automatic shutter mechanism on the vertical busbar connection opening may be applied.

❹ Automatic shutter

1/1 unit



Option
- Automatic shutter mechanism of 1/1 Unit module

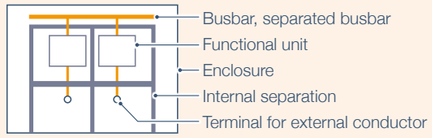
Provided by Customer
- ❺ Padlock

(9) Form of Internal Separation (Form 4b)

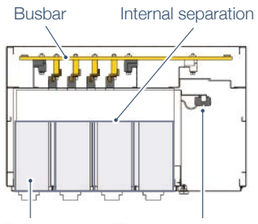
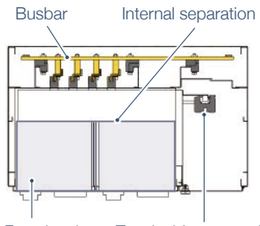
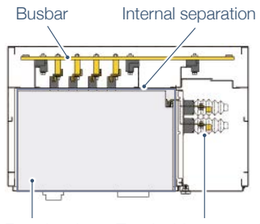
■ Form 4b

- Based on IEC 61439-2 Form 4b, there must be separation between the functional unit, busbar, the terminal for external conductor and each functional unit, and the terminal for the external conductor is not located inside the same compartment as the functional unit(s) it is connected to.
- Stored inside a closed protected space and inside a compartment.

Form 4b of internal separation



The diagrams below show the internal separation (Form 4b) for the MCC-D.

Unit name	1/4 unit	1/2 unit	1/1 unit
Form (4b) Internal separation			

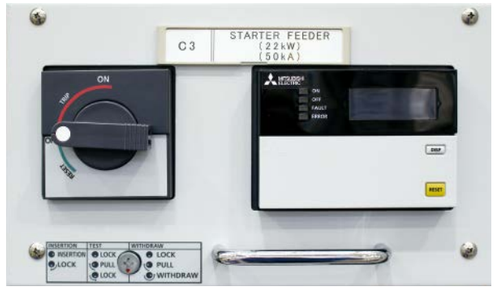
(10) MCCB Lock

On the MCCB operating handle, a locking rod †1 or padlock may be attached in either ON or OFF positions.
Up to three padlocks can be used.

Option
- locking rod

Provided by Customer
- Padlock

1/2 Unit Front Panel



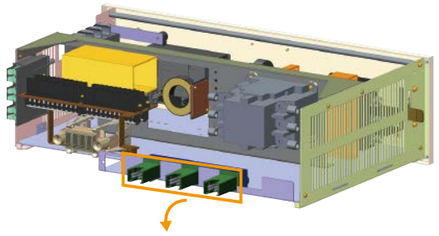
locking rod
(Option)

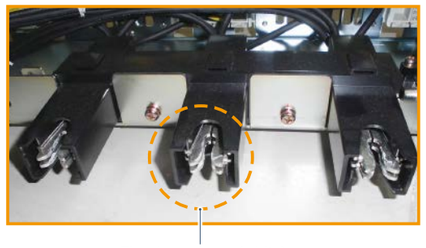
Padlock
(Prepared by customer)

(11) Unit Easy Maintenance

Use of Long-lasting Grease in the Power-supply Junction

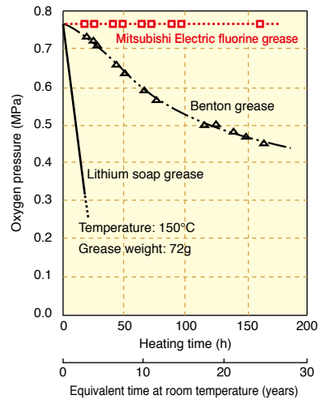
Mitsubishi Electric's original fluorine grease is used at contact points for energizing the power-supply junction.
The oil content of the grease tends to resist evaporation, and the grease is characterized by its resistance to oxidization, in certain condition retaining its initial state for 30 years or more, as verified by testing.





Fluorine grease (white)

Unlike conventional grease, which tends to cake and necessitates a great deal of labor for removal and re-application, the new grease remains highly lubricative, hence significantly reduces the maintenance work. (In practice, contamination by foreign matter/dust still requires routine maintenance.)



Deterioration test (JIS K2220)

In general, the oxygen pressure tends to drop as grease bonds with oxygen and as a result deterioration progresses. Mitsubishi Electric fluorine grease is characterized by its resistance to oxidation and deterioration.

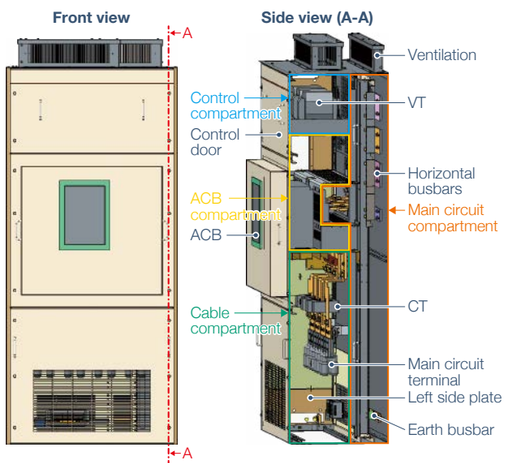
†1: One locking rod is included per arrangement.
Additional locking rods can be purchased (option).

2.6 Features of Low-Voltage Switchgear

(1) Construction

■ Structure and Functions of Housing

- The fixed frame of the metal housing, compartment and air circuit breaker (ACB) are grounded to the earth busbar.
- The compartment comprises of the control, ACB, cable and main circuit.
- The compartment is separated from other areas with a grounded metal partition.
- The compartment complies Form 4b of IEC-61439-2.
- For the LV-Switchgear, cable can be routed either from the top row or bottom row.
  (the housing shown to the right has cable routed from the bottom.)
- It is possible to mount measuring instruments, switchover switches, etc. to the control door. However, the door shape may change depending on the shape of the mounted apparatus.
- The ACB can be moved to test position /disconnected position with the front cover attached.
  As such, the LV-Switchgear's IP grade is not impacted.



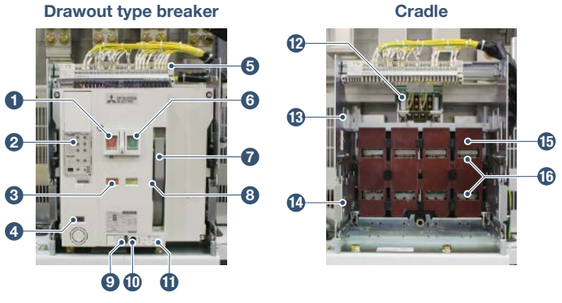
(2) Form of Internal Separation (Form 4b)

■ Form 4b

- For details, please refer to P17 (9) Form of internal separation

(3) Air circuit breaker (ACB) compartments (arcing class B)

- The ACB compartment comprises of the ACB and fixed frame (main circuit terminal block, control circuit terminal block, drawout rail).
- The ACB is a drawout type, with primary/secondary circuit automatic connection.



1. OFF button
2. Electronic trip relay
3. ON/OFF indicator
4. Counter
5. Control circuit terminal block
6. ON button
7. Charging indicator
8. Charging indicator
9. Position lock
10. Aperture for the drawout handle
11. Drawout position indicator
12. Cell switch(CL)
13. Cradle
14. Extension rail
15. Safety shutter (Option)
16. Main-circuit terminal

(4) ACB Insert / Withdraw Operation

There are four operating positions involved in the insertion and withdrawal of the ACB.
By rotating the drawout handle, the ACB can easily be moved between the ❶ connected position, ❷ test position, and ❸ disconnected position. The ACB is moved manually from the ❹ disconnected position to the ❺ drawout position.

■ ACB operation positions

❶ **Connected position:**
The main circuit and control circuit of the ACB and panel-side fixed frame are connected (capable of operation)

❷ **Test position:**
The ACB's main circuit terminal is disconnected from the panel-side fixed frame, and the control circuit terminal is connected. The ACB can be opened and closed electrically.

❸ **Disconnected position:**
Both the ACB's main circuit terminal and control circuit terminal are disconnected from the panel-side fixed frame.

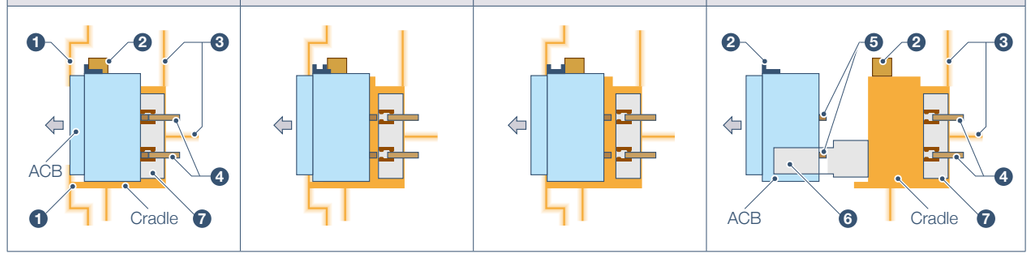
❹ **Drawout position:**
The ACB is drawn out of the panel from the disconnected position using the drawout rail of the fixed frame.
<Safety measure>
When the ACB is drawn out of the panel, the shutter of the panel-side fixed frame lowers automatically and covers the live portions of the main circuit (option).

ACB Front Panel

Operating position of drawout type

Structure of panel when cable is routed from the bottom.

❶ Connected position	❷ Test position	❸ Disconnected position	❹ Drawout position
• Main circuit : CONNECTED • Control circuit: CONNECTED	• Main circuit : DISCONNECTED • Control circuit: CONNECTED	• Main circuit : DISCONNECTED • Control circuit: DISCONNECTED	• Main circuit : DISCONNECTED • Control circuit: DISCONNECTED

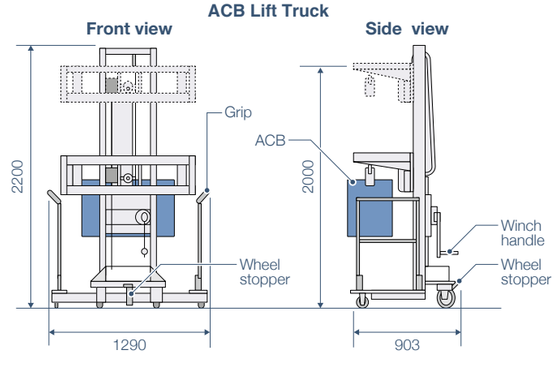


❶ Panel side ACB cover ❷ Control circuit terminal block ❸ Partition plate ❹ Main circuit terminal
❺ Main circuit conductor ❻ Extension rail ❼ Insulated base

■ ACB Lift Truck (Option)

[1] Easy loading/unloading of the distribution panel's ACB and transportation of the ACB.
[2] The ACB Lift Truck can move in all directions, including front/back/left/right.
[3] The ACB Lift Truck can carry ACBs weighting up to 1960N (200kgf).

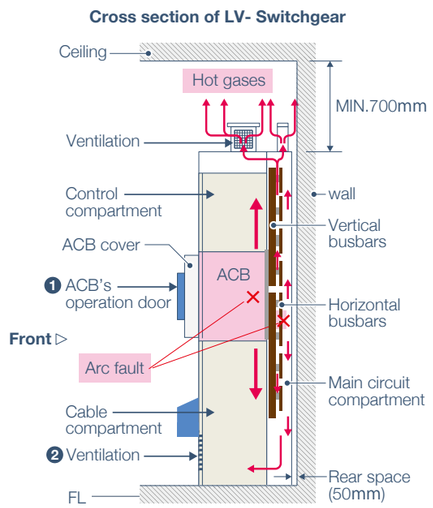
ACB Lift Truck

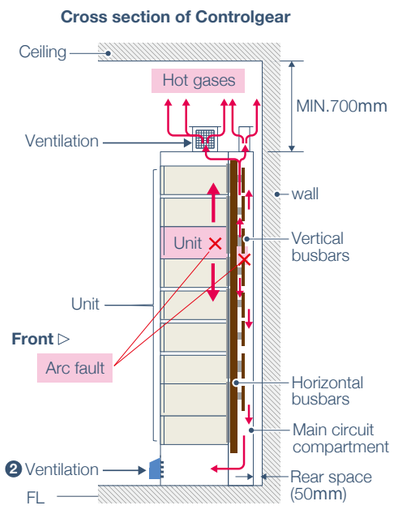


2.7 Internal Arc Pressure Relief Construction

(1) Panel Construction and Arc Gas Relief Space (IEC TR 61641)

When an internal arc fault occurs inside the panel, high-temperature gas is released from the panel ceiling ventilation to the ceiling of the electrical room at a distance from the operator. This makes it possible to secure the safety of anyone in the nearby area. ❶ ACB operation door and ❷ air vent can be attached to the front of panels with internal arc relief.
To secure sufficient space for releasing high-temperature gas and white heat particles from within the panel, at least 700mm between the panel ceiling and electrical room ceiling.
(Please see P56 regarding installation space)





(2) Internal Arc Fault Test and Classification

Type testing for the MCC-D (Low-Voltage Switchgear and Controlgear) internal arc fault was conducted at Mitsubishi Electric's High Power Laboratory in Japan.
In accordance with IEC TR 61641, if an arc is released (an arc fault occurs) inside a panel, the protection characteristic of people in the vicinity and the panel is categorized into arcing class A, B, C, and I.
The category for MCC-D (Low-Voltage Switchgear and Controlgear) is arcing class B †1 (Optional)

Internal arc fault test of controlgear.
85kA/0.3sec at 480V

Internal arc fault test of controlgear.
85kA/0.3sec at 480V

†1: In the case of "Arcing class B", the arcing test evaluation standards Item 1 – 6 of IEC TR 61641 apply.
MCC-D (LV- Switchgear and Controlgear) fall under "arcing class B" and in addition to providing personnel protection, must have the ability to confine the arc in a limited zone.

2.8 Features of Inverter Panelboard

(1) Construction

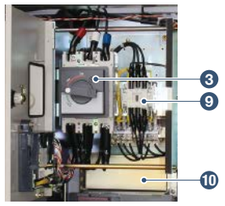
■ Housing structure

- The metal housing, compartment and unit frame are grounded to the earth busbar.
- The compartment comprises of the inverter, central ventilation and main circuit.
- The compartment complies with Form 2b of IEC-61439-2.

■ Improved maintainability

- By separating the door into three, doors A, B and C, it is possible to access only the necessary location for inspection purposes.
- The external cable compartment of the main/control circuits has been made slightly larger than our conventional inverter panel, making cable connection work easier.
- The unit panel has an interlock whereby it cannot be opened if the MCCB is on.

1/6(DL6) Inside of the Unit



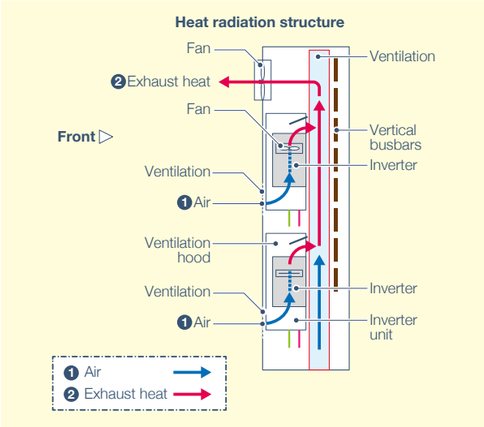
❶ Fan
❷ Parameter unit
❸ MCCB
❹ Application nameplate
❺ EMC-B
❻ Inverter
❼ Load terminal block
❽ Plug-in terminal block
❾ Electromagnetic contactor
❿ Ventilation hood

■ Outstanding heat radiation

- The design is such that, the heat generated by the panel's interior inverter is discharged outside of the panel by being carried on the air stream inside the ventilation by the panel's special-purpose ventilation and cooling fan.
  By suppressing temperature rise inside the inverter itself, reliability is improved due to extended inverter life. †2

< Flow of air (heat) inside panel >

❶ Outside air is taken in from the air vent on the door front.
❷ Heat generated from the inverter main unit is discharged out of the panel from the fan located at the panel's top via the interior ventilation.



†2:Temperature rise of the internal condenser, which has a large impact on inverter life, has been confirmed through a verification test to be within the permissible temperature range when stored inside a panel and the panel is operating in isolation.

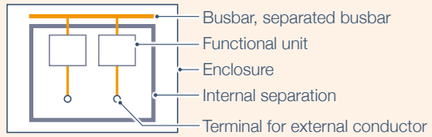
2.8 Features of Inverter Panelboard

(2) Form of Internal Separation (Form 2b)

■ Form 2b

- Based on IEC 61439-2 Form 2b, there must be separation between the functional unit and busbar, and separation between the terminal for external conductor and busbar. Stored inside a closed protected space and inside a compartment.

Form 2b of internal separation



(3) Unit construction

■ Example of unit arrangement

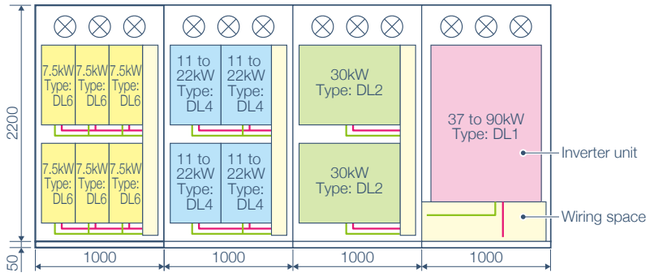
- 1/6 (DL6), 1/4 (DL4) and 1/2 (DL2) units all have a single standardized height, therefore units can be added and changed individually.
- For the 1/1 (DL1) unit, devices and apparatus are directly mounted to the housing of the inverter panel therefore it is not possible to add and change units individually. For the 1/1 (DL1) unit, it is possible to add/change devices such as the inverter, MCCB and contactor in the unit.

(E.g.) Unit is equipped so that it can be stored on a single MCC-D type inverter panel

Unit quantity per panel

Unit name	Q'ty/panel
1/6 (DL6)	6
1/4 (DL4)	4
1/2 (DL2)	2
1/1 (DL1)	1

Inverter unit layout (example)

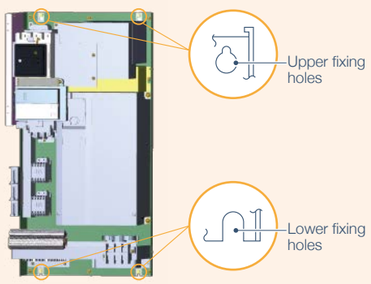


■ Installation and removal structure of the unit

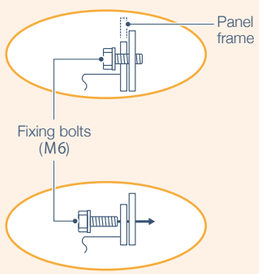
After the unit is mounted on the panel-side fixed frame it is secured by four bolts in the top and bottom of the unit frame.

< Target units >
- 1/6(DL6) unit
- 1/4(DL4) unit
- 1/2(DL2) unit

1/4(DL4) Unit



Unit fixing method



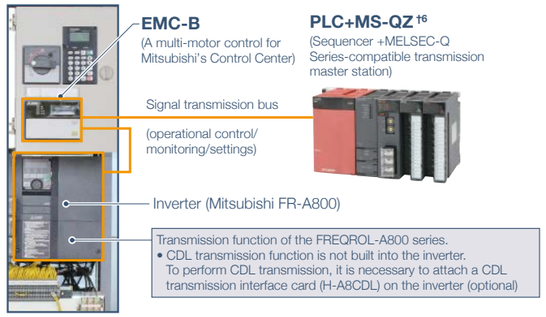
(4) CDL Transmission †4

- Equipped with an high-speed drive processor and Mitsubishi inverter (FREQROL-A800 series) †5 with enhanced control performance and response.
- The transmission system has been simplified by connecting the Mitsubishi inverter and EMC-B to the PLC+MS-QZ via a transmission bus.

[1] Data can be efficiently sent and received via the transmission line.

[2] Frequency control, monitoring of frequency and other measurements, operational control and parameter settings can all be performed via transmission.

Inverter transmission system



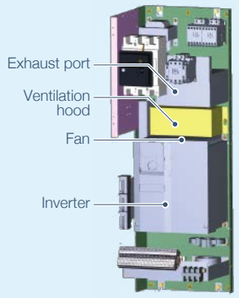
(5) Cooling fan replacement

Inspections and replacement of the fan or other parts have been made easy.

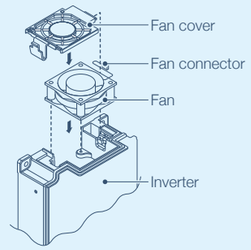
[1] Replacement of inverter inner fan †1

- The inverter inner fan has an expected life of approx. 10 years †2.

1/6(DL6) Unit



- The cooling fan of the inverter main unit can be replaced without disconnecting the main circuit wires.



[2] Replacement of panel-side cooling fan †3

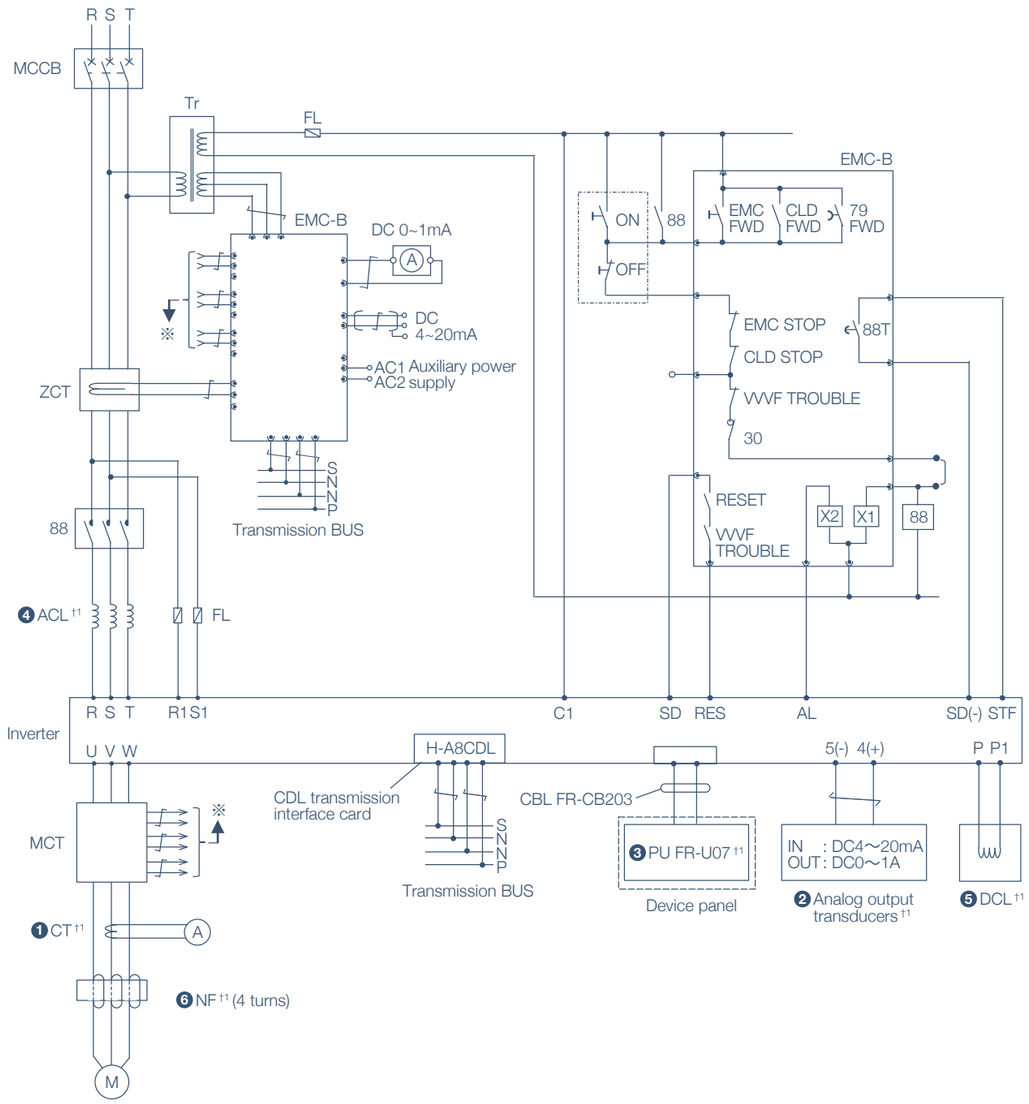
- Has an expected life of approx. 3 years in a normal operating environment.
- The fan with a rotating, low alarm point contact effectively supports preventive maintenance.
  An alarm is outputted when RPM falls to 60% or less.

†1: For the FR-A800 series, the fan can be replaced by removing the ventilation hood at the top of the inverter main unit.
†2: A special-purpose inverter inner fan is used to suit the inverter's life expectancy (approx. 10 years). However, this life expectancy is calculated based on an average annual ambient temperature of 40°C (and assumes no corrosive gas, oil mist, dust, etc.) (Not a guaranteed value)
†3: In regards to the panel main unit's fan, a general-purpose product is used with consideration to the panel's overall economic viability. (When replacing the fan, please turn off the fan circuit's MCCB. There is no need to turn of the panel's main/control circuits.)
†4: An interface unit for CDL is not a standard feature. It can be provided as an option. For details on CDL transmission , please see P49 4.2 CDL Transmission System.
†5: FREQROL-A800 series products are explosion-proof appropriate for use in explosion-proof areas (paint lines, chemical plants, etc.). (Option)
†6: H-A8CDL is specially designed to suit MS-QZ, a Q series sequence-compatible CDL transmission master station. It cannot be connected to other CDL transmission master stations.

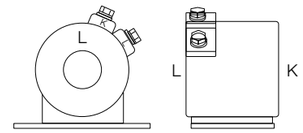
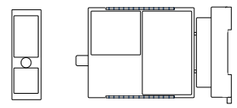
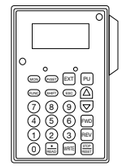
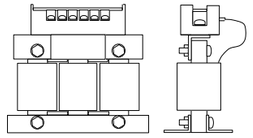
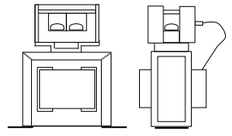
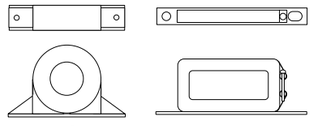
2.8 Features of Inverter Panelboard

(6) Inverter Unit Connection Diagram

■ **Connection diagram**



(7) Unit option

	Name (type)	Applications, Specifications, etc.	Structure
❶	Current transformer (CT secondary current: 1A or 5A)	For converting inverter output current into the current necessary for measuring instruments or relays.	
❷	Analog output transducers	For converting inverter analog output to the current or voltage necessary for measurement.	
❸	Parameter unit (FR-PU07)	Interactive parameter unit with LCD display	
❹	AC reactor (FR-HAL)	For harmonic current reduction and inverter input power factor improvement.	
❺	DC reactor (FR-HEL)		
❻	Line noise filter • FR-BSF01 (For small capacity inverter) • FR-BLF (For general inverter)	For line noise reduction	

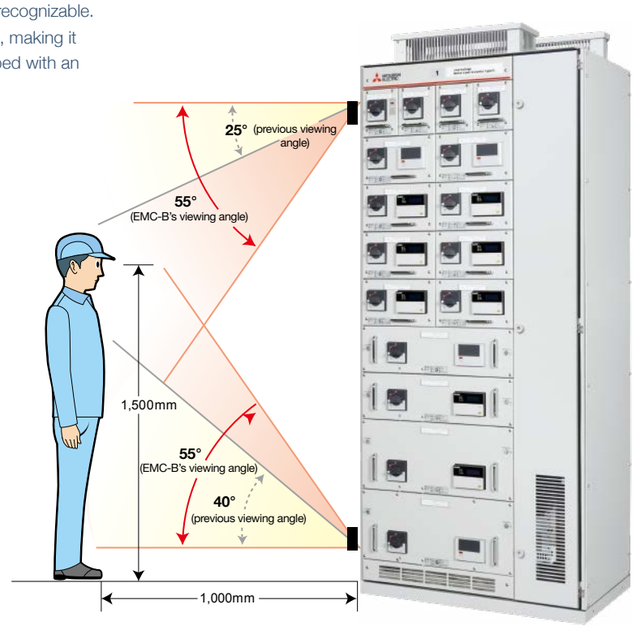
†1: Unit optional (see page 26 (7))

2.9 Practical Design (Attractively designed indicators)

Based on a universal design, the MCC-D is now even easier to use owing to the adoption of characters that enable accurate identification by anyone and a high-contrast design.

❶ Adoption of a display with varying color tones and character sizes has improved visibility, enabling specific pieces of equipment in an arrangement to be identified easily.
❷ Two background colors are used for the MCCB operating handle, making the current operating state easily recognizable.
❸ The EMC-B features a LED with a protruding lens, making it easy to confirm the operating state, and is equipped with an LCD display with excellent legibility.

GOOD DESIGN †1



❶ MCC-D

Each panel has been given a red line on its front upper section and an indicator with a panel-specific symbol/name, making it easier to identify specific equipment for operation and maintenance purposes.

❷ MCCB

The MCCB operating handle is fitted to a plate with a high-contrast two-segment design, making the current operating state easy to identify even when viewed at an angle.

(When OFF) (When ON)

Japanese Patent No.4912498

❸ EMC-B

The main display is a LCD specially designed to provide wide viewing angles, making inspections of topmost/bottommost units significantly easier than with previous models. The positive display (i.e., white text against a blue background) turns orange when a motor trips. Compared to displays on previous models, the new display is significantly more advanced in terms of visibility and legibility from wider viewing angles.

The LED used to indicate operating states is twice as bright as before. In addition, the LED portion protruding from the lamp body enables checking from both the front and sides.

†1 The Good Design Award is presented by the Japan Institute of Design Promotion and is awarded for comprehensive design incentive systems.

3.1 Robust Environmental Resistance

Added resistance to the effects of corrosive gas, radio noise and static electricity EMC-B Tough Motor Controller

External factor	Ability
Vibration/ Impact-resistant	Remains problem-free even after the Control Center contactor has switched ON/OFF a million times.
Dust	Keeps out dust thanks to its hermetic construction and specially coated board elements (to IP53 †2 when mounted on the Control Center). (The Control Center has a semi-hermetic construction and may be optionally protected against dust to IP43 †2 max.)
Water	Hermetic construction guards against intrusion of water (to IP53 †2 when mounted to the Control Center). (The Control Center has a semi-hermetic construction and may be optionally waterproofed to a maximum of IP43 †2.)
Radio Noise	Highly resistant to interference from cellular phones and transceivers. Cellular phones : may be used even at close proximity to the controller †3 Transceivers : may be used at a distance of 40cm or more (154MHz, 5W; 460MHz, 5W)
Static Charge	Withstands the effects of static electricity at the highest level in its class (15kV). (Complies with international standard IEC61004-2 Class 4 requirements [static discharge immunity testing].)
Corrosive Gas	Can be used in an environment subjected up to 50ppb of H_2S gas (ISA S71.04 G3 †4). †5 • Protected by a special high-performance coating for keeping out corrosive gas. • Housed in a semi-hermetic casing. • Fitted with gold-plated switches and connectors.
Surge/Noise	Prevents malfunctions caused by propagation/radiation of surge/noise and noise from the power supply. Withstands an impulse noise level of 5kV.

†2: Index of protective level against dust and liquids.
†3: According to the results of our studies of phones from multiple Japanese manufacturers (2010).
†4: ISA (Instrument Society of America) S71.04 (environmental conditions for process measurement and control systems) G3 (level of severity indicating an environment subject to a strong likelihood of corrosion).
†5: Here, the term "corrosive gas" refers to H_2S alone (50% RH or less).
The concurrent presence of another gas can accelerate corrosion and thus shorten the expected service life.
If the presence of a non- H_2S gas on its own is expected, contact us during the planning stage.
If operation in an environment subjected to corrosive gas is expected (up to 50ppb), contact us for considerations pertaining to devices other than the EMC-B.

3.2 Easy Operation

(1) Additional Button (DISP)

One press of the DISP (display) button turns on the LCD without needing to open the cover. †1

DISP button

(2) EMC-B Operation Buttons

The arrangement and design of the operation buttons have been fully reconfigured to improve ease of operation. The darker shade of the STOP button makes it easier to spot.

❶ Control Buttons

The EMC-B provides a way to directly control a single motor. Pressing the buttons will cause the motor to operate normally, in reverse, or stop. Setting the EMC-B to REMOTE enables external control.

❷ Display Selection/Settings Buttons

These buttons are used to switch between LCD modes and to change settings. Pressing the RESET button resets the controller in the event of fault-triggered tripping.

❸ LCD

The display provides a wide range of information, including readings for the main circuit current, leakage current, and other parameters.

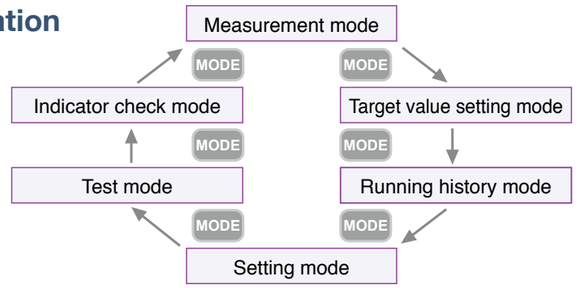
❹ LED Lamps

These lamps indicate the state of the motor (e.g., in operation, at rest, tripped).

(3) Easy-to-Learn Button Operation

■ Mode Sequence of the EMC-B

Shifting through modes is as easy as pressing the MODE button.



†1: Only valid in LCD Normally OFF mode (see page 43 3.8).

■ Simplified EMC-B Settings

❶ Item serial number

Each item that can be set has a corresponding number. To represent the hundreds column, an "a" is displayed at the top right of the number. In the example on the right, the display indicates the number "180".

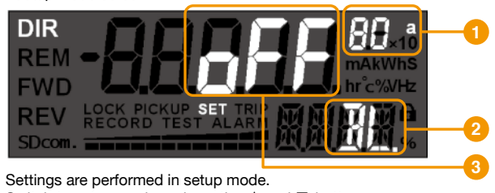
❷ Item setting guidance

Codes are displayed corresponding to the item to be set. In the example on the right, BL is displayed, which stands for backlight control.

❸ Setting contents

When the target item is displayed, the setting can be changed. The targeted item setting will flash and can be changed using the ▲ and ▼ buttons. When the desired value is reached, press the "SET" button.

<Setup mode screen>



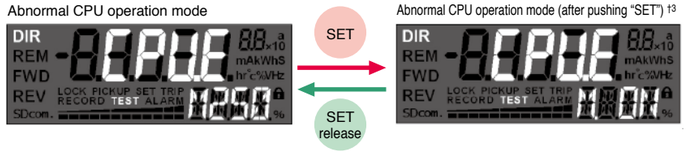
Settings are performed in setup mode.
Switch to setup mode and use the ▲ and ▼ buttons to move to the item to be set.

(4) Ample Test Functions †2

■ Abnormal CPU operation mode

The EMC-B can simulate system error!
In the abnormal CPU operation test mode, actual internal signals when the system is not operating properly (internal failure signal: M250) can be simulated simply by pushing a button.

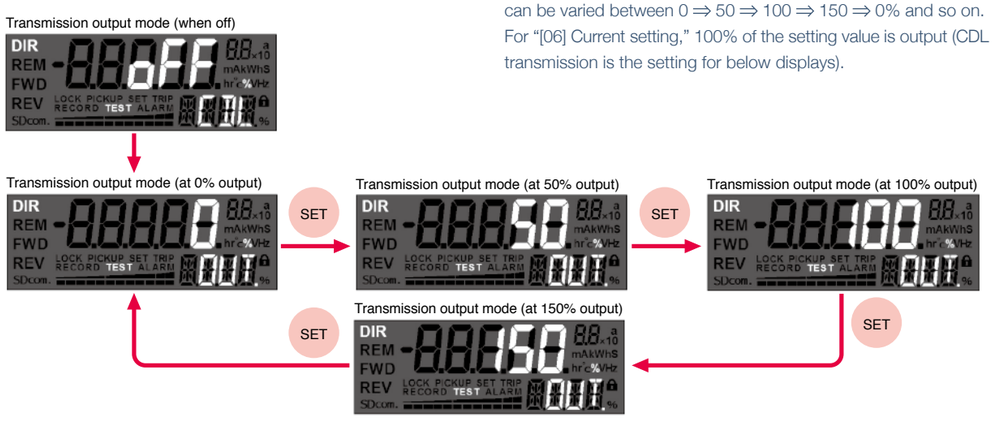
At the same time, when the CPU is operating abnormally transmission data is sent automatically, which means that generation of the transmission signals sent in the case of an actual system error can be simulated (with CDL transmission specifications).



■ Transmission output mode

Using EMC-B, the level can be changed and output enabled without having to perform actual input!

In transmission output test mode, it's possible to simulate the output of main circuit current transmission data. The output level can be varied between 0 ⇒ 50 ⇒ 100 ⇒ 150 ⇒ 0% and so on. For "[06] Current setting," 100% of the setting value is output (CDL transmission is the setting for below displays).

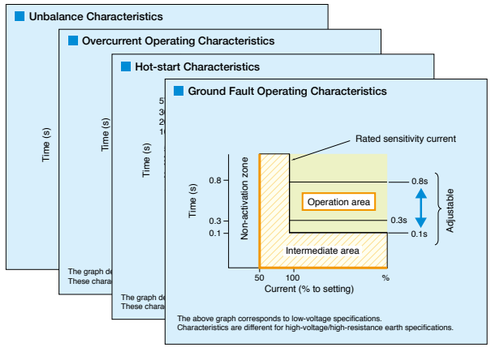


†2: Other possible tests not listed here include the overcurrent/ground fault trip test and external current output test.
†3: When "SET" is pushed, in the case of abnormal CPU operation, transmission notification is sent (for CDL transmission).

3.3 Other Benefits

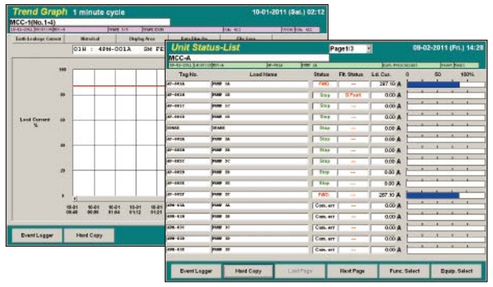
❶ Extensive Motor Protection Function

EMC-Bs meet a wide range of needs for motor protection. There is no need to provide separate relays to protect motors against overcurrent (OC), unbalance (UB), leakage current (ground fault, GF), instantaneous overcurrent (OCI), or undercurrent (UC) or power shortage.
The wide selection and range of settings eliminates the need to consider equipment replacement when planning or changing configurations.
The controllers can also be used in combination with harmonic circuits (inverter loads).



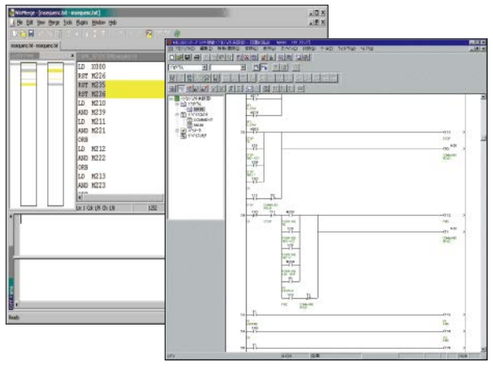
❷ Various Indicators/Readings

The state of the motor is indicated by LED lamps (e.g., operational, at rest, fault, error (including system error)).
The EMC-B provides current meter and leakage current meter functions, eliminating the need for separate meters and reducing cost and space requirements.
The readings are indicated on a LCD.
The standard power status/electrical energy meters are simplified. (The meters require advance settings of rated voltage, voltage used, and power factor.)
A current output function can also be incorporated (optional; 0-1mA DC, 420mA DC).



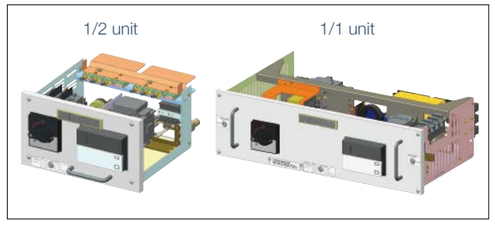
❸ Programmable Sequence

Using a MELSEC programmable controller and equivalent ladder software, it's possible to freely program the internal ladder program. Installing the ladder program internally reduces internal wiring in the unit, allowing cost to be reduced. Ladder programs can be changed using the software (max. steps: 350). There are five input points (forward × 1, reverse × 1 and general-use × 3), and 10 output points (trip/alarm: 1a1b × 1, stop: 1b × 1, forward: 1a × 1, reverse: 1a × 1, general-use × 6 [1a × 3, 1b × 2, 1c × 1]), which can be applied to various circuits.
As optional items, seven input points (eight output points), and 10 input points (five output points) are also available.
In addition, an instantaneous voltage drop restart function is included, enabling continuous operation.



❹ Compact Design

Compact design has enabled application to 1/2 units.
This helps to increase unit storage number and reduce the number of panels.



❺ Multiplexing Compliant

A range of communication options are provided for CDL / Modbus®-RTU †1 transmission.
Structuring transmission to include the distributed control system enables constant monitoring of operation and control.

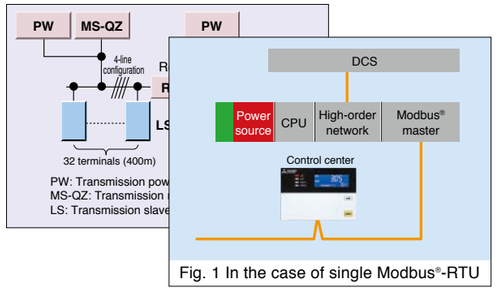
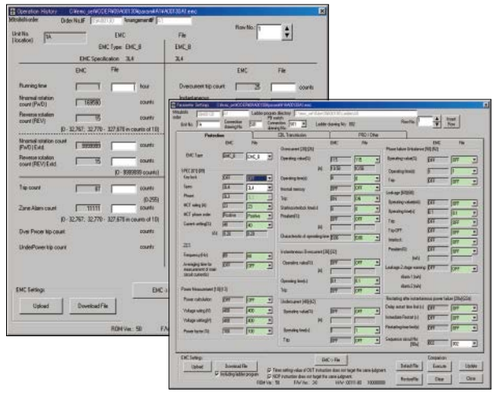


Fig. 1 In the case of single Modbus®-RTU

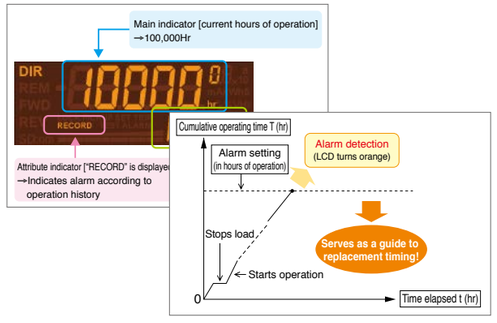
❻ Simplified Post-delivery Modification/Customization

Before EMCs were used in control centers, when currents reached unexpected levels due to motor capacity, there were many cases in which modifications such as the replacement of thermal relays or the addition of a reactor were carried out. However, since the introduction of EMCs, the adjustment range is large and most problems can be resolved by changing internal settings. In contrast to the adjustment scales of thermal relays, which are imprecise and produce large error, accurate settings are possible using EMCs.
EMCs are also convenient for adjustment because of the many functions incorporated, such as functions to automatically inspect the protective properties, test overcurrent/leakage current and test system error and transmission data output (see page 30 (4) for more information regarding test output functions).
The reduced time required for making adjustments also increases efficient use of time.



❼ Trouble Prevention

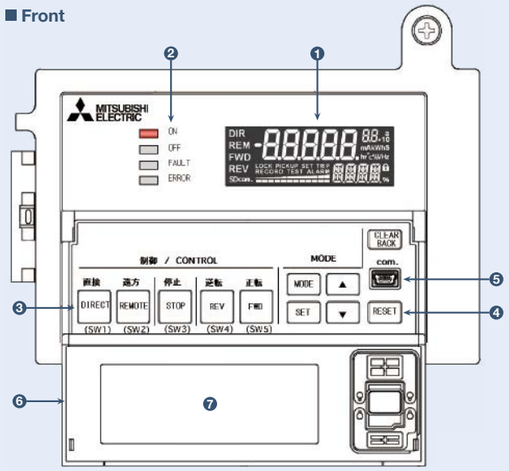
The EMC-B constantly monitors the system for load/leakage currents and retains histories of various operations to help predict and prevent troubles by indicating the hours of motor operation/number of contactor activations (open/close), and the nature and number of motor tripping events based on causative factors.
Other preventive functions include self-diagnostics, auxiliary power supply (optional), and various fail-safe mechanisms.



†1: Please confirm the delivery schedule, including that for standard products, separately.

3.4 Names and Functions

■ Front



❶ LCD
❷ LED Indicating Lamps
❸ Operation Buttons
❹ Indication Selection/Settings Button
❺ [com.] Connector
❻ Operation Button Cover
❼ Ratings Plate (Operator's Guide)

❶ LCD

DIR	(ON)	: Direct operation
REM	(ON)	: Remote operation
FWD	(ON)	: Normal rotation
REV	(ON)	: Reverse rotation
SD	(ON)	: CDL transmission indication (ON during transmission)
com.	(ON)	: Indicated during communication with PC
RECORD	(ON)	: Running history mode
		: Flashing for running time/count alarms
SET	(ON)	: Setting mode
TEST	(ON)	: TEST mode
LOCK	(ON)	: Operation button lock state
🔒	(ON)	: Security function ON
TRIP	(flashing)	: Fault tripping †1
PICKUP	(flashing)	: Pickup indication †1
ALARM	(flashing)	: Alarm indication †1

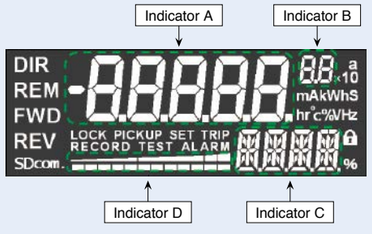
■ **Segment/Bar Graph Indication (alphanumeric/bar graph indication)**

- Indicator A (7 SEG):
  Measurements (main circuit current, leakage current, power level), settings, error
- Indicator B (7 SEG):
  Main circuit current phase indication, history indication (7-digit indication max. by Indicator A+B), setup screen serial number
- Indicator C (14/16 SEG):
  Measurements (relative value of main circuit current, deviation range), setup screen guidance, fault cause
- Indicator D:
  Measurements (relative value of main circuit current, deviation range, relative value of leakage current) in bar graph

❶ Enlarged View of the LCD

A few characters appearing on the display on their own are assigned different meanings. For the sake of convenience, they are identified as follows:

Character	Location on LCD	Notation used herein
a, A	Upper right	a
	Middle right	A
%	Middle right	% UP
	Bottom right	% DOWN



- a (ON) :
  In setting mode, indicates settings No. 100 through 199 when ON; indicates settings No. 0 through 99 when OFF
- A (ON) :
  Indicates unit of main circuit current ([A]), unit of leakage current ([mA])
- %UP (ON) :
  Indicates unit for numerical input in percentage (%) in setting mode (setting value appearing in Indicator A)
- %DOWN (ON) :
  Indicates unit for relative value and deviation range appearing in Indicator C

†1: Flashes in response to a specific fault, pickup, or alarm.

❷ LED Indicating Lamps †2

(†3)	ON	red (ON)	: Run
	OFF	green (ON)	: Stop
	ON	red (flashing)	: Transmission error during run
	OFF	green (flashing)	: Transmission error during stop
	FAULT	orange (flashing)	: Fault tripped status
	ERROR	red (ON)	: System error inside the main unit

❷

❸ Operation Buttons †4

DIR	(direct)	: Direct operation (SW1)
REM	(remote)	: Remote operation (SW2)
STOP	(stop)	: Stop (SW3)
REV	(reverse rotation)	: Reverse rotation (SW4)
FWD	(normal rotation)	: Normal rotation (SW5)

❸

❹ Indication Selection/Settings Button

MODE	: Switches through various modes.
SET	: Stores setting in memory. Retains target current value. Starts/Stops counting of zone alarms.
▲, ▼	: Increases/Decreases indicated values.
CLEAR/BACK	: Clears running history values.
RESET	: Resets after fault tripping. : Resets indication of running time/count alarms.

❹

❺ [com.] Connector

- Used to connect a PC using a special cable for communication.
- Used to mount a security key to set up security parameters.

❺

❻ Operation Button Cover

The following operations are possible when the operation button cover is closed:

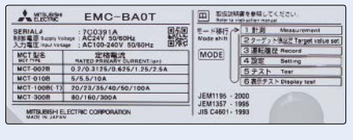
DISP : With the cover closed, the CLEAR/BACK button serves as the DISP button. One press of the button turns on the LCD.

RESET : With the cover closed, the RESET button here provides the same function as the indication selection/settings RESET button (4 above).

❻

❼ Ratings Plate (Operator's Guide)

❼



†2: The above are sample indications, modifiable using a ladder program.
†3: It's possible to change ON to green and OFF to red.
†4: Switches 1～5 can be enabled/disabled.
The layout of the operating switches can be changed.

3.5 Specifications

(1) General Specifications

Item		Specifications
Control power supply	Power supply voltage	Main circuit voltage: 200/220VAC, 50/60Hz (with special transformer); Tertiary power-supply voltage: 12/13.2VAC
		Main circuit voltage: 400/440VAC, 50/60Hz (with special transformer); Tertiary power-supply voltage: 2/13.2VAC
	Permissive power supply voltage regulation	85 – 110%
	Rated power supply frequency	50/60Hz
	Permissive power supply frequency regulation	±5% of rated power supply frequency
Environmental conditions	Ambient temperature for service	–15°C – + 60°C
	Ambient humidity for service	10% to 90% RH (without condensation; indoor control center: 45% to 85% RH)
	Ambient temperature for storage	–20°C – + 60°C
	Ambient humidity for storage	10% to 90% RH (without condensation)
	Atmosphere	Hydrogen sulfide H2S 50 ppb or less (other corrosive gases not part of consideration) ISA Standard G3 Class

Item		Specifications
Consumption VA	Control power supply	Normal: Approx. 4.0VA (approx. 6.0VA with external current output in use) [input: 1; output: 1; backlight: normally off]
		Max.: Approx. 7.5VA [input: 5; output: 5; backlight: normally on; all lighting mode]
Inrush current	Control power supply	Power OFF ⇒ ON: approx. 10A, 3ms
Weight	EMC-B unit	Approx. 400g
	EMC-B unit + auxiliary power supply + external current output	Approx. 480g
	MCT-002B (010B, 100B)	Approx. 180g
	MCT-300B	Approx. 350g
	ZCT-100B	Approx. 180g
	BT-05S	Approx. 1,340g
Standards followed	JEM1195-2000	Motor Control Center
Standards followed as necessary	JEM1357-1995	Static protective relay for electric motor
	JEM1356-1994	Dynamic and electronic protective relays for electric motor
	JIS C 4601-1993	Ground fault relay for high-voltage power reception

(2) Functions

Function	Description
Applicable load	Low-voltage 3-phase (including inverter load)
Specifications	Standard (low-voltage (L), high-voltage (H), high-resistance grounding (G)), micro-leakage current measurement (M), low-sensitivity ground overcurrent (LL), 1-phase, 3-wire (S)
Protection	Overcurrent (600/800% saturation), instantaneous overcurrent, undercurrent, leakage current (ground fault), unbalance (other than inverter load)
Measurement	Main circuit current (up to 1,270% of motor rated value), leakage current (up to 1,400mA), trip current (same as main circuit current/leakage current),power (0 to 9,999kW), electrical energy (0 to 9,999,999kWh) [abbreviated power level/electrical energy]
Indicators	LED: Run, stop, fault, transmission error, system error LCD: Remote, direct, normal rotation, reverse rotation, trip (trip current, trip cause), alarm, settings (settings guidance + settings No.), running history, system error code
Sequence	Remote/direct operation switching, fault alarm output, contact output at system error, fault reset, programmable sequence
Control	Normal rotation, reverse rotation, stop
Analog input	MCT current sensor (main circuit current), ZCT zero-phase transformer (leakage current)
Digital input	5 points (1 for normal rotation, 1 for reverse rotation [for general use if in non-reversible sequence], 3 for general use) (7 points for 7-point input specifications)
Analog output (optional)	External current output (0-1mA DC 1-ch, triple/quintuple extension scale), external current output (4-20mA DC 1-ch, with zero/span adjustment function)
Digital output	10 points (1a1b x 1 point for tripping/alarm, 1b x 1 point for stop, 1a x 1 point for normal rotation, 1a x 1 point for reverse rotation [for general use if in non-reversible sequence], 6 points for general use (1a x 3 points, 1b x 2 points, 1c x 1 point) (8 points at time of 7-point input specifications)
Instantaneous voltage drop restart	3-mode instantaneous voltage drop restart (with instantaneous voltage drop immediate restart function)
Alarm	Alarms for individual items under protection, running time/count alarm, target current alarm
Running history	Running time (0 to 327,670hr), number of normal rotations (0 to 9,999,999), number of reverse rotations (0 to 9,999,999), number of faults (0 to 255) Number of zone alarms (0 to 327,670), number of following occurrences (0 to 255 each): overcurrent, instantaneous overcurrent, undercurrent, unbalance, leakage current, externally caused tripping Number of instantaneous voltage drop restarts (0 to 255), electrical energy (0 to 9,999,999kWh), self-diagnosis error code, trip history (5 most recent occurrences)
Settings	Varies depending on specifications (see below)
Transmission (optional)	CDL transmission interface, CC-Link transmission interface, Modbus®-RTU transmission interface
Fail-safe	Load condition setup for unit failure (load condition trip/lock)
Test	Automatic inspection of protective characteristics, overcurrent/leakage current forced trip test, 0-1mA DC/ 4-20mA DC forced output test, CDL transmission forced output test, system error contact output test, CPU error operation test
Self-diagnosis	Error code indication in response to system error
Security	Key lock function, security function
Energy-saving	LCD control selection (2-step brightness settings)

(3) Names and Functions of Parts

Setting name	Setting range
[01] Key lock selection	OFF/ON
[02] Specifications	Low-voltage (L)/High-voltage (H)/High-resistance grounding (G)/Micro-leakage current measurement (M)/Low-sensitivity ground overcurrent (LL); 1-phase,3-wire (S)
[03] Phase selection	Single-phase 2-lines/3-phase 3-lines
[04] MCT rating	Low-voltage: 21 types; high-voltage: 16 types
[05] MCT phase and order	Positive/negative
[06] Current setting value	40 – 110%
[07] ZCT selection (with LL specifications)	ZCT1, ZCT2
[08] Power-supply frequency	50/60Hz
[09] Average time for main circuit current measurement	OFF, 1 – 30s
[10] Power operating selection	OFF / ON
[11] Voltage rating	Low-voltage: 14 types, High-voltage: 2 types
[12] Voltage setting	Low-voltage: 84 – 484V High-voltage: 2,600 – 9,000V
[13] Power factor	0 – 100%
[20] Overcurrent operating level	100 – 120%
[21] Overcurrent operating time	1 – 64s
[22] Overcurrent thermal memory	Cold/Hot
[23] Overcurrent trip output selection	OFF/ON
[24] Overcurrent starting interlock time	0 – 120s
[25] Overcurrent pre-alarm operating value	50 – 115%
[26] Overcurrent operating time characteristic	600/800%
[30] Instantaneous overcurrent operating level	50 – 900%
[31] Instantaneous overcurrent operating time	0.1 – 9s
[32] Instantaneous overcurrent trip output selection	OFF/ON
[40] Undercurrent operating level	30 – 100%
[41] Undercurrent operating time	1 – 9s
[42] Undercurrent trip output selection	OFF/ON
[50] Unbalanced operating level (excluding S specifications)	5 – 180%
[51] Unbalanced operating time (excluding S specifications)	1 – 9s
[52] Unbalanced trip output selection	OFF/ON
[60] Leakage sensitivity current	Low-voltage: 30 – 1000mA High-voltage: 100 – 800mA
[61] Leakage operating time	Low-voltage: 0.1, 0.3, 0.8s High-voltage: 0.1, 0.2, 0.3, 0.8s
[62] Leakage trip output selection	OFF/ON
[63] Leakage trip OFF fault indication retention selection	OFF/ON
[64] Leakage interlock	OFF/ON
[65] Leakage pre-alarm operating value	30 – 70%
[66] Leakage 2-stage warning	OFF/ON
[67] Leakage alarm level 1 (with M specifications)	OFF, 0.2 ～ 50.0mA
[68] Leakage alarm level 2 (with M specifications)	OFF, 0.2 ～ 50.0mA
[20a] Instantaneous voltage drop supply recovery time	0.5 – 65s
[21a] Instantaneous voltage drop immediate restart time limit	0.1, 0.2s
[22a] Instantaneous voltage drop restarting time limit	0 – 127s

<During CDL transmission (30a–38a)>	
Setting name	Setting range
[30a] CDL transmission function	OFF/ON
[31a] CDL transmission address	00 – 40 hex
[32a] CDL transmission mode	1 – 7
[33a] CDL transmission simultaneous same information group number	0 – 7
[35a] CDL transmission master station no response detection time	7 – 160s
[36a] CDL sending interval at startup	0.1 – 2.0s
[37a] CDL sending period at startup	1 – 127s
[38a] CDL transmission bus low error detection time	1.5 – 30s

<During Modbus®-RTU transmission (30a–36a)>	
Setting name	Setting range
[30a] Modbus® transmission function	OFF/ON
[31a] Modbus® transmission station number	1 – 247dec
[32a] Modbus® transmission speed	2.4k, 4.8k, 9.6k, 19.2k, 38.4k, 57.6k, 115.2k
[33a] Modbus® parity setting	Non, odd, even
[34a] Modbus® stop-bit setting	1.2
[35a] Modbus® master station non-response detection time	OFF/1 – 300s
[36a] Modbus® output selection in case of transmission error	Hdd, clr

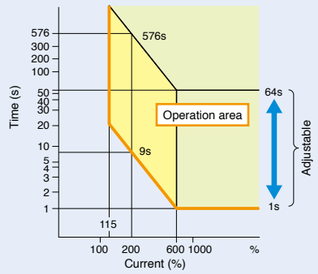
Setting name	Setting range
[50a] Triple/quintuple extension scale	3, 5
[51a] CT primary rating current value	37 types
[52a] External current output for site meter (DC 0-1 mA) †1	OFF/ON
[54a] External current output for site meter (DC 4-20 mA) †1	OFF/ON
[56a] Phase selection for transmission current output (with S specifications)	1, 0, 2
[60a] Running time alarm	10 – 300,000hr
[61a] Running count alarm	10 – 900,000times
[62a] Saving interval of log information on trip current value	0.05 – 1.6s
[70a] Target count value display function selection †2	OFF/ON
[71a] Bar graph display function selection †2	OFF/ON
[72a] Zone alarm setting value [upper side] †2	5 – 90%
[73a] Zone alarm setting value [lower side] †2	5 – 90%
[74a] Zone alarm at starting delay time †2	1 – 160s
[75a] Zone alarm detection time †2	1 – 600s
[76a] Zone alarm count time †2	60 – 600s, 0.5 – 24hr
[77a] Zone alarm retention selection †2	OFF/ON
[80a] Backlight control for LCD	Continuously ON(ultra low/low/high brightness), ON onlyduring operation
[81a] Security setting	OFF/ON
[82a] Security level setting	OFF/ON
[83a] Internal clock (year, month, day)	2000.1.1 - 2099.12.31
[84a] Internal clock (hour, minute, second)	00:0.0 - 23.59.59

†1: Does not appear on models with no external current output function.
†2: Does not apply to S specifications.

3.5 Specifications

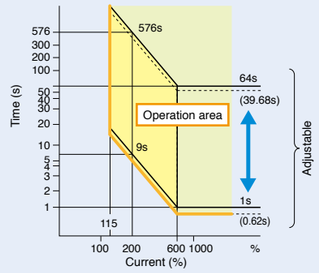
(4) Protection Characteristics

Time Delay Overcurrent



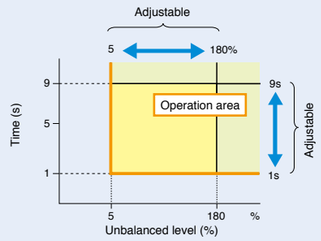
The graph depicts time-based overcurrent operating characteristics with settings at 600%.
These characteristics also apply at 800%.

Hot-start

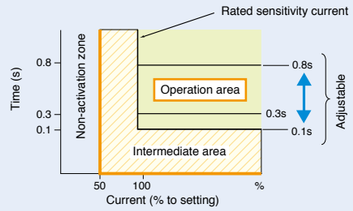


The graph depicts time-based overcurrent operating characteristics with settings at 600%.
These characteristics also apply at 800%.

Unbalance

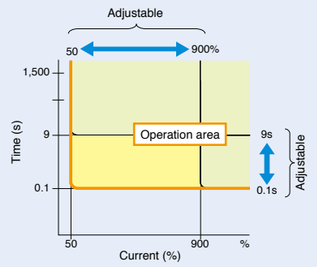


Ground Fault

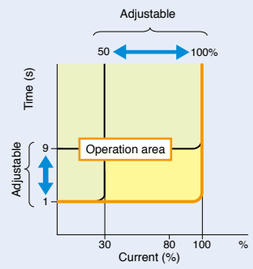


The above graph corresponds to low-voltage specifications.
Characteristics are different for high-voltage/high-resistance earth specifications.

Instantaneous Overcurrent

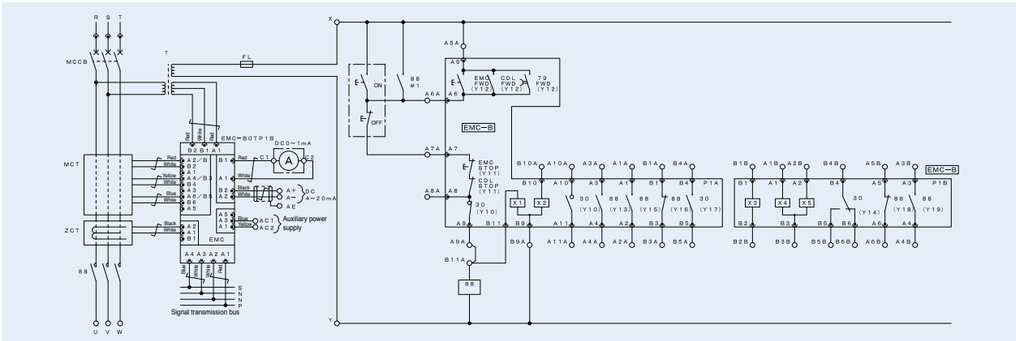


Undercurrent



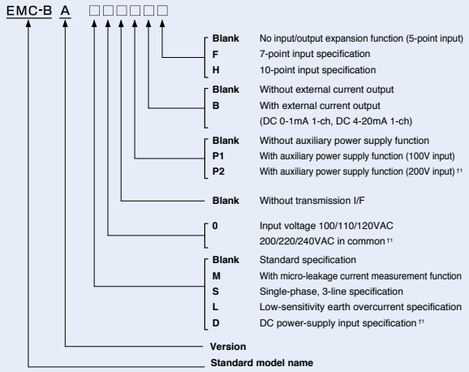
(5) Sample Wiring

Standard EMC-B for a non-reversible sequence (CDL transmission, 5-point input)

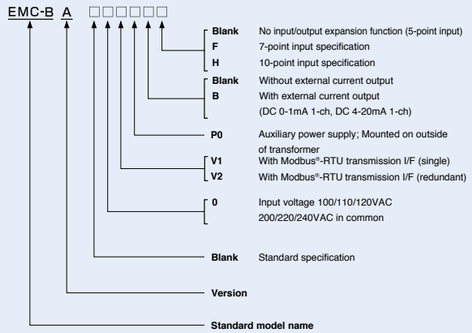


(6) Product Configuration

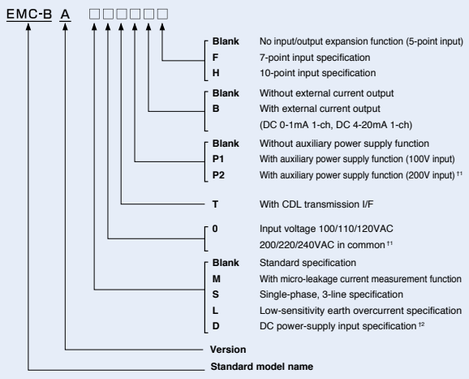
EMC-B standard specifications



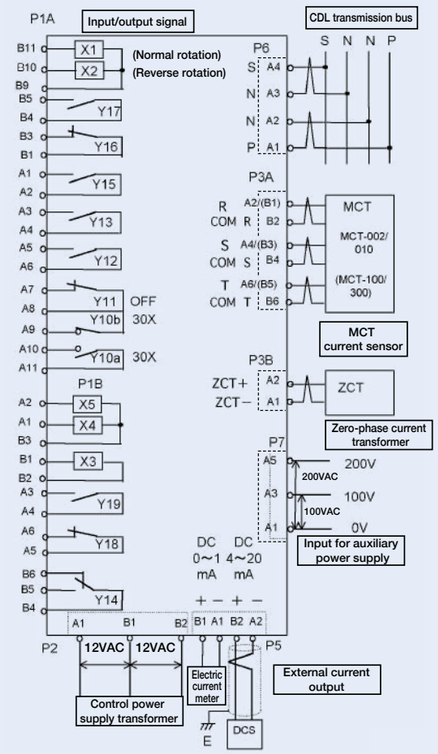
EMC-B Modbus®–RTU transmission specifications †2
(Option) [See P45 to P48]



EMC-B CDL transmission specifications
(Option) [See P49 to P51]



(7) Internal Circuit Diagram



(8) Associated Equipment

The following equipment must connected when using the EMC-B.

Special Transformer	BT-05, BT-07, BT-15
Special Current Sensor (MCT)	MCT-002B, MCT-010B, MCT-100B, MCT-300B
Special Zero-phase Current Transformer (ZCT)	ZCT-35B, ZCT-100B, ZCT-100BZ, ZCT-300B

Special Transformer

Special Current Sensor (MCT)

Special Zero-phase Current Transformer (ZCT)

†1: For DC power-supply input specifications, the input voltage is DC and there is no auxiliary power-supply function.
†2: Please confirm the delivery schedule separately.

3.6 Extended Maintenance Support

The support function is comprised of (1) operation monitoring function, (2) operational availability monitoring function, and (3) maintenance monitoring function.

(1) Operation Monitoring Function
(3-mode Restart Function after Instantaneous Voltage Drop)

Supports the load option upon restart after an instantaneous voltage drop.

■ In the case of short instantaneous voltage drops

Short instantaneous voltage drops are characterized by relatively small differences in phase between supply voltage and motor residual voltage when voltage returns.

⇒ The startup inrush current is relatively low.

< Setting procedure >

Even if all loads are allowed to start up at the same time following recovery from an instantaneous voltage drop, the power system is minimally affected. Loads are initiated by ❶ immediate restart, for sustained operations.

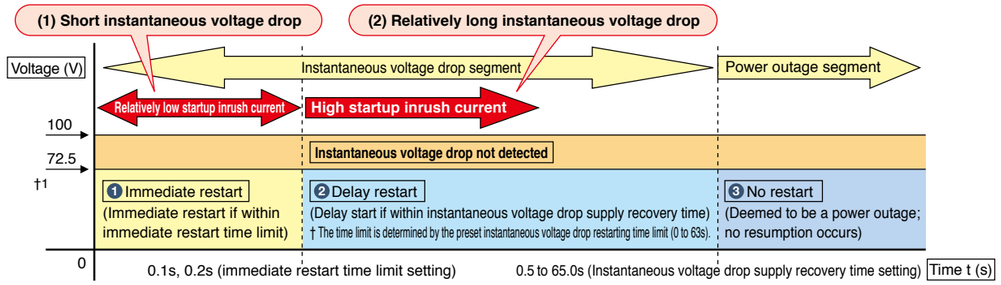
■ In the case of relatively long instantaneous voltage drops

Relatively long instantaneous voltage drops are characterized by larger differences in phase between the supply voltage and motor residual voltage when voltage returns.

⇒ High startup inrush current.

< Setting procedure >

Since starting all loads at the same time is likely to impose a burden that outstrips the supply power, they are started one after another in accordance with ❷ delay restart setup.



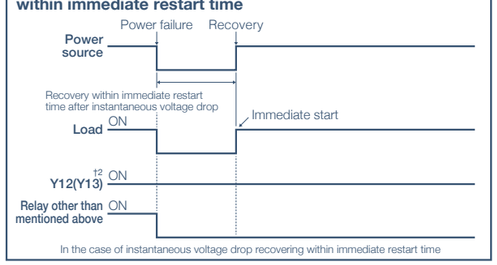
Operation is possible in patterns 1 through 3 in connection with an instantaneous voltage drop.
- Pattern 1: Set 3 modes (❶, ❷, ❸) for switchover between simultaneous and time series startups, based on the level of the motor startup inrush current.
- Pattern 2: Set 2 modes (❷, ❸) for sequential startup of motors in the event of an instantaneous voltage drop.
- Pattern 3: Keep the instantaneous voltage drop restart mechanism disabled.

■ Short instantaneous voltage drop detection

● In the case of an instantaneous voltage drop that recovers within the immediate restart time

Detects a power outage when the voltage has dropped below the instantaneous voltage drop detection level and ignores the restart time limit to initiate load if the voltage recovers to recovery level or higher within the instantaneous voltage drop immediate restart time (0.2s).

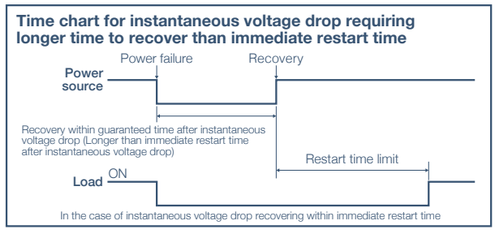
Time chart for instantaneous voltage drop recovering within immediate restart time



● In the case of instantaneous voltage drops requiring longer time to recover than immediate restart time

Detects a power outage when the voltage has dropped below the instantaneous voltage drop detection level and initiates load after the restart time limit if voltage recovers to the recovery level or higher within the instantaneous voltage drop compensation time (0.5 to 65.0s).

Time chart for instantaneous voltage drop requiring longer time to recover than immediate restart time



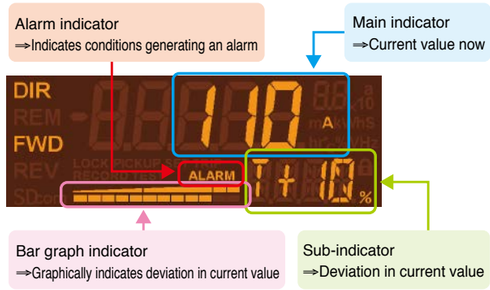
†1: 72.5V = Instantaneous voltage drop detection voltage level (when main circuit supply voltage is 100/110VAC)
†2: In the case Y12 (Y13) is used for an instantaneous voltage drop

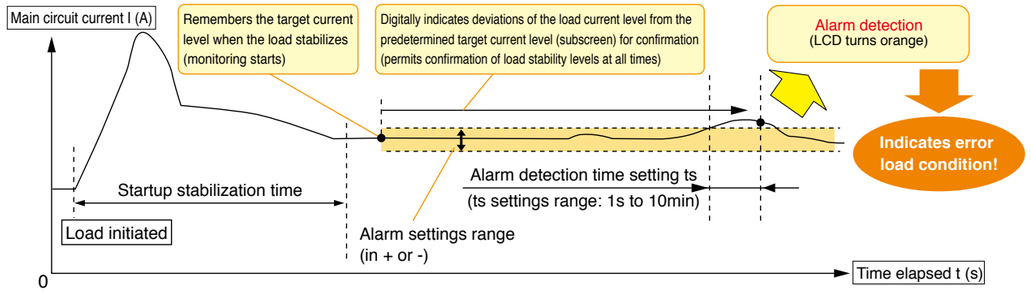
(2) Operational Availability Monitoring Function
(Target Current Setup)

The EMC-B remembers the stable current value (target current level) for you !
The EMC-B monitors the readings for you !

<During Alarm Condition>

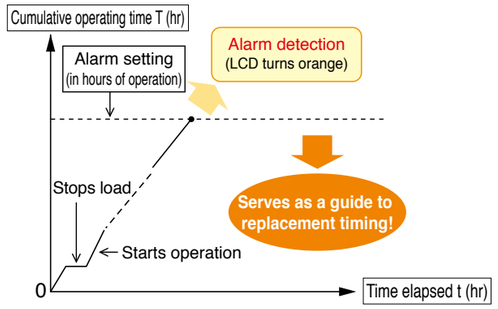
LCD turns orange to indicate that an alarm has been issued. Press the RESET button to reset the alarm condition

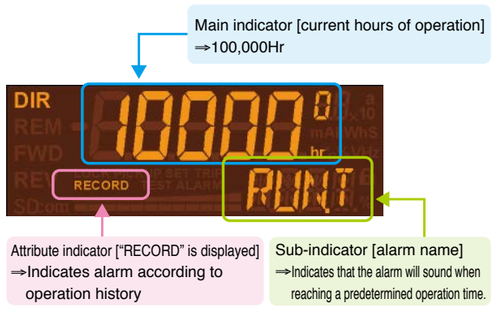




(3) Maintenance Monitoring Function
(Running Time/Count-based Alarms)

The EMC-B notifies what needs to be replaced, and when.





3.7 Easy Maintenance

(1) Replacement of Parts

When a replacement part †1 reaches the end of its life, it can now be replaced by the user without detaching the EMC-B unit (i.e., without disconnecting all connectors). †2 The EMC-B allows replacement of the aluminum electrolytic capacitor PCB †3 and display PCB (i.e., LCD, LED).

■ Replacing the Aluminum Electrolytic Capacitor PCB

When the aluminum electrolytic capacitor reaches the end of its life… †4 → the power supply may fail, preventing normal startup.

1 Slide the unit in the direction of the arrow.

2 Disconnect the connectors, replace the part, and reassemble the unit.

■ Replacing the Display PCB (LCD, LED)

When the LCD reaches the end of its life… †5 → the text may become too light, certain segments may not illuminate, or the visibility may deteriorate altogether.

1 Place the screwdriver tip in the tab, and pry apart in the direction of the arrow.

2 Detach the part while tilting it in the direction of the arrow.

3 Attach the new part and reassemble.

CAUTION

Capacitors tend to deteriorate over time while in storage. Contact us if capacitors kept in reserve need to be replaced.

Be sure to take every precaution to protect against static electricity to avoid physical and subsequent functional damage to the product.

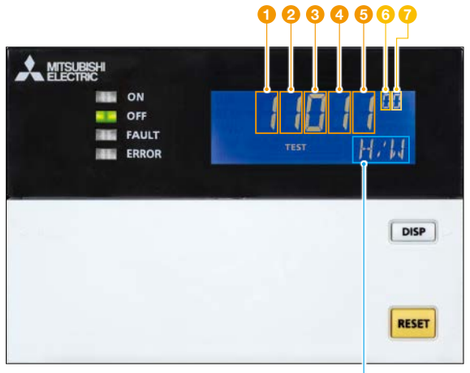
†1: Aluminum electrolytic capacitor, LCD, LED.
†2: Replacement parts are sold separately. Contact us to place your orders.
†3: A long service life aluminum electrolytic capacitor rated at 125°C and 5,000hr is adopted.
†4: We designate replacement time of the aluminum electrolyte capacitor as 10 years.
†5: The liquid crystal display (LCD) is likely to require replacement after 10 years or so of use.

(2) Adding/Changing Specifications

It's no longer necessary to replace the EMC-B main unit.
Specifications can be changed simply by making additions/changes to the options board. †6

■ Procedure for Checking Specifications

The present specifications and specifications after making changes can be easily checked in test mode.



H/W: Indicates that specifications are based on hardware.

<EMC-B hardware-based specifications list>

1. Micro-leakage current measurement specification
   Micro-leakage current measurement data:
   (0: None, 1: Yes)
2. Auxiliary power supply
   Auxiliary power supply data: (0: None, 1: Yes)
3. No external current output
   External current output data: (T/D: Transducer)
   (0: None, 2: 0-1mA + 4-20mA)
4. 5-point input
   Input/Output data:
   (0: None, 1: 5-point input + 10-point output, 2: 7-point input + 8-point output)
5. CDL transmission
   protocol: (0: None, 1: CDL, 2: CC-Link, 3: Modbus®-RTU)
6. No system error contact output function
   System error contact output function: (0: None, 1: Yes)
7. No low-sensitivity ground overcurrent specification
   Low-sensitivity ground overcurrent specification:
   (0: None, 1: Yes)

†6: Changes are not possible for some product versions. Please check with a Mitsubishi Electric representative.

3.8 Energy Savings

■ LCD Normally Off Mode

The EMC-B LCD can be set to normally on or normally off.

● LCD Normally Off mode

In this mode, the LCD is normally off, prioritizing energy savings. The LCD turns on (high brightness) during key operation and turns off two minutes after key operation stops.
Please note that use of the Normally On mode shortens the service life of the LCD. Therefore, we recommend operation in Normally Off mode.

● LCD Normally On mode

In this mode, the LCD is always on, prioritizing visibility. The low/ultra - low brightness mode can be used for energy-saving operation but the service life will be shorter compared to use in Normally Off mode. In high-brightness mode, the LCD remains on with high brightness regardless of the amount of time elapsed. In low/ ultra-low brightness mode, the LCD switches to high brightness when key operation begins, and returns to low brightness two minutes after key operation stops.

■ Settings can be used to prioritize saving energy or visibility.

LCD mode	Backlight on/off status				
	Key operation	⇒	Normal (2min after key operated)	⇒	Key operation again
LCD Normally Off mode	High brightness	⇒	Off	⇒	High brightness
LCD Normally On mode (low/ultra-low brightness)	High brightness	⇒	Low/ultra-low brightness	⇒	High brightness
LCD Normally On mode (high brightness)	High brightness	⇒	High brightness	⇒	High brightness

■ Power/Electrical Energy

The EMC-B comes with a simplified power/electrical energy measurement function as standard, providing measurements of power and electrical energy according to a preset input voltage/power factor. Measurement of power/electrical energy is provided to improve energy-savings.

■ 0-1mA DC Current Output

The existing main circuit current (running current) may be output in the form of a 0-1mA DC current (optional).
After doing so, there is no longer any need to add CT for an external meter, and the output current may be reduced from 1 (or 5) A to 1mA , further contributing to various energy-saving schemes.

■ Small-capacity Control Transformer

In addition to the existing 75-VA and 150-VA control transformers, a 50-VA small-capacity control transformer has been added to the line-up to accommodate wide-ranging energy-saving schemes.

3.9 Security

The EMC-B now makes it possible to deploy a soft padlock (security function †1) designed to lock data electronically via special software.
Previously, the cover had to be equipped with a physical padlock to ensure data protection.

Security key

Security key in use

†1: The security function requires a special security key (EMC-B-SKEY, available separately).

4 Communication

4.1 Modbus®-RTU Transmission System

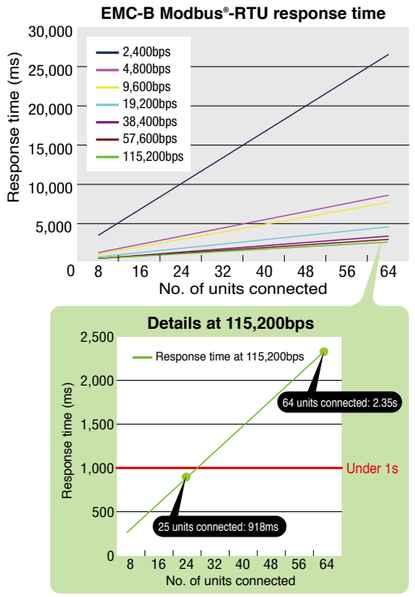
(1) What is Modbus®-RTU †1 Transmission?

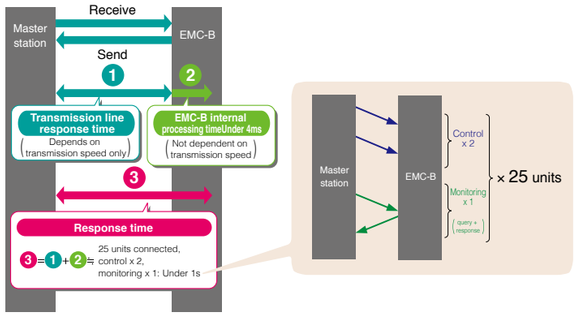
Modbus® †2 transmission is a de facto standard bus †3 equipped with the Modbus® protocol. †4 Modbus® transmission is used widely throughout industries based on the fact that the protocol has been released for public use, and also because of its simple configuration. As a multi-vendor network, Modbus® transmission-compliant devices are provided from manufacturers worldwide, so system configuration and expansion capabilities are excellent. Additionally, RS485 and other standards can be used as the physical layer.

Feature **Realizes Fast Response Time Under 1s (control x 2, monitoring x 1) When 25 EMC-B units are Connected**

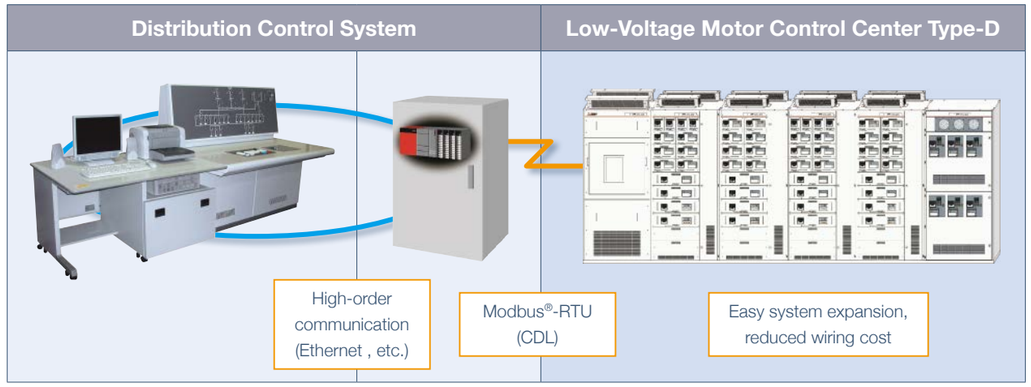
The EMC-B Modbus®-RTU supports transmission speeds of up to 115.2kbp

- Based on our unique technologies, the EMC-B internal processing time per unit has been reduced to less than 4ms.
- Based on the above, transmission of monitoring/control data at the maximum transmission speed setting (115.2kbps) when 25 EMC-B units are connected is under 1s, realizing smooth, stress-free responsiveness (calculations based on three communication exchanges [control x 2; monitoring x 1]).
- Even when the maximum of units (64) is connected, response time is still an impressive 2.5s (under the same conditions as those described above).





System configuration example



†1: As a form of serial communication, Modbus® transmission has a remote terminal unit (RTU) mode and an American Standard Code for Information Interchange (ASCⅡ) mode. In general, the RTU mode (known as Modbus®-RTU), which allows one byte of data to be sent without changes, is used (including for our EMC-B).
†2: Modbus® is a registered trademark of Schneider Electric SA.
†3: The worldwide standard transmission bus for all practical purposes irrespective of whether or not there are established standards or norms.
†4: A communications protocol developed by Modicon Inc. (AEG Schneider Automation International S.A.S.) for programmable logic controllers (PLCs).

(2) Advantages of EMC-B Modbus® Transmission

- Excellent responsiveness ⇒ Equal to or under 10ms, excluding transmission route (fixed regardless of transmission speed)
- Faster transmission speed than the standard Modbus® transmission ⇒ Set speed up to 115.2kbps
- Increased No. of connected terminals ⇒ Up to 64 units can be connected (standard: 32 units)

	Item	Specifications
Physical conditions	Transmission medium	Three-line twist sealed cable [0.3sq], FG line [1.25sq]
	Transmission distance	1,200m (at 19.2kbps) (changes depending on transmission speed)
	Topology	Bus method
	Connected terminals	Max. 64 units
	Settable addresses	1 ～ 257 (amount for 64 units)
	Transmission line	Five in total: DA(RX+) (transmission line), DB(RX-)(transmission line), DG(GND), FG and SLD
	Terminal resistance	120Ω
	Physical layer	RS485 †5
Electrical conditions	Transmission speed	2.4k, 4.8k, 9.6k, 19.2k, 38.4k, 57.6k, 115.2bps (control center standard is 19.2k)
	Bus connection method	Photo coupler
	Transmission power source	Not required (supplied from EMC-B)
Logic system	Transmission/Control system	Single master/multi-slave system, †6 function code †7
	Synchronizing method	Asynchronous (data: 8-bit, parity: 1-bit)
	General frame configuration	AF | FF | DATA | CRC AF: Address field (1 byte) DATA: Data field (max. 253 bytes) FF: Function field (1 byte) CRC: Cyclic redundancy check (error check field) (2 bytes)
	Parity bit	Non, odd, even †8
	Stop bit	1 or 2 †8
	Error detection	Parity, CRC †9
Other functions	Broadcast	Broadcast query †10
	Redundancy specifications	Double-master system/Standby-master system (for both systems, consult a Mitsubishi Electric representative regarding the delivery schedule)

†5: RS485 are standards relating to the level of the communications-protocol physical layer, which consists of two lines: the communications line and grounding line.
†6: In Modbus® transmission, only the master station can issue a query (start transmission). The slave stations see the query, perform the specified function and send a response message.
†7: In Modbus® transmission, a code known as the function code is prepared. This code defines the transmission function and allows support functions to be adopted or rejected for each device (the supporting function codes for the EMC-B are shown below).
†8: Parity-bit and stop-bit settings are correlated as follows.
① Parity bit: Odd or even ⇒ Stop bit: 1 ② Parity bit: Non ⇒ Stop bit: 2
†9: Cyclic redundancy check (CRC) is an error-detection technique that uses a prepared, standardized generator polynomial, and considers the data frame that transmits the CRC to be a high-degree polynomial.
†10: Special queries transmitted as a batch from a master station to all slave stations. The receiving slave stations execute functions as directed by the query but cannot send an answer.

4 Communication

4.1 Modbus®-RTU Transmission System

(3) Example Modbus®-RTU Transmission System Configuration

Examples of single and redundant configurations are shown below for the case of the EMC-B with Modbus®-RTU transmission system. The EMC-B can be connected to any machinery or system that conforms to the Modbus®-RTU transmission protocol.

For the EMC-B with redundant system configurations, various configurations can be realized in the range where redundancy is desired (see ❶ to ❹ below). It is also possible to connect directly to a distributed control system (DCS) without going through a programmable logic controller (PLC).

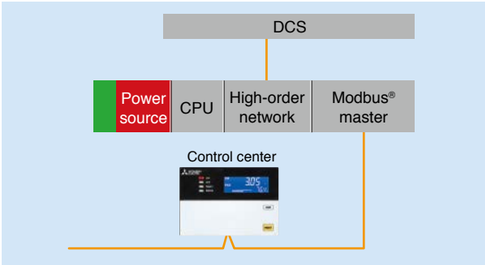


Fig. 1 In the case of single Modbus®-RTU

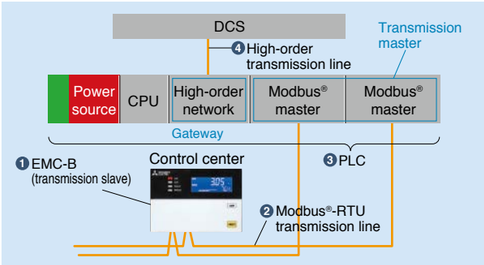


Fig. 2 In the case of redundant Modbus®-RTU

Range where redundancy is possible in our EMC-B
(In Fig. 2, redundancy is from EMC-B to transmission master (❶ + ❷ below))

❶ EMC-B (transmission slave)
❷ Modbus®-RTU transmission line (between EMC-B ⇔ PLC)
❸ PLC (power source, CPU, transmission master, gateway †1)
❹ High-order transmission line (between PLC ⇔ DCS)

(4) Redundant Modbus®-RTU Transmission Control System: A Choice of Two Types to Suit Customer Operations

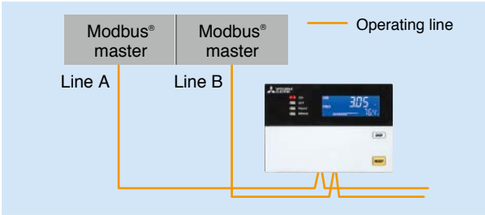


Fig. 3 Double-master system (standard)

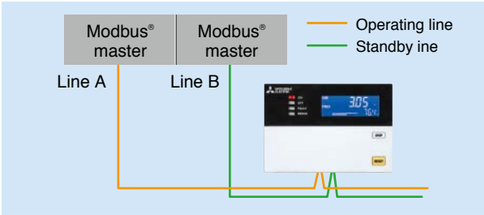


Fig. 4 Standby master system (option)

Control system	Double-master system	Standby master system
Features	Consists of two operating lines (A and B), and the same commands (control, monitoring) are sent simultaneously for both lines. • Useful for equipment where a power outage is not acceptable.	Control is via the operating line (line A) only. The standby line (line B) is only used to check system soundness (monitoring). • The system that is in general use.
Merits	No need to consider the switching time regardless of which line the error occurs in.	No need to set timing for either line (operating, standby). Can be applied to single transmission routes.
Demerits	Care is needed to ensure that the difference in control timing between the two lines does become too large to make sure that subsequently received control signals can be accepted. Cannot be applied to single transmission routes.	Need to consider switching time (dead time: dependant on system) when an error occurs in the operating line.
Applicable (recommended) systems	Systems that require 24-hour operation or where it is difficult to secure time for switching (i.e., systems where a power outage is not acceptable).	Standard systems or systems with single transmission route (e.g., systems where only the master is redundant).

†1: A transmission system component that enables overall communications through mutual conversion of data differing in terms of medium or protocol.

(5) Functions Provided by Modbus®-RTU Transmission

Transmission function	Modbus®-RTU support
Status monitoring	○
Current monitoring	○
Operation log monitoring	○
Error monitoring	○
Polling transmission †2	△
Control command	○
Automatic inspection execution command	○

Transmission function	Modbus®-RTU support
Operation log clear command	○
Condition change notification †3	×
Setting change notification †3	×
Read setting value	○
Write setting value	○
Loopback test †4	○
Broadcast transmission	○

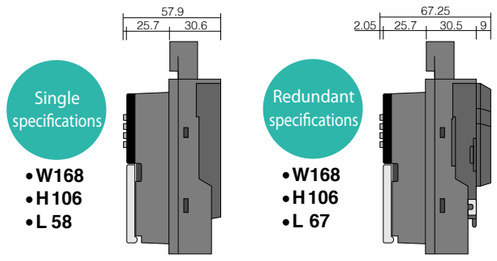
(6) Modbus® Function Code

For EMC-B, the following items are supported within the function code defined in the Modbus® protocol.

				Function		EMC-B support †5
				Code	Sub Code	
Data access	Bit Access	Physical discrete inputs	Read discrete inputs	02		○
		Internal bits or physical coils	Read coils	01		○
			Write single coil	05		○
			Write multiple coils	15		○
	16 Bits Access	Physical input registers	Read input registers	04		○
		Internal registers or physical output registers	Read holding registers	03		○
			Write single register	06		○
Diagnostics			Diagnostics	08	Only 00 supported	△

(7) Structures of EMC-B

The EMC-B has an industry-leading compact size thanks to use of the same external dimensions (length, width) for both redundant and single transmission specifications. In addition, MCC units with a height equivalent to the 1/2 unit can be stored with an increase in the depth dimension of only approximately 10mm.



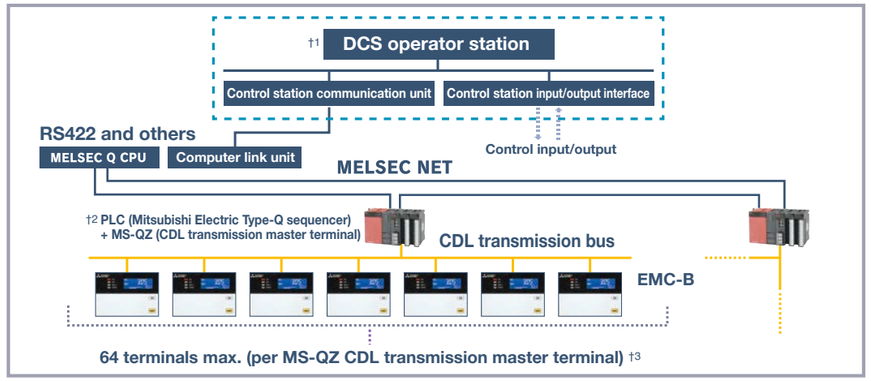
†2: There is no polling function in Modbus®-RTU transmission, but polling can be achieved via a master-side application.
†3: There is no notification function in Modbus®-RTU transmission; the EMC-B only replies to queries from the master station.
†4: Only supported in Modbus®-RTU transmission.
†5: Circles (○) indicate total support; triangles (△) indicate partial support.

4.2 CDL Transmission System

(1) What is a CDL Transmission System?

Control center data link systems (CDLs) were developed to establish a control/information network connecting various devices and equipment in a power distribution system. They are primarily used as part of a configuration for monitoring power distribution systems managed from control centers. Connecting devices and equipment with a flexible, branching digital network reduces wiring costs, facilitates distributive control/collective supervision/maintenance, and results in reliable systems.

Sample Configuration for a CDL Transmission System



(2) Calculating Transmission Distance

A CDL transmission system uses electric current to transmit signals. Feasible transmission distances depend on transmission line impedance and the number of connected terminals. The specific transmission type affects the propagation time of the entire transmission system. This makes it important to determine transmission distances in ways that satisfy both of the following requirements:

- The transmission system is divided into independent systems (nodes) separated by relays (RPG) or optical converters (OEG) with the maximum length of each node assigned the value in Table 1.
- The overall transmission system consists of nodes. The maximum distance between the two terminals that are farthest apart is the figure given in Table 2.

Table 1

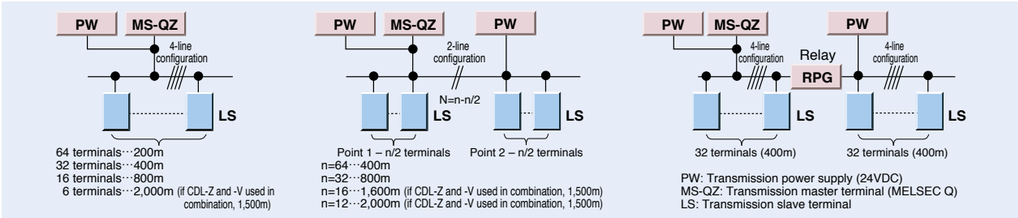
Transmission line type [Single]	Maximum node length (N being 64 max.)
0.75mm² (AWG 18, ϕ1.0mm)	76/N×100m
1.25mm² (AWG 16, ϕ1.3mm)	128/N×100m
2.0mm² (AWG 14, ϕ1.6mm)	200/N×100m

N: number of terminals.

Table 2

Conditions	Maximum transmission system length
Basic system (not using relays or optical converters)	2,000m (if CDL-Z and -V used in combination, 1,500m)
Transmission system using a repeater	4,000m (if CDL-Z and -V used in combination, 3,000m)
System with "n" repeaters (n = 1, 2, 3, 4)	2,000 × (n+1) m (1,500 × (n+1) m when using CDL-Z or CDL-V) Max. length is 10,000m (6,000m when using CDL-Z or CDL-V)
Transmission system using an optical converter	Silica glass GI type optical fiber 2,000m

Example using 1.25mm² transmission line (AWG 16, ϕ1.3mm, single line)



†1: Distributed Control System.
†2: Programmable Logic Controller.
†3: For the maximum number of MS-QZs that can be accommodated by a PLC, see the catalog for the "Network System CDL for Mitsubishi Electric Power Distribution Systems" (Japanese only) (JNEE-SL-0123).
If adding a local station to the system, please be certain to turn off the transmission power-supply first. Devices may be damaged due to factors such as cabling errors or short-circuiting between the pins.

(3) CDL Transmission-based Functions

Transmission function	CDL support
Status monitoring	○
Current monitoring	○
Operation log monitoring	○
Error monitoring	○
Polling transmission †4	○
Control command	○
Automatic inspection command	○

Transmission function	CDL support
Clear operation log command	○
Status change notification	○
Setting change notification	○
Read settings	○
Write settings †5	×
Loopback test †6	×
Broadcast transmission	○

(4) CDL Transmission System Specifications

	Item	Specifications	
Physical conditions	Transmission medium	Electricity	Twisted pair cable KV/KHV/CPEE 0.75 to 2.0mm² (AWG 14 to 18)
		Light	Silica glass GI50/125 optical fiber
	Transmission distance	By electricity	2,000m (depending on cable size and number of terminals) †7
		By light	Silica glass GI optical fiber 2,000m †7
	Topology	Bus type (loop connection also possible)	
	Connected terminals	64 terminals max. (depending on type)	
	Transmission line	4 in total, i.e., P (power): 1; N (GND): 2; S (signal): 1	
Electrical conditions	Transmission speed	9.6kbps (bit/s)	
	Signal/Type	Time-division multiplex digital transmission †8, Baseband †9, Current bus †10	
	Bus connection	By photocoupler	
	Transmission power supply	24VDC (signal line: 12VDC)	
Logic	Control	CSMA/NBA †11	
	Synchronization	Asynchronous (8-bit data, 1-bit parity)	
	Basic frame construction	SA | DA | CW | BC | DATA | FCC SA: Self address (1 byte) DA: Destination address (1 byte) CW: Control code (1 byte) BC: DATA byte size (1 byte) DATA: Transmission data FCC: Frame check code (1 byte)	
	Error detection	Combined parity/FCC	
Self-diagnosis	Bus low-level detection/separation	The duration for which the level of the signal line (S) remains low is monitored. If it remains low for more than a specific period (200 to 500ms), an error condition is assumed, resulting in cutting off the terminal signal line in question from the CDL transmission bus.	
	Double-address detection	The use of the same address by different slave terminals results in a double-address error.	

†4: Standard function for CDL transmission.
†5: For CDL transmission, it is not possible to write settings.
†6: Only Modbus®-RTU transmission is supported.
†7: May be increased to 10km max. using repeaters.
†8: Refers to a transmission system in which a single transmission channel is used by multiple terminals through a time-share scheme.
†9: Refers to a transmission system in which digital signals are sent to a transmission channel without modulation.
†10: Refers to a transmission system using electric current.
†11: Refers to a transmission system often used in field networks intended primarily to connect field equipment and sequencers or to connect controllers to other controllers. Individual terminals and nodes (master terminals) monitor the common bus, initiating transmission when it becomes available. (Transmission collisions are circumvented by applying a set of rules that grant varying precedence to individual nodes.) Since any of the nodes is likely to be using the bus at any given time, the system is highly efficient. The abbreviation stands for Carrier Sense Multiple Access with Non-destructive Bitwise Arbitration.

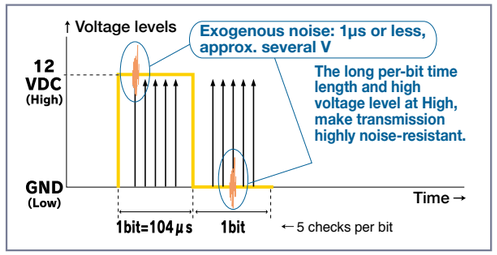
4.2 CDL Transmission System

(5) High Reliability (noise resistance)

■ CDL Transmission and Noise Resistance

In CDL transmission, the level of the signal line at High is 12VDC. This is sufficiently high relative to noise waveforms (approximately several V). At transmission speeds of 9.6kbps, the per-bit time length (104μs) is also sufficient for noise waveforms (several μs or less). These factors make the line highly resistant to external noise. Combined with the signal level check (bit checks) executed as often as five times per bit, they make CDL a remarkably reliable transmission system.

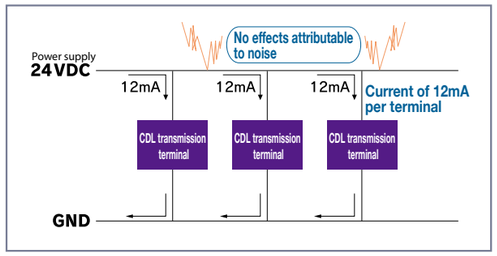
Noise Resistance Characteristics of CDL Transmission



■ Current Loop Scheme

CDL transmission applies a current loop scheme whereby signals are sent using changes in electric current. As a transmission system that takes advantage of an appreciable amount of current (i.e., 12mA per terminal), it is relatively unaffected by transmission cable resistance and offers high S/N ratios and high noise resistance.

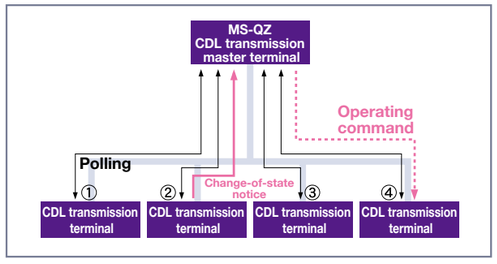
Current Loop Scheme



(6) Improved Response

In CDL transmissions, slave terminals normally respond in sequence (①⇒②⇒③⇒④) to polling (periodical queries) from the master terminal based on assigned addresses. In this method, it takes 12.8s for the master terminal to call on a specific slave terminal (polling) regardless of the number of connected terminals. (In the diagram to the right, each of the terminals ① through ④ are called once every 12.8s.) Thanks to a CSMA/NBA system [18], a change in the state of a slave terminal (e.g., in its output contact or presence of a fault) is immediately reported before polling by the master terminal occurs. Likewise, data initiating a command for operations written to the master terminal will be executed immediately on the slave terminal in question. Signal transmission (change-of-state notice, operating commands) between master and slave terminals occurs based on the priority specific to a CDL transmission.

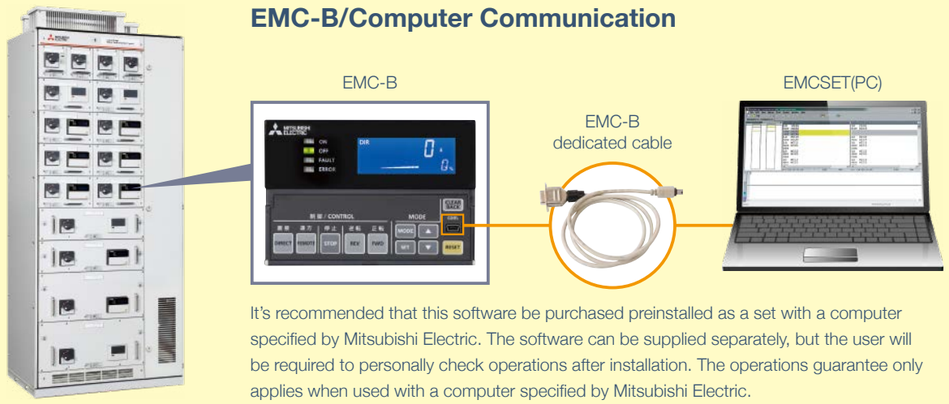
Improved Response



4.3 EMCSET Plant Startup/Maintenance Support Software (Computer Version) (Optional)

This software makes it easy to efficiently read/write internal sequence data and edit setting data/display operation logs of the EMC-B using a computer.

EMC-B/Computer Communication



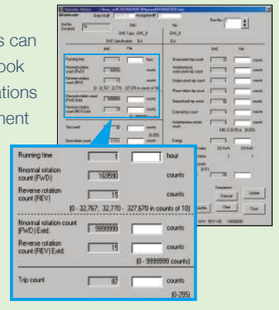
It's recommended that this software be purchased preinstalled as a set with a computer specified by Mitsubishi Electric. The software can be supplied separately, but the user will be required to personally check operations after installation. The operations guarantee only applies when used with a computer specified by Mitsubishi Electric.

Advantages Demonstrated in Four Situations

1. Supports plant startup work

Quickly test operations at time of plant startup

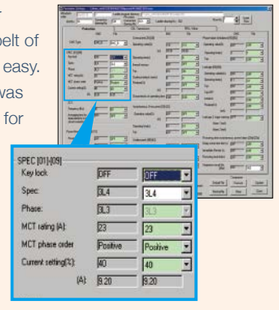
The number of motor operations and failures can be checked easily. It took less time to test operations when installing equipment for production line A.



2. Simple data editing

Easily complete settings using data-editing software

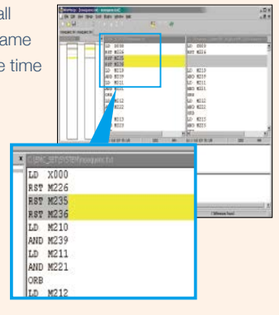
Setting the EMC-B for expanding conveyor belt of production line B was easy. All that was required was carrying over the data for existing EMC-B settings.



3. Computer-based centralized management

Carry-over sequence circuits too…

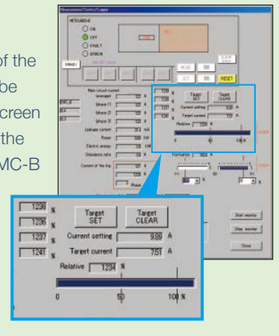
It's now easier to put all the EMCs under the same sequence circuit at the time of plant startup too.



4. Simple to change EMC-B internal sequence circuits

Integrate EMC-B status displays

When starting up production line C, all of the measurements could be checked on a single screen without having to use the control panel of the EMC-B main unit. The data log function is also very convenient for maintenance.



5 Motor Deterioration Diagnosis (Optional)

The multi-controller (EMC-BA-PRO) equipped on the Control Center analyzes motor current and voltage signals to diagnose motor deterioration.

EMC-BA-PRO can diagnose deterioration on both the mechanical and electrical system motors of pumps, compressors, fans and so on.

It can even detect bearing and insulation defects that cause around half of all motor failures.

5.1 Advantages of deterioration diagnosis

- Efficient maintenance
  Through combining time-based maintenance (TBM) and condition-based maintenance (CBM), stable diagnosis, both effective and economical maintenance is possible.
- Regular diagnosis
  Through analysis of motor current and voltage values, which does not depend on inspector skill, this function helps alleviate the workload of inspectors.
- Prevention of sudden breakdowns
  Constant online monitoring detects faults in advance, therefore making it possible to prevent equipment stoppages caused by sudden breakdowns.

Applicable models

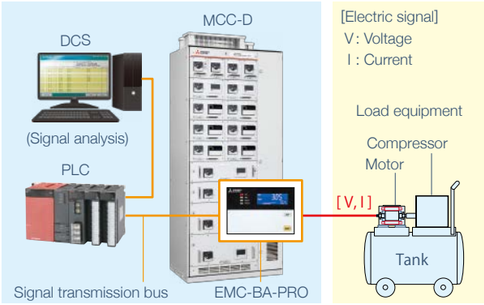
Item		Current models		Old models		
Controlgear		Type-D	Type-B	Type-A	Type-Z	Type-V
New panel		Applicable		Applicable	————	
Modification	Individual unit	Replaceable		Replaceable		
	EMC unit	Replaceable*		Not replaceable		

* A voltage input wire must be added

5.2 System configuration

Feature of the system

- Adopts the constant online monitoring approach based on electric signal (current/voltage) analysis. Issues a breakdown alarm when the pre-set threshold is exceeded.
- Breakdown alarms can be confirmed at the host DCS using the transmission function. (Option)
- Current/voltage signals are obtained at the Control Center therefore no electrical work is required. Signals are affected by the installation environment of the motor and load equipment.
- Faults inside the motor (stator winding/rotor bar) are also detectable.
- It is also possible to detect torque faults of the load equipment.



Detection accuracy †1

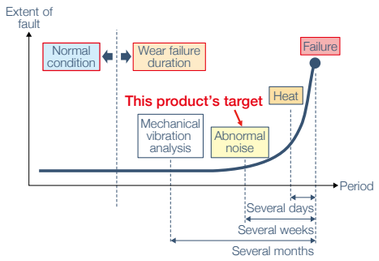
Diagnosis using the electrical signal method (current/voltage) makes it easy to detect faults that can't be diagnosed using the mechanical vibration method; namely "breakage or damage of rotor bar" and "layer shorts of stator winding."

◎ Detection available (high accuracy) ○ Detection available × Detection unavailable

Item		Electrical signal	Mechanical vibration
Fault detection	Mechanical	○	◎
	Bearing*	○	◎
	Misalignment	○	◎
	Rotor bar	○	×
	Stator winding	○	×
	Belt fault	○	○
Diagnosis method		Constant online monitoring	On-site diagnosis

* Regarding bearing defects, faults are detected at the abnormal sound stage (several weeks prior to failure)

Diagnosis for motor wear failure



†1: Detection accuracy changes depending on the motor type and operating environment.

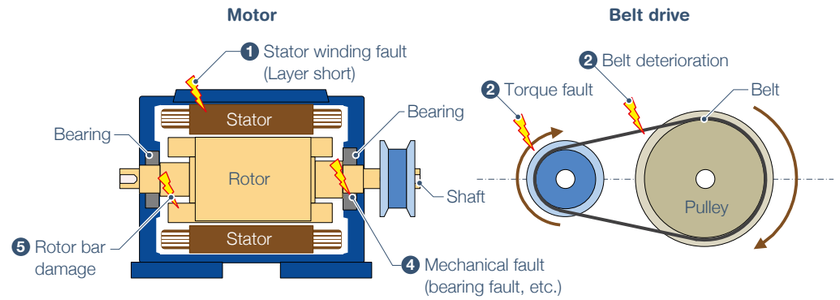
5.3 Deterioration diagnosis

Diagnosis setting †2

Item	Failure content
Motor rated voltage	200 V AC, 400 V AC (100 V AC unavailable)
No. of motor poles	2 poles, 4 poles, 6 poles
Phase/wire system	3 phase, 3 wire
Drive type	Commercial power (inverter unavailable)
Measurement time	Only during motor operation (diagnosis may not be possible if motor is only operating for a short time)
Voltage unbalance	Voltage unbalance ratio ≦1% (1%>: layer short detection unavailable)

Detection method

Current/voltage signals during motor operation are analyzed with EMC-BA-PRO (frequency analysis, reverse-phase component analysis, flux analysis) and five categories of fault symptoms are detected.



Item	Current	Current/voltage	
Electrical signal	Electric current value	Electric current – voltage value	
Analysis	Frequency Characteristic component	Reverse-phase component	Flux
Diagnosis item	❸ Belt deterioration †3 ❹ Mechanical fault (bearing fault, etc.) †4 ❺ Rotor bar damage †4	❶ Stator winding fault (layer short)	❷ Torque fault

Diagnosis item

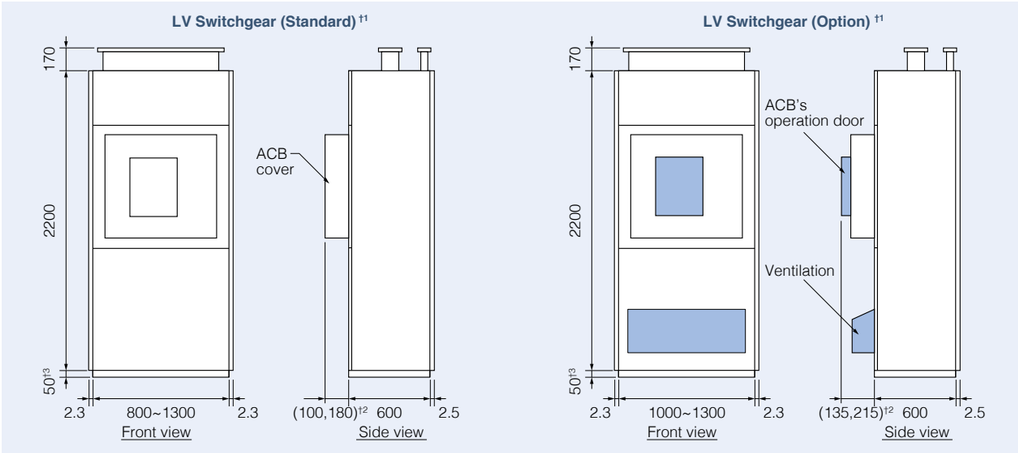
Diagnosed potion		Failure content	Alarm
Motor	Main unit	Abnormal vibration, mechanical fault, misalignment, loosening	Mechanical fault †4
	Bearing	Damage (flaking)	
	Rotor bar	Bar break, damage, etc.	Rotor fault †4
	Stator winding	Layer short	Layer short fault
Connection	Belt connected portion	Belt disconnection, belt loosening, etc. (slip)	Belt fault †3
Load	Equipment	Torque fault	Torque fault

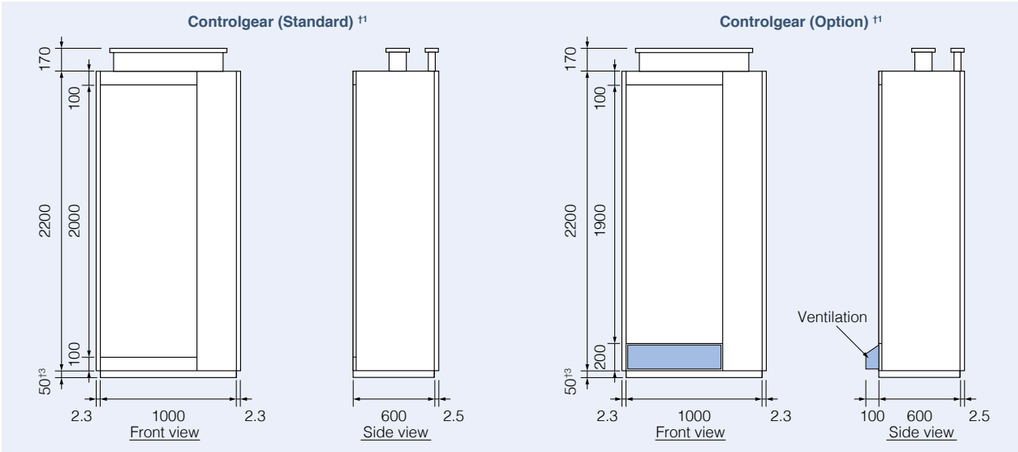
†2: When performing diagnosis, it is only necessary to input the motor test report data, bearing number, etc. into EMC-BA-PRO.
In regards to Mitsubishi Electric's SF-PR (0.75 - 55kW), SF-JR (0.2 - 55kW), no input is required.
†3: Belt drive device only
†4: Diagnosis cannot be performed on the gear drive unit.

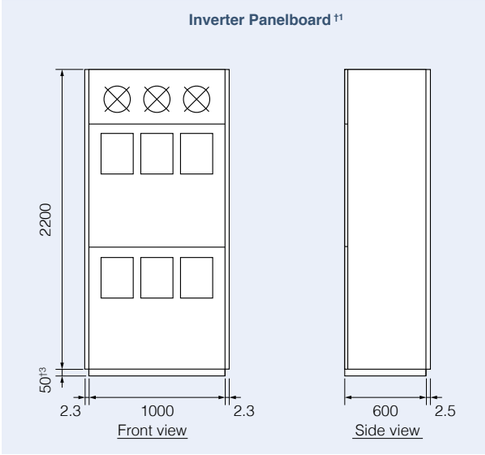
6 Dimensions and Installation of MCC-D

6.1 External Dimensions

Unit:mm







†1: List of standard and special protection structures

Panel name	Specifications	Degree of protection	Internal arc
LV Switchgear	Standard	IP2X	——
	Option	IP43 †4	●
Controlgear	Standard	IP2X	——
	Option	IP43 †4	●
Inverter Panelboard	Standard	IP2X	——

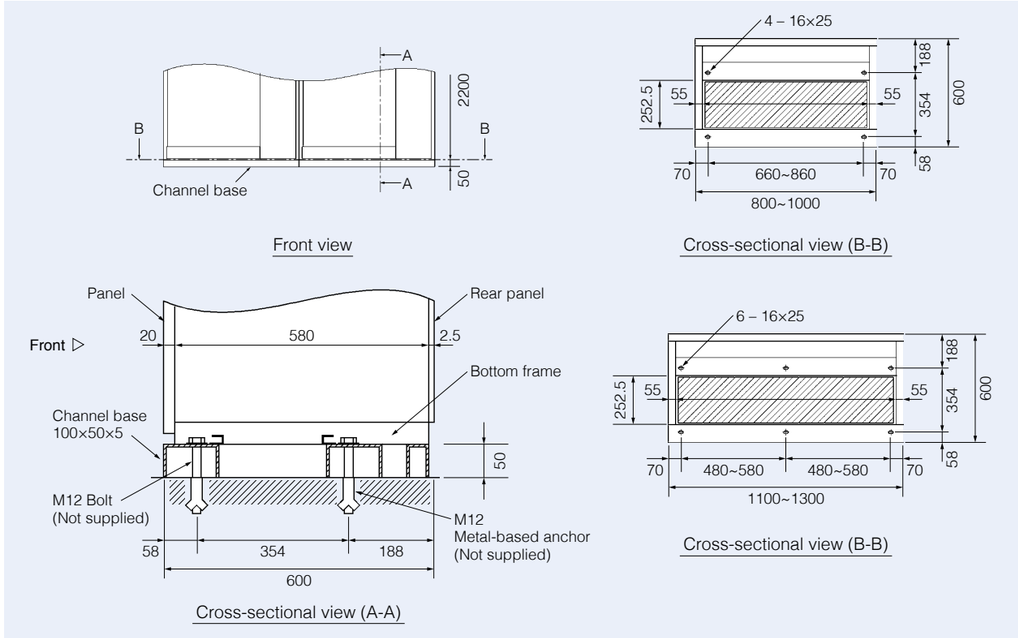
†2: List of ACB front cover and front door dimensions

Panel Specifications	ACB Rated current / Rated conditional short-circuit current	ACB cover	ACB's operation door
Standard	≦ 2000A	100mm	——
	> 2000A	180mm	——
Option	≦ 2000A	135mm	
	> 2000A	215mm	

†3: The 50mm height of the channel base is not included in the height dimension.
†4: A roof is included if the ventilation is drip-proof.

6.2 Installation

Unit:mm



(Note)
1. Channel base is per panel only.
2. Channel base height is 50mm.
3. Packaging is at per panel.
4. Only the necessary number of foundation bolts (above) are supplied upon request.
5. After removing the shipping brackets, attach the decorative plate included to the side of the channel base using the M5 tapping screws.

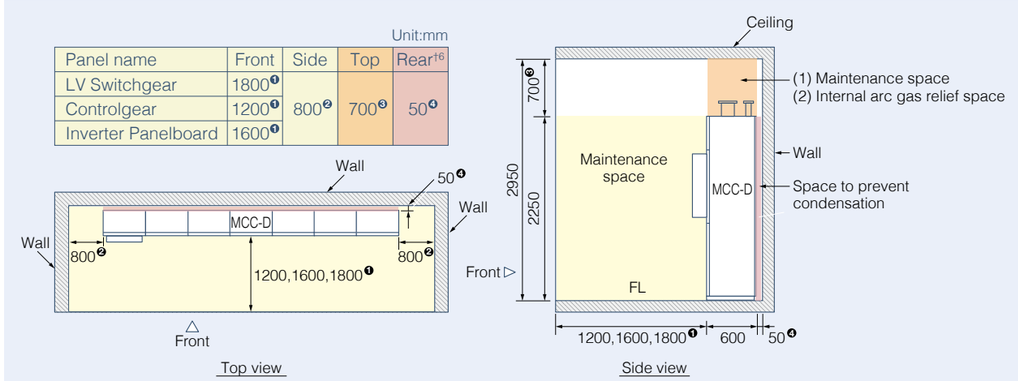
6.3 Minimum Dimensions for the Switchgear Room

(1) Maintenance space †5

Unit:mm

Unit:mm

Panel name	Front	Side	Top	Rear†6
LV Switchgear	1800❶	800❷	700❸	50❹
Controlgear	1200❶			
Inverter Panelboard	1600❶			



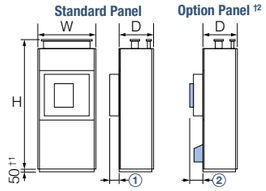
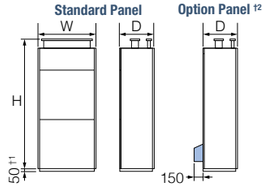
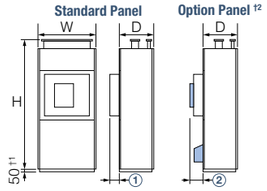
(2) Internal arc gas relief space

Please secure at least 700mm between the respective ceilings of the cubicle and electric room.

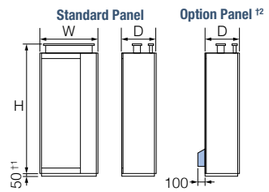
†5: Please secure more maintenance space than the dimension indicated in the table.
†6: Space to prevent condensation

7 Selection Table of MCC-D

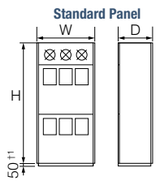
7.1 Low-Voltage Switchgear Ratings

Panel frame size				Rated voltage	Rated short-time withstand current
Incomer Bus tie		• Width : 1000 to 1300mm • Height : 2370mm • Depth : 600mm • Weight : Approx. 1300kg †3 **ACB cover depth dimension** (Unit: mm) ≦2000A / >2000A ① 100 / 180 ② 135 / 215	Panel ACB (see page 58)	Up to 690V	Up to 85kA, 1Sec
Bus riser		• Width : 800 to 1000mm • Height : 2370mm • Depth : 600mm • Weight : Approx 1000kg †3	Panel		
Outgoing feeder		• Width : 1000mm • Height : 2370mm • Depth : 600mm • Weight : Approx 800kg †3 **ACB cover depth dimension** (Unit: mm) ≦2000A ① 100 ② 135	Panel ACB (see page 58)		65kA, 1Sec

7.2 Controlgear Ratings

Panel frame size				Rated voltage	Rated short-time withstand current
		• Width : 1000mm • Height : 2370mm • Depth : 600mm • Weight : Approx 750kg †3	Panel	Up to 690V	Up to 85kA, 1Sec
			Controlgear Unit (see page 59)	Up to 480V	65kA, (85kA †4)

7.3 Inverter Panelboard Ratings

Panel frame size				Rated voltage	Rated short-time withstand current
		• Width : 1000mm • Height : 2200mm • Depth : 600mm • Weight : Approx 500kg †3	Panel	Up to 690V	Up to 85kA, 1Sec
			Inverter Unit (see page 63)	Up to 440V	65kA

†1: The 50mm height of the channel base is not included in the height dimension.
†2: The special panel has a protection rating (IP43) and internal arc specifications. For drip protection with a protection rating of IP43 , a roof can be attached to the Ventilation.
†3: This weight is the standard value and may slightly change depending on the rated current, stored device, etc. so please contact us for details on weight.
†4: To be released later.

8 Selection Table of Unit

8.1 Low-Voltage Switchgear Unit Selection Table

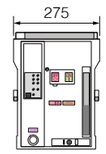
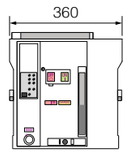
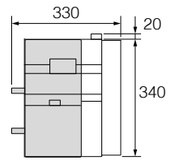
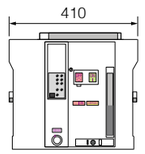
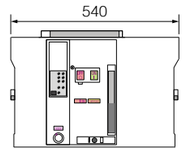
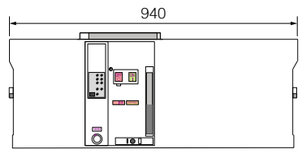
(1) Air circuit breaker (ACB) Ratings

Applied standard: IEC 60947-2

Panel name	Rated voltage	Rated short-time withstand current	Rated current									
			AE630-SW	AE1000-SW	AE1250-SW	AE1600-SW	AE2000-SWA	AE2000-SW	AE2500-SW	AE3200-SW	AE4000-SWA	AE4000-SW
			630A	1000A	1250A	1600A	2000A		2500A	3200A	4000A	
Incomer	690V	65kA / 1s	●	●	●	●	●	—	—	—	—	—
		75kA / 1s	—	—	—	—	—	●	●	●	●	—
		85kA / 1s	—	—	—	—	—	—	—	—	—	●
Bus tie	690V	65kA / 1s	●	●	●	●	●	—	—	—	—	—
		75kA / 1s	—	—	—	—	—	●	●	●	●	—
		85kA / 1s	—	—	—	—	—	—	—	—	—	●
Outgoing feeder	690V	65kA / 1s	●	●	●	●	●	—	—	—	—	—
Weight †5 (kg)		3P	37	38	38	39	39	57	58	59	59	115
		4P	47	48	48	49	49	70	71	72	75	123

(2) External Dimensions of Air circuit breaker (ACB)

(Unit:mm)

Model	Front		Side
	3P †6	4P †6	
AE630-SW AE1000-SW AE1250-SW AE1600-SW AE2000-SWA			
AE2000-SW AE2500-SW AE3200-SW AE4000-SWA			
AE4000-SW			

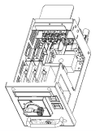
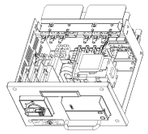
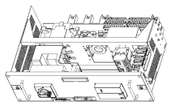
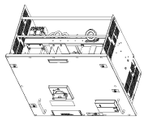
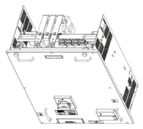
†5: Weight of the ACB in isolation, Does not include the drawout frame.
†6: 3P and 4P are the number of poles in the ACB's main circuit

8 Selection Table of Unit

8.2 Controlgear Unit Selection Table

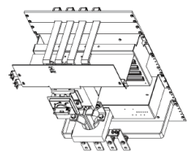
(1) Unit Ratings

■ **Automatic Connection unit**

†2			Coordination †3	Rated voltage	Rated capacity	Rated conditional short-circuit current	NOS pole	Weight (kg)
1/4 Unit : **Type D2Q** • Width : 150mm • Height : 200mm • Depth : 380mm		Power feeder	Type 1	Up to 460V	≦30A	≦50kA	3P	7
							4P	7
			Type 2 †4	Up to 415V	≦30A	≦85kA	3P	†5
							4P	†5
1/2 Unit : **Type D2H** • Width : 300mm • Height : 200mm • Depth : 380mm		Power feeder	Type 1	Up to 480V	≦63A	≦65kA	3P	11
							4P	12
			Type 2 †4	Up to 480V	≦50A	≦85kA	3P	†5
		Motor starter †2	Type 1	Up to 460V	≦22 kW	≦50kA	3P	14
			Type 2 †4	Up to 415V	≦7.5 kW	≦85kA	3P	†5
1/1 Unit : †1 **Type D2** • Width : 600mm • Height : 200mm • Depth : 520mm		Power feeder	Type 1	Up to 480V	≦225A	≦65kA	3P	32
							4P	33
			Type 2 †4	Up to 480V	≦225A	≦85kA	3P	†5
							4P	†5
		Motor starter †2	Type 1	Up to 480V	≦55kW	≦65kA	3P	38
			Type 2 †4	Up to 415V	≦50kW	≦85kA	3P	†5
				Up to 480V	≦37kW	≦85kA	3P	†5
1/1 Unit : †1 **Type D3** • Width : 660mm • Height : 300mm • Depth : 520mm		Power feeder	Type 1	Up to 480V	≦225A	≦65kA	3P	38
							4P	39
			Type 2 †4	Up to 480V	≦ 225A	≦ 85kA	3P	†5
							4P	†5
		Motor starter †2	Type 1	Up to 480V	≦90kW	≦65kA	3P	49
			Type 2 †4	Up to 415V	≦50kW	≦85kA	3P	†5
1/1 Unit : †1 **Type D4** • Width : 660mm • Height : 400mm • Depth : 520mm		Motor starter †2	Type 2 †4	Up to 480V	≦90kW	≦85kA	3P	†5
1/1 Unit : †1 **Type D6** • Width : 660mm • Height : 600mm • Depth : 540mm		Power feeder	Type 1	Up to 480V	≦400A	≦65kA	3P	55
							4P	60
			Type 2 †4	Up to 480V	≦400A	≦85kA	3P	†5
							4P	†5
		Motor starter †2	Type 1	Up to 480V	≦132kW	≦65kA	3P	85
			Type 2 †4	Up to 480V	≦132kW	≦85kA	3P	†5
1/1 Unit : †1 **Type D0** • Width : 660mm • Height : 1000mm • Depth : 540mm		Motor starter †2	Type 1	Up to 480V	≦200kW	≦65kA	3P	100

Frame size : Unit type

■ **Fixed unit**

Frame size		Coordination †3	Rated voltage	Rated capacity	Rated conditional short-circuit current	NOS pole	Weight (kg)
1/1 Unit : **Type D6 - DM** • Width : 1000mm • Height : 600mm up to 2200mm • Depth : 600mm 	Power feeder	Type 1	Up to 460V	Over 400A to 2000A	≦50kA	3P 4P	†6
		Type 1	Up to 480V		≦65kA		
		Type 2 †4	Up to 480V		≦85kA		
	Motor starter	Type 1	Up to 460V	Over 200kW to 300kW	≦50kA	3P	†6
		Type 1	Up to 480V		≦65kA		
		Type 2 †4	Up to 480V	Over 132kW to 300kW	≦85kA		

Frame size : Unit type

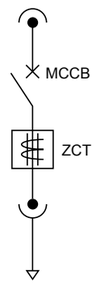
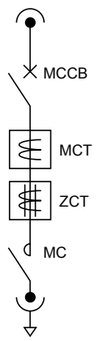
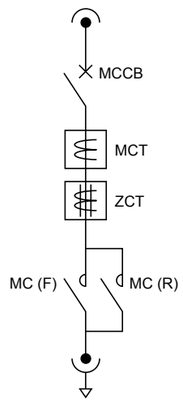
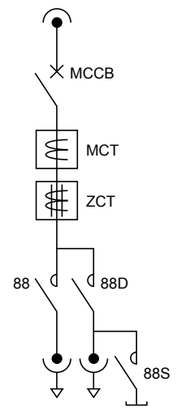
†1: If devices, apparatus, etc. are added to 1/1 Unit and these cannot all be stored in the unit, units with heights increasing in increments of 100mm can be used.
†2: The motor starter used is the standard non-reversible starter specifications.
If devices, apparatus, etc. cannot be stored in a unit due to using a different motor starter (reversible, Y-△, start reactor, etc.), units with heights increasing in increments of 100mm can be used.
†3: Coordination for Protective Devices. (see page 7 note (†7) for details)
†4: To be released later
†5: The weight of the Type 1 Coordination unit is shown for explanatory purposes.
Depending on the external dimensions and shape of stored devices, Type 2 Coordination unit may be larger than Type 1 Coordination unit, therefore please contact us for details on unit frame size and weight.
†6: 1/1 Unit (Type D6 – DM) can store devices between 600mm and 2200mm height-wise. Unit weight is not shown as this changes depending on the rated value of devices. Please contact us for details on weight.

8.2 Controlgear Unit Selection Table

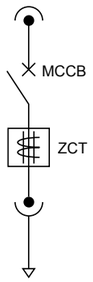
(2) Unit Selection Table (Automatic connection unit)

■ **Starter type**

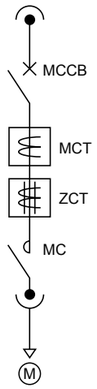
A typical starting method for Controlgear is expressed using skeleton diagrams.

Power feeder unit	Motor starter		
	Non-reversible	Reversible	Star/Delta
			

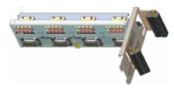
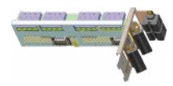
■ **Power feeder unit**

Skelton diagram	Rated current (A)	Type 1 †1		Type 2 †1, †2	
		460V	480V	415V	480V
		50kA	65kA	85kA	85kA
	30	Type D2Q	——	Type D2Q	——
	50	Type D2H	——	Type D2H	Type D2H
	63	——	Type D2H	——	——
	100	Type D2	Type D2	Type D2	Type D2
	225	Type D2	Type D2	Type D2	Type D2
		Type D3	Type D3	Type D3	Type D3
	400	Type D6	Type D6	Type D6	Type D6

■ **Starter unit †3**

Skelton diagram	Type 1 †1			Type 2 †1, †2		
	Rated capacity (kW)	460V	480V	Rated capacity (kW)	415V	480V
		50kA	65kA		85kA	85kA
	5.5	Type D2H	Type D2	7.5	Type D2H	——
	15	Type D2H	Type D2	——	——	——
	22	Type D2H	——	——	——	——
	26	——	Type D2	——	——	——
	30	Type D2	——	30	Type D2	Type D2
	37	Type D2	Type D2	37	Type D2	Type D2
	45	Type D2	Type D2	——	——	——
	55	Type D2	Type D2	50	Type D2	——
		Type D3	Type D3		Type D3	——
	75	Type D3	Type D3	——	——	——
	90	Type D3	Type D3	90	Type D4	Type D4
	132	Type D6	Type D6	110	Type D6	——
	200	Type D0	Type D0	132	——	Type D6

(3) Distributor Ratings

Frame size			Coordination for Protective Devices	Rated capacity	Rated conditional short-circuit current	NOS pole	Weight (kg)
1/4 Distributor	 • Width : 660mm • Height : 200mm	Power feeder	Type 1	≦30A	50kA	3P	21
			Type 2 †2	≦30A	85kA	4P	21
1/2 Distributor	 • Width : 660mm • Height : 200mm	Power feeder	Type 1	≦63A	65kA	3P	21
			Type 2 †2	≦63A	85kA	4P	21
		Motor starter	Type 1	≦22kW	65kA	3P	21
			Type 2 †2		85kA		

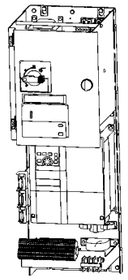
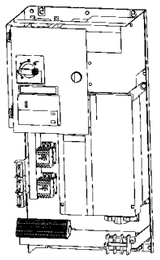
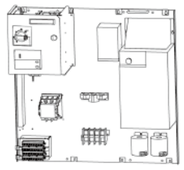
†1: Coordination for Protective Devices.
†2: To be released later

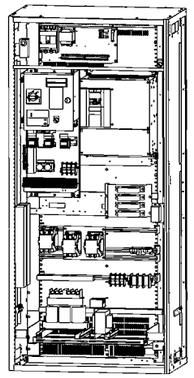
†3: For starter type, the non-reversible unit has been used for explanatory purposes.
We also have a reversible unit and Star/Delta unit so please contact us regarding product specifications.

8 Selection Table of Unit

8.3 Inverter Unit Selection Table

(1) Unit Ratings

Unit type †1			Rated voltage	Rated capacity (kW)	NOS pole	Unit size (mm)			Weight (kg)
						Width	Height	Depth	
Motor starter	1/6 Unit Type DL6		Up to 240V	≦3.7kW	3P	260	800	300	25
			Up to 480V	≦3.7kW					28
				5.5kW ≦ 7.5kW					30
	1/4 Unit Type DL4		Up to 240V	5.5kW ≦ 11kW		400			45
				15kW					52
			Up to 480V	11kW ≦ 15kW					45
				18.5kW ≦ 22kW					52
	1/2 Unit Type DL2		Up to 240V	18.5kW ≦ 37kW		800			80
			Up to 480V	30kW					

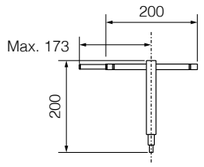
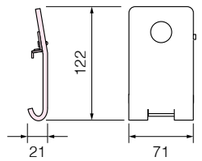
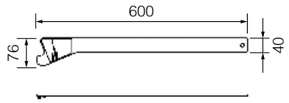
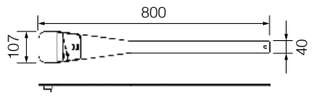
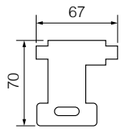
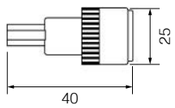
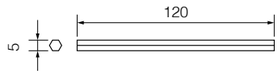
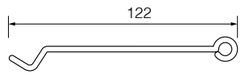
Unit type			Rated voltage	Rated capacity (kW)	NOS pole	Unit size (mm)			Weight (kg)
						Width	Height	Depth	
Motor starter	1/1 Unit Type DL1		Up to 240V	45kW ≦ 90kW †2	3P	1000	2200	600	500
			Up to 480V	37kW ≦ 90kW †2					
			Up to 480V	110kW ≦ 280kW		†3			

†1: The units 1/6(DL6), 1/4(DL4) and 1/2(DL2) can be added or changed as individual units.
Units are attached to the panel's fixed panel with four bolts in the top and bottom of the unit frame. (Refer to page P23).

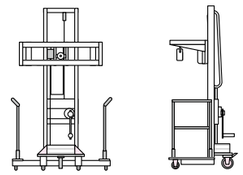
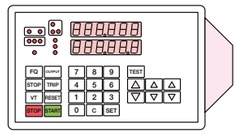
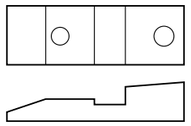
†2: For the 1/1 (DL1) unit, devices and apparatus are directly mounted on the inverter panel, therefore the external dimensions and standard weight (excluding options) of one inverter panel are shown.
†3: If certain devices of 480V 110kW or greater cannot be mounted in one inverter panel , two panels are used, therefore this is not mentioned above.
Please contact us for details on the number of panels and weight.

9 Accessories

Unit:mm

LV Switchgear	Controlgear	Inverter Panelboard	Tool Name		Quantity
●	—	—	Drawout handle (For drawout type ACB)		1 per ACB
●	—	—	Lifting hooks for ACB (For drawout type ACB)		1 set per ACB
—	●	—	Operation handle for inserting/withdrawing unit(up to 225 A) JNJ962C012N01		1 per panel array
—	●	—	Operation handle for inserting/withdrawing unit(400 A) JNJ962C025N01		1 per panel array
—	●	—	Operation tool for inserting/withdrawing distributor JNJ962C021H01		1 per unit
—	●	—	Short hexagon socket for torque wrench 985-10(HAZET)		1 per unit
—	●	●	Hexagonal bar wrench (for MCCB) JNG968C002H01		1 per unit
—	●	—	MCCB trip tool JNJ968C006H01		1 per unit

10 Optional product

Model	Device/part name	Purpose of use	Concept diagram/photo
LV Switchgear Controlgear	ACB Lift Truck	For transporting the ACB	
	Field test device for ACB (Type: Y-2005) Control power: AC 100 – 240V 50/60Hz	Able to confirm the characteristics of the electronic trip relay.	
Controlgear	locking rod G960C443H01	For locking of the MCCB operation handle	

11 Specifications Sheet (for planning by customer)

11.1 Specifications

Item			Standard specification	Optional specification
Applied standard			☐IEC	
General conditions			☐Corrosion-proof spec ☐Water-proof spec	
Painting			☐Outer surface color: N288	☐Other_____ (However, interior frame and unit case are manufacturer's standards.)
			☐Outer surface color: 5Y7/1 (However, interior frame and unit case are manufacturer's standards.)	
			☐Membrane thickness specified _____ μm or more	
Panel			☐Indoor ☐With panel-to-panel partition ☐Base plate (Material: ☐Vinyl chloride ☐Steel ☐Aluminum ☐Fire-resistant board) ☐Channel base forward	
			☐IP2X	☐IP_____ (Max IP43)
	Switchgear and Controlgear		☐Form 4b (Switchgear) †1 ☐Form 4b (Controlgear)	☐Internal arc (arcing class B)
	Inverter panelboard		☐Form 2a	
Busbars	Material		☐Copper (tin plating)	☐Copper (silver plating) †2
	Horizontal		☐Insulation (bare), busbar capacity _____A	☐Insulated
	Vertical		☐Insulation (bare), 1000A	☐Insulated (molded case)
	Earth		☐Horizontal and vertical earth busbar (6×50mm, bare)	
	Short-circuit withstand		☐50kA (1s) ☐65kA (1s) ☐85kA (1s)	
	Neutral		☐Half-capacity	☐Full-capacity
Incoming power arrangement			☐Direct to horizontal/vertical busbar Lead-in direction(☐Top ☐Bottom) ☐Expansion of existing panel Existing equipment serial no.:_____	☐Incoming MCCB ☐Instrument (☐Voltmeter ☐Ammeter ☐Power meter) ☐Bus duct from top, capacity: _____A
			☐Terminal lug not supplied	☐Supplied (crimp type) ☐Compression terminal (☐Not supplied ☐Supplied)
Wiring	Material	Main circuit	☐Main circuit: non-halogen wire, 3.5mm² or more, black	☐Special_____
		Control circuit	☐Vinyl wire HIV, 1.25mm², yellow	☐IEC, PVC-Insulated non-sheathed wire, 1.5mm², yellow ☐Special_____
	Phase (color) markers		☐Not required	☐Unit interior + vertical channel
	Main circuit terminals †3		☐Terminal lug not supplied	☐Supplied (1/4 & 1/2 Unit : Ferrule lug) ☐Supplied (1/1 Unit : Round crimp-type lug)
Unit cable connection method		Main circuit	☐Plug-in connection for power supply/load †4	
			☐Fixed type (400A over unit)	
		Control circuit	☐Plug-in connection †4	
			☐Connection by multi-pin connector (630A over unit)	
MCC-D Function	LV Switchgear		☐Incomer ☐Outgoing feeder ☐Coupler	
	Controlgear		☐Power feeder ☐Motor starter (☐Non-reversible ☐Reversible ☐Star/Delta)	
	Inverter panelboard		☐Motor starter (Non-reversible)	

†1: The standard (Form 4b) applies to "Incomer", "Outgoing feeder" and "Bus tie" (includes Bus riser).
†2: Only when Horizontal busbar is selected
†3: Please contact a Mitsubishi Electric representative for special terminals.
†4: Excluding units exceeding 400A and special units.

Item		Standard specification	Optional specification
Unit short-circuit protective device	ACB	☐65kA ☐75kA ☐85kA	
	MCCB	☐50kA ☐65kA ☐85kA †6	
Short-circuit protection method		☐Full-capacity interruption	
Coordination for protective devices		☐Type 1 ☐Type 2 †6	
Control circuit fuse		☐Standard (cartridge)	
EMC-B †5		☐Required	☐EMCSET Plant sartup/Maintenance support software ☐Motor deterioration diagnosis
Communication device	EMC-B †5	☐Not required	☐Modbus®-RTU †7 ☐CDL †7
	Inverter	☐Not required	☐CDL †7
Inverter unit		☐Required (Inverter, EMC-B, MCCB) ☐Not required	☐Current transformer (☐1A or ☐5A) ☐Analog output transducers ☐Parameter unit (FR-PU07) ☐AC reactor (FR-HAL) ☐DC reactor (FR-HEL) ☐Line noise filter (FR-BSF01 or FR-BLF) ☐Explosion-proof type inverter ☐Commercial power supply-inverter switchover function †8
Leakage current relay		☐None ☐EMC-B ☐Leakage current relay	
Space heater/Thermostat		☐None	☐Space heater ☐Thermostat
Automatic shutter		☐None	☐Supplied (ACB of LV Switchgear) ☐Supplied (1/1 unit of controlgear) †9
Nameplate		☐Film + Acrylic	
Others		☐None	☐Witness test ☐Site investigation ☐Site commissioning test
Power system	Power supply transformer _____Φ _____kVA Main circuit _____V _____Hz Control circuit _____V _____Hz		Incoming power cable size _____ mm² (☐Crimping ☐Compression) , _____ piece (s) per phase

11.2 Accessories

LV Switchgear	☐Drawout handle dimensions for ACB ☐Lifting hooks for ACB (For drawout type ACB)
Controlgear	☐Operation handle for inserting/withdrawing unit(up to 225 A) ☐Operation handle for inserting/withdrawing unit(400 A) ☐Operation tool for inserting/withdrawing distributor ☐Short hexagon socket for torque wrench ☐Hexagonal bar wrench (for MCCB) ☐MCCB trip tool
Inverter Panelboard	☐Hexagonal bar wrench (for MCCB)

11.3 Optional product

LV Switchgear	☐ACB Lift Truck ☐Field test device for ACB (Type: Y-2005)
Controlgear	☐locking rod

†5: Multi-function motor controller.
†6: To be released later
†7: Only when EMC-B is selected.
†8: Operation switches to commercial power only in the case of operating the motor at a commercial power frequency. Switches to inverter when the motor is accelerated, decelerated or operated at low frequency.
(1) Two units ' worth will be planned for 1/6 Unit (Type DL6), 1/4Unit (Type DL4) and ½ Unit (Type DL2).
(2) Please contact us in the case of 1/1 Unit (Type DL1) voltage rating: 200 V or more, capacity rating: 37 kW or more.
†9: Automatic connection unit only.

12 Use and Ordering

12.1 Points to Note When Placing an Order

Thank you for your continued patronage of Mitsubishi Electric products. Before ordering the Mitsubishi Electric product described in this catalog (hereinafter, the Product), please carefully read the following conditions (assuming there are no requirements for special conditions relating to matters such as estimates, contracts, specifications or catalogs other than this one). When placing an order, you (the customer) agree to the stipulations stated hereinbelow.

1. Warranty Period

The free service warranty period for the Product is one (1) year from the date of delivery, provided that no separate agreement has been made between Mitsubishi Electric and the customer.

2. Scope of Warranty

If the Product is found to have a fault or defect attributable to Mitsubishi Electric during the warranty period, Mitsubishi Electric shall provide the necessary replacement parts and/or exchange/repair the faulty part at no cost to the customer. However, if it becomes necessary to dispatch a technician to the site to conduct repairs either domestically or internationally, the customer shall be liable for the expenses incurred to dispatch said technician. In addition, Mitsubishi Electric shall not be liable for work related to replacing a defective unit, onsite recalibrations or operation trials. Furthermore, defects or faults attributable to one of the causes listed in a. to g. below are not covered by the warranty; that is, defects or faults attributable to:

a. Handling or use of the Product not in accordance with the directions in this catalog, the operations manual, specifications or related documents.
b. A cause not resulting from use of the Product.
c. Modifications or repairs other than those performed by a Mitsubishi Electric representative after the Product was purchased or delivered.
d. A phenomenon that was impossible to predict using the science/technology in practice when the Product was purchased or the purchase contract was signed.
e. Use of the Product after incorporating it into the customer's machinery if the fault or defect could have been avoided had the customer's machinery been equipped with functions, structure or other mechanism generally accepted as necessary by industry standards.
f. Use of the Product for a purpose other than that originally intended by Mitsubishi Electric.
g. Unavoidable external factors, such as fire or irregular voltage, or natural phenomena such as earthquakes, lightning, wind or water damage.

3. Exclusion of Warranty Obligations for Opportunity/Secondary Loss

Regardless of whether or not the warranty is valid, Mitsubishi Electric shall not be liable for: Any damage found not to be attributable to the Product; the loss of opportunity or profits for the customer or user caused by any fault in the Product; damage, secondary damage or accident compensation resulting from special factors regardless of whether or not such factors could be predicted by Mitsubishi Electric; damage to products of other companies; compensation for replacement work, onsite recalibrations of machinery/equipment, trial start-up operation or other work performed by the customer.

4. Changes to Specifications

Please be aware that the specifications described in the catalog, manual or technical documents are subject to change without prior notice.

5. Scope of Services

The price of the Product does not include service costs such as the dispatch of technical personnel. Customers are requested to contact Mitsubishi Electric if such services are required.

12.2 Improving Reliability and Recommended Renewal Period

1. Improving Reliability of Safeguards

The parts equipped in protective relays have a limited service life; the rate of deterioration varies according to the application, number of years in service, usage environment and individual performance of parts. Mitsubishi Electric generally designs its products to have a recommended renewal period of 15 years. However, based on the above, there may be times when components, etc. require replacement prior to the end of the 15-year period. To avoid situations where relays do not operate properly/fail to operate as a result of unintended circumstances/conditions, depending on the importance of the equipment, the customer is advised to take countermeasures; for example, use a redundant system for safeguards, and monitor relay status using products equipped with alarm output contacts that enable constant self-monitoring.

2. Recommended Renewal Period

In general, Mitsubishi Electric recommends a scheduled renewal approximately 15 years after manufacture. This is based on the recommended renewal period described in "JEM TR-156: Guidelines for Maintenance/Inspections of Protective Relays" issued by the Japan Electrical Manufacturers' Association (in Japanese). This renewal period does not reflect the manufacturer's guaranteed values for functions and performance, but rather the period generally considered beneficial, including economically, to replace the Product with a new product considering the deterioration of machinery structural materials in a standard usage environment where standard maintenance/inspections are conducted. Unexpected malfunctions or operational failures may occur if the Product is used beyond the recommended renewal period. Furthermore, Mitsubishi Electric recommends that peripheral devices such as transformers be included in the renewal process. As described in 1. above, Mitsubishi Electric generally designs its products to have a recommended renewal period of 15 years.

12.3 Maintenance/Inspections

1. For the Product to provide satisfactory performance, appropriate regular inspections and maintenance are essential. Please perform an initial inspection before turning the power on for the first time and then at least once every one to three years after that.
2. Please check that all the terminal connections are securely tightened, as loose connections of conductive parts may cause abnormal heat generation.
3. The LCD parts, including the LEDs used in the LCD, have a limited service life and will gradually decrease in brightness (this varies depending on the usage environment). Please replace the LCD if the lamps or LCD screen become dark or the characters become unclear (for details, please contact a Mitsubishi Electric representative).

MEMO

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⚠ Safety Precautions

Please read the instruction manual
before using the device.

G-199-7-CA117-C HAI 1903 Printed in Japan(IP)

Revised publication effective Mar. 2019.
Superseding publication of G-199-7-CA117-B Feb. 2018.
Specifications are subject to change without notice.