MITSUBISHI ELECTRIC

MITSUBISHI Low-Voltage Air Circuit Breakers type AE

Modbus Interface unit (BIF-MD)

INSTRUCTION MANUAL

ACB types covered in this manual

AE630-SW AE1000-SW AE1250-SW AE1600-SW
AE2000-SWA
AE2000-SW AE2500-SW AE3200-SW
AE4000-SWA
AE4000-SW AE5000-SW AE6300-SW

IMPORTANT NOTE: Before using these Series AE breakers, please read these instructions carefully, and make sure that all actual users also read them.

● SAFETY PRECAUTIONS ●

Make sure to observe the following matters of safety

- Before using the device, make sure to read these safety precautions and instruction manual thoroughly. The cautionary items noted herein are of the utmost importance for the safe use of this device, and should always be strictly followed.
- Make sure that the final user receives this manual.
- This instruction manual is prepared for an electrical expert.

The following symbols have been used:

⚠ DANGER	Failure to follow these instructions may result in dangerous conditions, which in turn could lead to severe personal injury or even death.

⚠ CAUTION	Failure to follow these instructions may result in dangerous conditions, which could result in moderate to slight personal injury or damage to equipment and facilities

	This means prohibition. Never ignore this indication.
	Make sure to follow these instructions without fail.

⚠ DANGER

- Do not use the device on the conditions over range. Failure to do so may result in fire.
- Do not touch the terminals. There is a risk of electrical shock.

⚠ CAUTION

- A qualified electrician should install this equipment.
- Make sure to tighten the terminal screws to the torque specified in this manual. Failure to do so may result in malfunction or fire.
- Do not install in areas subject to high temperatures, high humidity, dust, corrosive gas, vibrations, shocks, etc. To do so may result in malfunction or fire.
- Install so that trash, concrete dust, iron filings or rainwater cannot get into the device interior. Failure to do so may result in malfunction or fire.

⚠ CAUTION

Mitsubishi Electric Corporation puts the maximum effort into making electric products better and more reliable, but generally electric products may incorrect-operate under the influence of a noise etc.
In order not to cause abnormalities to a system by the influence of a noise etc., please retry 3 times or more with master software in case of error reply or no reply.

■EMC Directive

In IEC60947-2, following EMC tests are required.

1) Radiated radio frequency emission
2) Radiated radio frequency electromagnetic field immunity

BIF-MD shall be installed in the panel board. It effects not only for safe against electric shock but also to interrupt noise emission from the device. BIF-MD is confirmed to IEC60947-2 in accordance with following conditions.

●Installation

Install the device in power distribution board or control panel board that is made of conductive materials.
Power distribution board and control panel board have to be grounded to the earth with a thick wire of low impedance.
The frame ground terminal (FG) in the device has to be grounded to the earth with a thick wire of low impedance. (*grounded resistance: 100 ohm or less).

●Cables

Modbus cable, Internal Transmission cable shall be kept distance more than 100mm from the power distribution circuit.
However, when parallel installation with the power distribution circuit is required, it is necessary to increase to 300mm.

■Dielectric voltage test

The dielectric voltage test should be executed according to the table below. Do not test in points other than a following table because unit is damaged.

Measuring point	Condition
Between main circuit and BIF-MD terminals (P1, P2)	2500VAC 1min.
Between main circuit and BIF-MD terminal (FG, Ter, T/R+, T/R-, COM, SLD)	
Between BIF-MD terminals (P1, P2) and BIF-MD terminal (FG, Ter, T/R+, T/R-, COM, SLD)	1500VAC 1min.
Between main circuit and BIF-CON terminals (C1, C2, A1, A2, U1 and U2)	2500VAC 1min.
Between BIF-MD terminals (P1 and P2) and BIF-CON terminals (C1, C2, A1, A2, U1 and U2)	1500VAC 1min.
Between BIF-MD terminals (FG, Ter, T/R+, T/R-, COM, SLD) and BIF-CON terminals (C1, C2, A1, A2, U1 and U2)	
BIF-CON terminals (C1 and C2), BIF-CON terminals (A1 and A2), BIF-CON terminals (U1 and U2), each other	

■Guarantee

The period of guarantee is for 1 year from the sale date except in case of the failure has been caused by bad handling of the device.

- Table of Contents -

1. System Overview

BIF-MD (Modbus Interface unit) is used for monitoring and operating ACB with Modbus RTU protocol.

●Monitoring:
- *Measurement items (current, voltage, power, harmonics, energy, etc)*
- *Trip and alarm information (present status, history)*
- *Breaker status (Breaker ON/OFF status, Position of Breaker (*BIF-CON and BIF-CL is required)).*

●Operating:
- *Breaker control (ON/OFF/Spring charge). (*CC/SHT/MD and BIF-CON is required.)*
- *Reset (Trip indicator, Maximum and Minimum measurement, history information).*

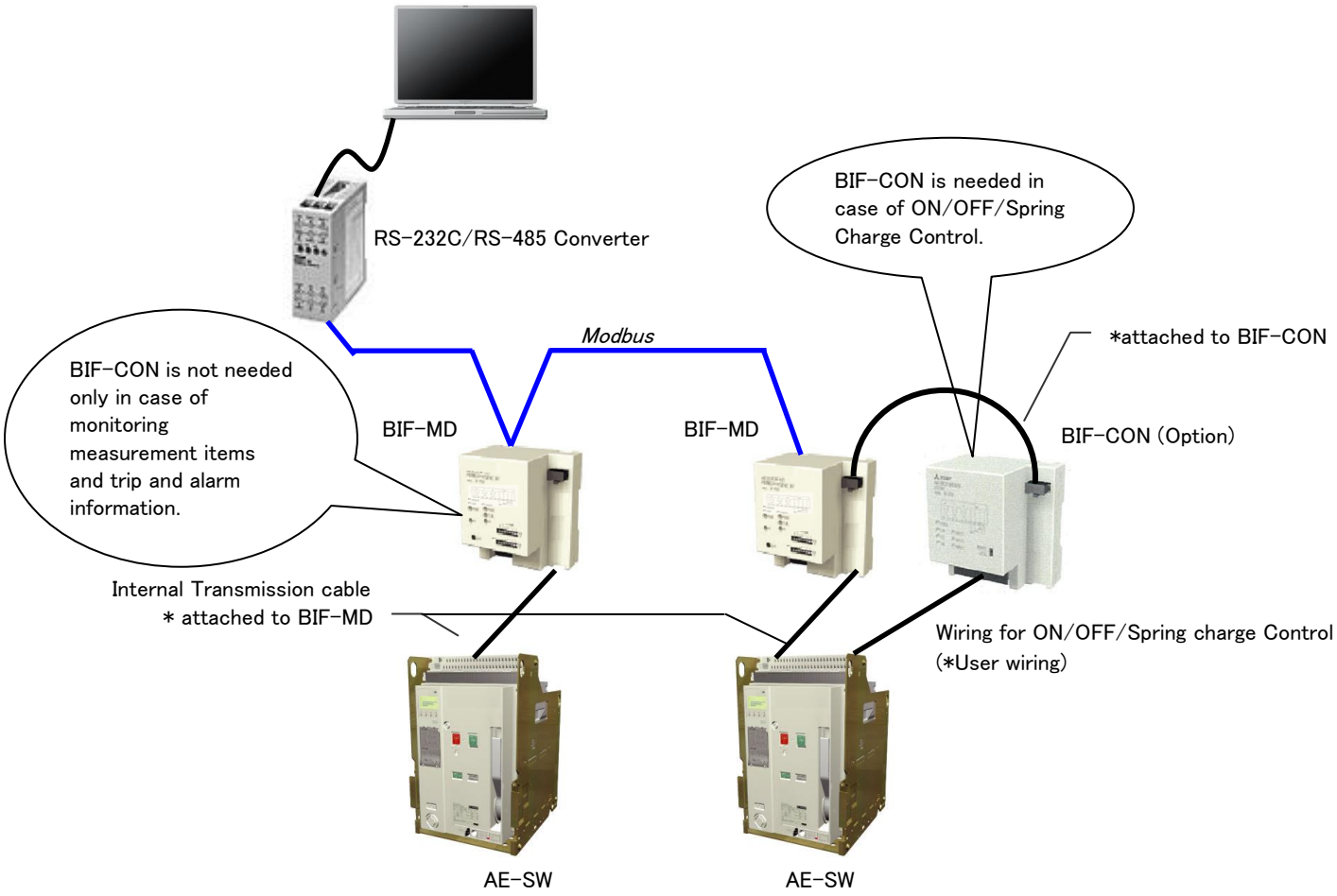


Fig 1.1 System Overview

2. Specifications

2.1 BIF-MD

The general specification of BIF-MD is shown in table 2.1.

Table 2.1 General specification of BIF-MD

Item	Specifications
Type name	BIF-MD
Power supply	100-240V AC・DC (50/60Hz)
Power consumption	3VA (not including BIF-CON) 5VA (including BIF-CON)
External dimensions	100(H) x 90(W) x 65(D)
Operating ambient temperature	-5 to +40℃ (However, the average of temperature per 24hours must not exceed +35℃)
Storage ambient temperature	-20 to +60℃ (However, the average of temperature per 24hours must not exceed +35℃)
Operating/Storage ambient humidity	Max. 85%RH (no condensation) at the max. +40℃ in the clean air conditions. (Do not use and store in corrosive gas atmospheres (e.g. sulfide gas, ammonia gas, etc.)
Operating/Storage ambience	H_2S≤ 0.01ppm, SO_2≤ 0.1ppm, NH_3≤ 0.25ppm
Operating altitude	Max. 2000m (6600ft.)
Installation	35mm IEC rail/Bracket

The functional specifications of BIF-MD are shown in table 2.2.

Table 2.2 Modbus specification of BIF-MD

Item	Specifications
Physical interface	RS-485
Protocol	Modbus RTU mode
Transmission Wiring Type	Multi-point bus (either directly on the trunk cable or forming a daisy-chain)
Baud Rate	2400, 4800, 9600, 19200, 38400 bps (selectable)
Data bit	8
Stop bit	1,2 (selectable)
Parity	Odd, Even, Non (selectable)
Maximum number of unit (without repeater)	31
Range of setting bus address	1 to 127
Response time	500ms or less
Recommended cable	Shielded twisted pair, AWG 24 or wider gauge.
Distance	1000m
Terminate	120Ω (1/2W) (There is a terminate register in BIF-MD. In case of the ends of network, connect two Ter. terminals by short wire.)

The setting items specifications of BIF-MD are shown in table 2.3.
Refer to Section 5.6 for details.

Table2.3 Setting items specification of BIF-MD

Item		Setting parameter/range	Setting for shipment
Date & Time	Date	Year:00(2000) to 99(2099), Month :01 to 12, Day:01 to 31	JAN/01/2004
	Time	Hour:00 to 23, Minute:00 to 59, Second:00 to 59	00:00:00
Demand Time	Load Current (I)	0s to 50s (step: 10s)/ 1min to 15min (step: 1min)/ 20min/30min	2min
	Leakage Current (Ig) [2]		2min
	Power (P) [1]		2min
Alarm Hold		Auto Reset/Self-Holding	Auto Reset
earth leakage pre-alarm (EPAL) [2]	Iep	0 [3] /500mA/600mA/700mA/…/IΔn [4] (Step: 100mA)	0(=OFF)
	Tep	100ms/200ms/…/3000ms (Step: 100ms)	3000ms

■1): This cannot be used when VT unit (VT) is not equipped.
■2): These can be available only when the Optional setting module type is E1 (Earth leakage protection).
■3): In case of Iep =0mA, pre-alarm earth leakage function is prohibited.
■4): Iep must be set to IΔn or less.

The measurement specifications of BIF-MD are shown in table 2.4.
Refer to Section 5.6 for details.

Table2.4 measurement items specification of BIF-MD

Item		Measurement Range	Unit	Accuracy	Cut off
Load current		0 to 2×In [A]	In < 500A : [0.1A] In ≥ 500A : [A]	±2.5% 6)	2.0% 6)
Earth Leakage current 2) 5)		0 to 2×IΔn_max [A]	[0.1A]	±15% 3) 6)	3.0% 6)
Voltage 1) 5)	Line	0 to 725[V]	[V]	±2.5% 6)	10V
	Phase	0 to 420[V]			
Power 1) 5)	Active	−√3×(2xIn[A])×725 [V] to +√3×(2xIn[A])×725 [V]	In < 1000A : [0.1kW] In ≥ 1000A : [kW]	±2.5% 6)	2.0% 6)
	Reactive	−√3×(2xIn[A])×725 [V] to +√3×(2xIn[A])×725 [V]	In < 1000A : [0.1kvar] In ≥ 1000A : [kvar]	±2.5% 6)	2.0% 6)
	Apparent 4)	0 to +√3×(2xIn[A])×725 [V]	In < 1000A : [0.1kVA] In ≥ 1000A : [kVA]	±2.5% 6)	2.0% 6)
Power factor 1) 5) 8)		−50 [%] to 100 [%] to +50 [%]	[0.1%]	±5.0% 6)	−
Energy 1)	Active	0 to 99999999 [kWh]	[kWh]	±2.5% 7)	0.4% 6)
	Reactive	0 to 99999999 [kvarh]	[kvarh]	±2.5% 7)	0.4% 6)
Harmonics current 1) (Max 19th)	RMS	0 to 2×In [A]	In < 500A : [0.1A] In ≥ 500A : [A]	±2.5% 6)	2.0% 6)
	Distortion	0 to 200 [%]	[0.1%]		−
Frequency 1)		45 to 65 [Hz]	[Hz]	±2.5% 7)	−
Fault current	LTD/STD/INST	0 to 20×In [A]	[10A]	±20% 7)	−
	GFR	0 to 2×In [A]	[A]		
	ER	0 to 2×IΔn_max [A]	[0.1A]		

■1): These items cannot be metered when VT unit (VT) is not equipped.
■2): The leakage current metering is available only when the Optional setting module type is E1 (Earth leakage protection).
■3): Include the accuracy of ZCT.
■4): When using at 3φ3W system, the apparent power is calculated by (√3/2)×(I1×V12+ I3×V23).
Therefore, the accuracy may not be ensured in the unbalanced circuit.
■5): Rated voltage of measurement is 440V. Rated power and energy of measurement is √3×In×440V.
Rated earth leakage current of measurement is IΔn_max (=10A). Rated power factor is 90 degrees.
■6): Accuracy and cut off are defined as percentage of rated value.
■7): Accuracy is defined as percentage of true value.
■8): Power factor is measured for only fundamental wave. A waveform distortion is not included for power factor calculation.

2.2 BIF-CON (Option)

The general specifications of BIF-CON are shown in table 2.5.

Table 2.5 General specifications of BIF-CON

Item		Specifications
Type name		BIF-CON
Power supply		Supplied from BIF-MD
Digital input	Number of channel	3 channels (INPUT1, INPUT2, INPUT3, general use)
	Isolation	Photo coupler isolation
	Signal level	12VDC, 30mA
Digital output	Number of channel	3 channels (*SHT 1)/CC/MD exclusive use)
	Isolation	Relay isolation
	Contact capacity	8A at 250V AC・DC (resistive load) 1)
External dimensions		100(H) x 90(W) x 65(D)
Operating ambient temperature		−5 to +40℃ (However, the average of temperature per 24hours must not exceed +35℃)
Storage ambient temperature		−20 to +60℃ (However, the average of temperature per 24hours must not exceed +35℃)
Operating/Storage ambient humidity		max. 85%RH (no condensation) at the max. +40℃ in the clean air conditions.
Operating/Storage ambience		Do not use and store in atmospheres with sulfide gas, ammonia gas, etc. (H_2S≤ 0.01ppm, SO_2≤ 0.1ppm, NH_3≤ 0.25ppm)
Operating altitude		max. 2000m (6600ft.)
Installation		35mm IEC rail/Bracket

■1): SHT (AC380-500V) cannot be used.

3. Part Names and Settings

3.1 BIF-MD

The unit overview is shown as below.

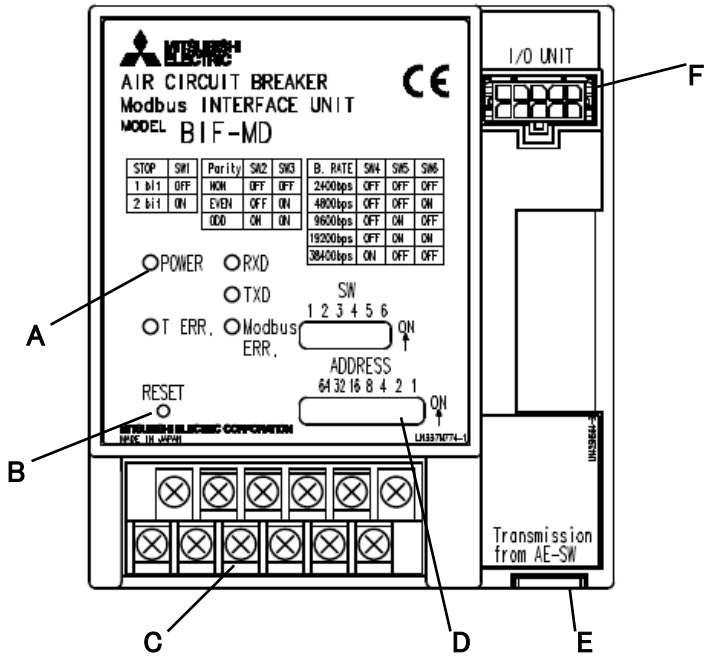


Fig 3.1: Front view

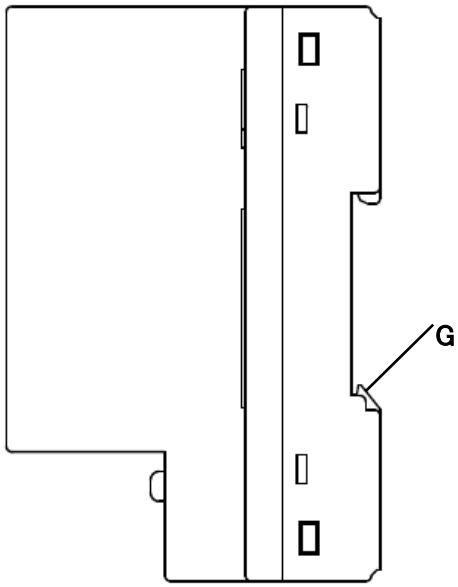


Fig 3.2: Side view

●(A) LEDs

Name	Indication	Description	Check
POWER	ON	Power is supplied.	
	OFF	Power is not supplied.	
T ERR.	Flashing	Internal transmission fault	Connection of internal transmission cable. Power supply of Power supply module (P1-P5).
	OFF	Normal operating state	
RXD	Flashing	Frame reception.	
	OFF	No reception.	
TXD	Flashing	Frame sending.	
	OFF	No sending.	
Modbus ERR.	Flashing	Transmission fault	Setting of Stop bit, Parity, Baud Rate. Connection of internal transmission cable. Connection of Modbus cable. Terminator. Programming (Function code, address, setting data.)
	ON	Setting switch fault	Setting of Stop bit, Parity, Baud Rate, Bus address.
	OFF	No fault	

●(B) RESET Switch

RESET Switch is used to reset the BIF-MD without power off.
After changing the switch while power supply is on, push this switch.

●(C) Terminals

Name [1)]	Description	Screw [2)] (Tighten torque)	Notes
P1, P2	100-240V AC・DC	M3 (0.5 to 0.6N.m)	Fuse or Circuit Breaker shall be installed in power supply line. Do not connect to main circuit of breaker directly.
FG	Frame ground		1. This terminal has to be grounded to the protective ground conductor by a thick wire of low impedance (*ground resistance: 100 ohm or less). 2. Connect the FG terminal of each BIF-MD independently. If not use ground independently, use common ground according to the figure 3.3.
T/R+	RS-485 signal +		For Modbus cable.
T/R-	RS-485 signal -		
COM	RS-485 signal GND		In case of two wires cable, no need to use.
SLD	Modbus cable shield		
Ter.	Terminator		There is a terminate register in this device. In case of the ends of network, connect two Ter. terminals by short wire as shown in figure 3.4.

■1): Terminal assignment is shown in *"6. Outline dimensions"*.
■2): These terminals should be connected with wire using crimp-type terminal.
The available crimp-type terminal is shown in figure 3.5.

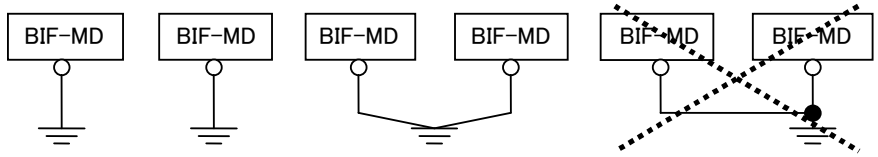


Fig 3.3: Ground connection

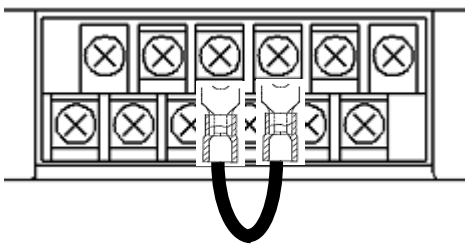


Fig 3.4: Short wire in case of ends of network

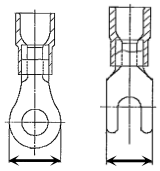


Fig 3.5: Crimp-type terminal

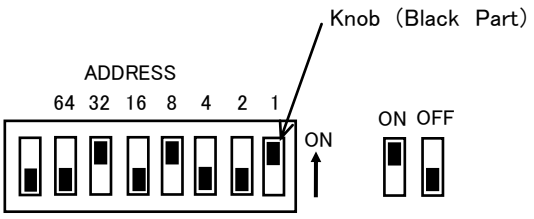
●(D) SWITCH

The setting of switches is effective when power supply is turned ON.
After changing the switch while power supply is on, push RESET switch (see also *"(B) RESET switch"*).

<BUS ADDRESS>

The BIF-MD supports the address range from 1 through 127.
The address is set in binary form shown as below sample.

Sample setting:
ON : 32, 8, 1
OFF: 64, 16, 4, 2
ADDRESS: 32 + 8 + 1 = 41



<Stop bit, Parity, Baud RATE>

Setting of stop bit, parity, Baud Rate must correspond with master setting.

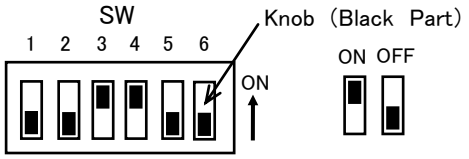
STOP bit	SW 1
1 bit	OFF
2 bit	ON

Parity	SW 2	SW 3
NON	OFF	OFF
EVEN	OFF	ON
ODD	ON	ON

B. RATE	SW 4	SW 5	SW 6
2400bps	OFF	OFF	OFF
4800bps	OFF	OFF	ON
9600bps	OFF	ON	OFF
19200bps	OFF	ON	ON
38400bps	ON	OFF	OFF

Do not change the setting of switches with mechanical pencil. It may cause malfunction by carbon dust.

Sample setting:
Stop bit : 1 bit
Parity: EVEN
B. RATE: 38400bps



●(E) Connector for AE-SW internal transmission cable

This connector is used for internal transmission with AE-SW.
Wiring connection is shown as below.
■Note: Only one BIF-MD can be connected to AE-SW.

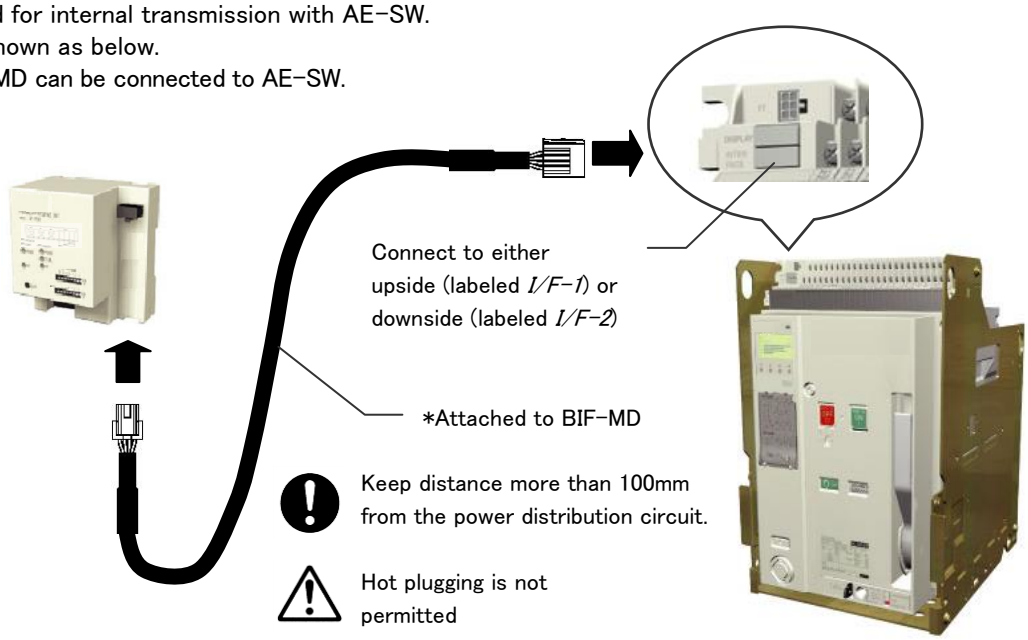


Fig 3.6: Wiring Connection

●(F) Connector for I/O unit (BIF-CON) connection

This connector is used for connection to I/O unit (BIF-CON).
Wiring connection is shown as below.

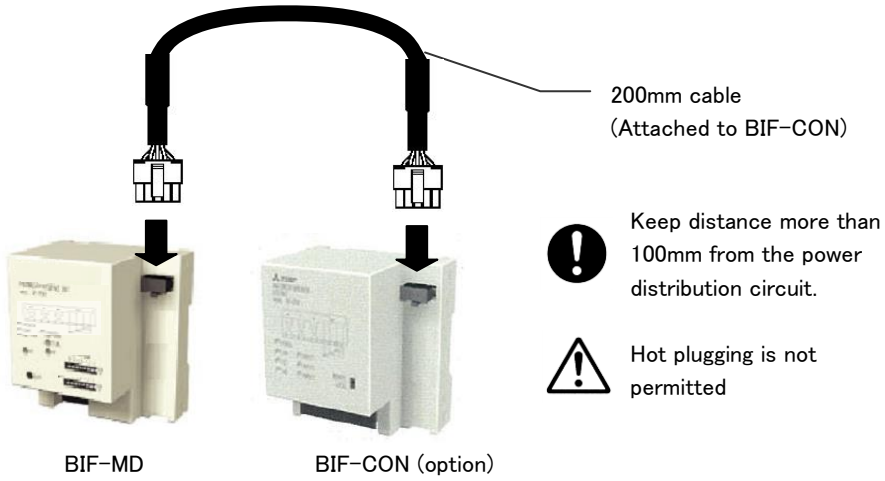


Fig 3.7: Wiring Connection

●(G) IEC rail latch

This is used to attach the BIF-MD to a IEC mounting rail.
IEC rail installation is shown in *"4.1 IEC rail installation"*.

3.2 BIF-CON

The unit overview is shown as below.

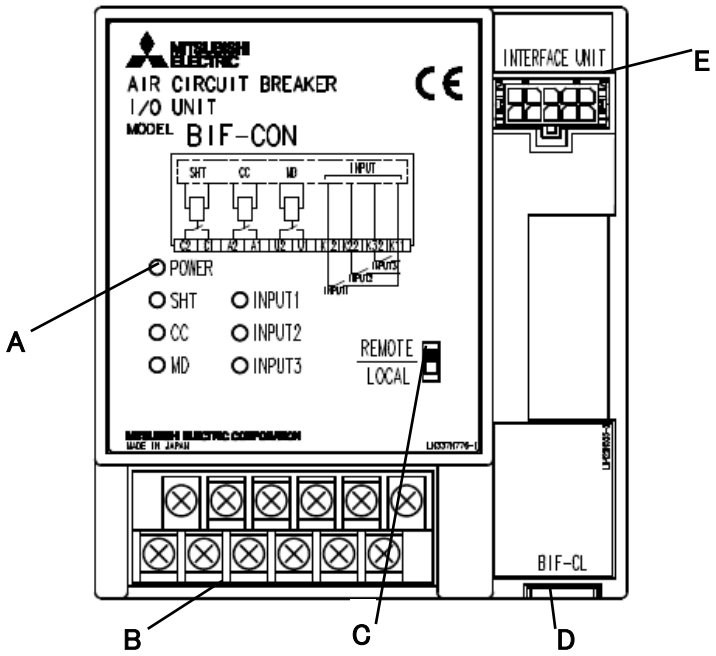


Fig 3.8: Front view

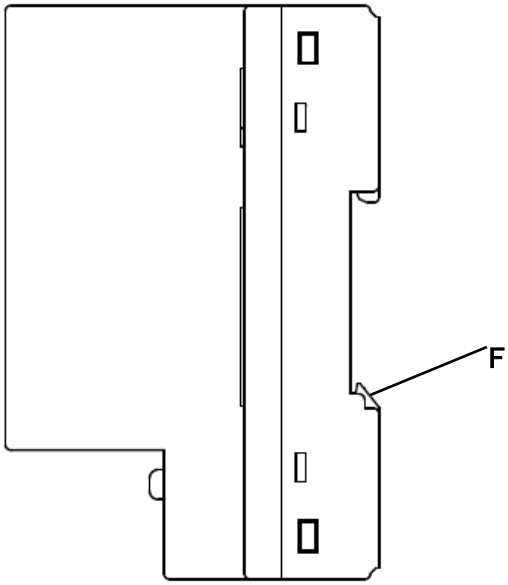


Fig 3.9: Side view

●(A) LEDs

Name	Indication	Description
POWER	ON	Power is supplied from BIF-MD correctly
	OFF	Power is not supplied
SHT	ON	1a contact for SHT [1)] is closed (500ms)
	OFF	1a contact for SHT [1)] is open
CC	ON	1a contact for CC [2)] is closed (500ms)
	OFF	1a contact for CC [2)] is open
MD	ON	1a contact for MD [3)] is closed (5s)
	OFF	1a contact for MD [3)] is open
INPUT1	ON	INPUT1 signal is ON
	OFF	No INPUT1 signal
INPUT2	ON	INPUT2 signal is ON
	OFF	No INPUT2 signal
INPUT3	ON	INPUT3 signal is ON
	OFF	No INPUT3 signal

■1): SHT is a type name of *AE-SW Shunt trip device* which open the main contact via remote control.
For details about SHT, please see *"AE-SW INSTRUCTION MANUAL"*.

■2): CC is a type name of *AE-SW Closing coil* which close the main contact via remote control.
For details about CC, please see *"AE-SW INSTRUCTION MANUAL"*.

■3): MD is a type name of *AE-SW Motor charging device* which charges the closing spring for motor operating.
For details about MD, please see *"AE-SW INSTRUCTION MANUAL"*.

●(B) Terminals

Name [1]	Description	Screw [2] (Tighten torque)
C1, C2 [3]	Output terminals for SHT	M3 (0.5 to 0.6N.m)
A1, A2 [3]	Output terminals for CC	
U1, U2 [3]	Output terminals for MD	
K12	Digital input1 terminal	
K22	Digital input2 terminal	
K32	Digital input3 terminal	
K11	Input common	

■1): Terminal assignment is shown in *"6. Outline dimensions"*.
■2): These terminals should be connected with wire using crimp-type terminal. The available crimp-type terminal is shown in figure 3.10.
■3): These output terminals are exclusive to SHT/CC/MD.
■4): About the remote control via the Modbus network, or local control with pushbuttons, the sample of user's wiring with BIF-CON and AE-SW is shown in figure 3.11.

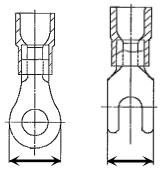
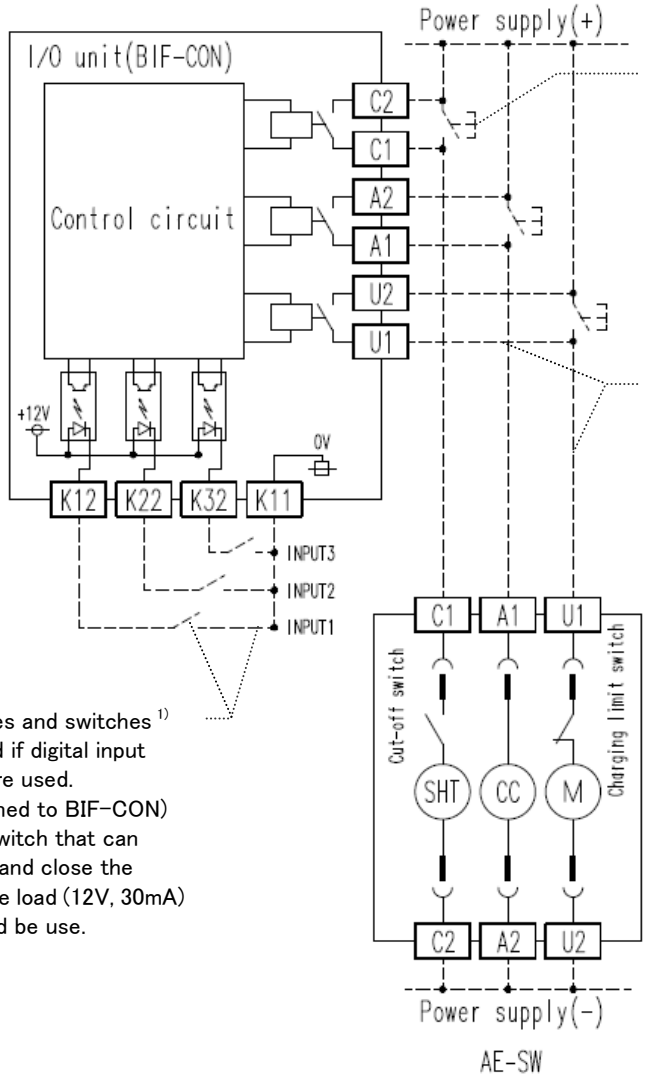


Fig 3.10: Crimp-type terminal



Pushbuttons [1] are required only if SHT/CC/MD are driven by local operation [2].
■1): Pushbuttons are not attached to BIF-CON. Therefore, these should be prepared by the user.
■2): In case of local operation by pushbuttons, REMOTE/LOCAL switch placed on the BIF-CON should be in LOCAL position for safety. (see also *"(C) REMOTE/LOCAL switch"*).

These connection cables [1] are required if SHT/CC/MD are driven by remote control [2].
■1): These cables are not attached to BIF-CON. Therefore, these should be prepared by the user.
■2): In case of remote control, REMOTE/LOCAL switch placed on the BIF-CON should be in REMOTE position. (see also *"(C) REMOTE/LOCAL switch"*).

These cables and switches [1] are required if digital input functions are used.
(*not attached to BIF-CON)
■1): The switch that can open and close the minute load (12V, 30mA) should be use.

SHT and CC cannot be driven simultaneously.

Description	
SHT	Shunt tripping device
CC	Closing coil
M	Motor(Motor charging device)
--------	User's wiring
—C—	Control circuit connecter (drawout type)

Fig 3.11: Sample of user's wiring

●(C) REMOTE/LOCAL switch

The REMOTE/LOCAL switch is used for change over of remote/local control of AE-SW.
When this switch is in REMOTE position, the remote control (ACB ON/OFF and charging the spring) are available via Modbus network.
When this switch is in LOCAL position, the remote control can not be operated.

●(D) Connector for AE-SW Drawout position switch (BIF-CL) connection

This connector is used for connection to BIF-CL (*Option).
For details about BIF-CL, see *"Instruction Manual for AE-SW Drawout position switch"*.
Wiring connection is shown as below.

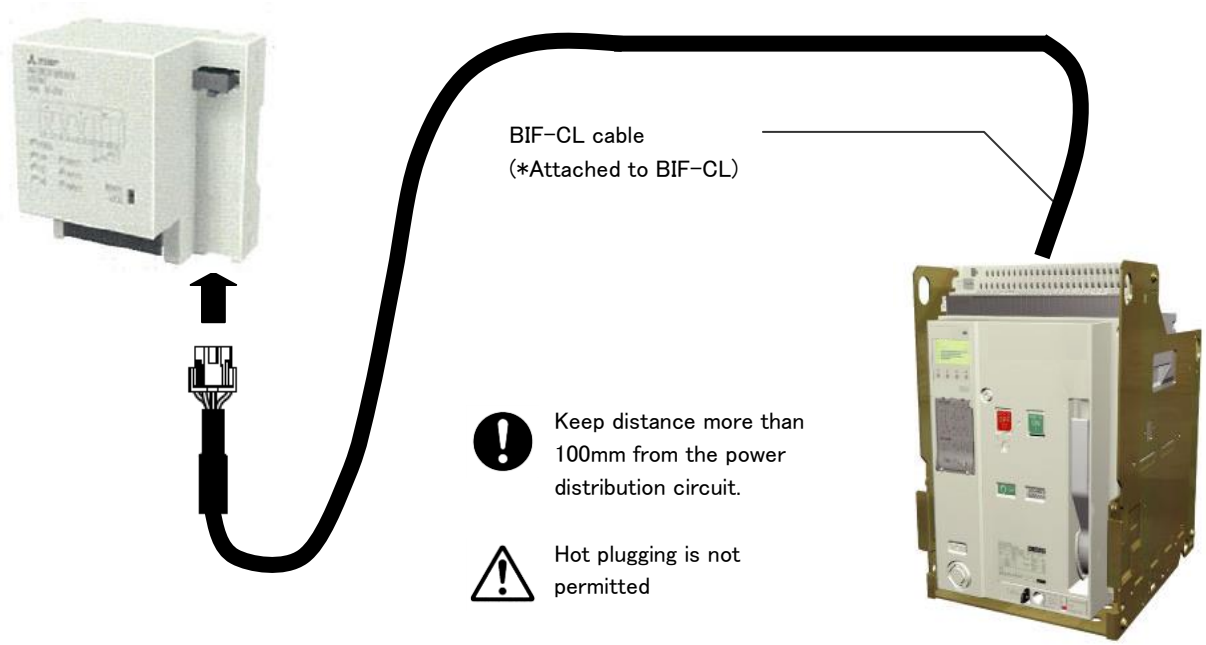


Fig 3.12: Wiring Connection

●(E) Connector for BIF-MD connection

This connector is used for connection to BIF-MD.
Wiring connection is shown as below.

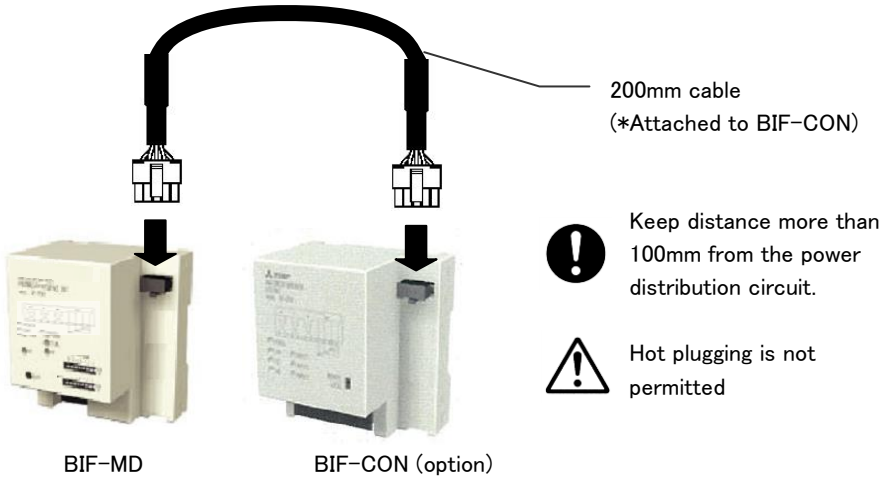


Fig 3.13 Wiring Connection

●(F) IEC rail latch

This is used to attach the BIF-CON to a IEC mounting rail.
IEC rail installation is shown in *"4.1 IEC rail installation"*.

4. Installation

4.1 IEC rail installation

Installation of BIF-MD and BIF-CON on the 35mm IEC rail (DIN rail) is shown as below.
The applicable IEC rail is shown in figure 4.1.

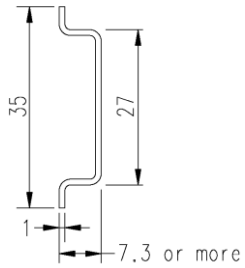


Fig 4.1: 35mm IEC rail

(A) Installation

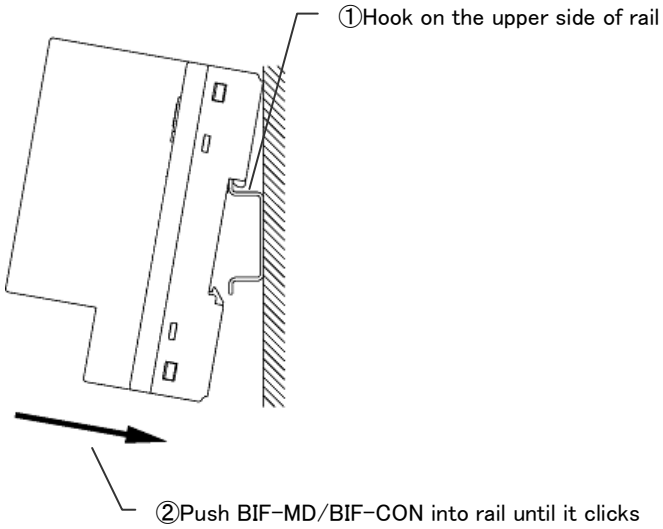


Fig 4.2: Installing

(B) Removing

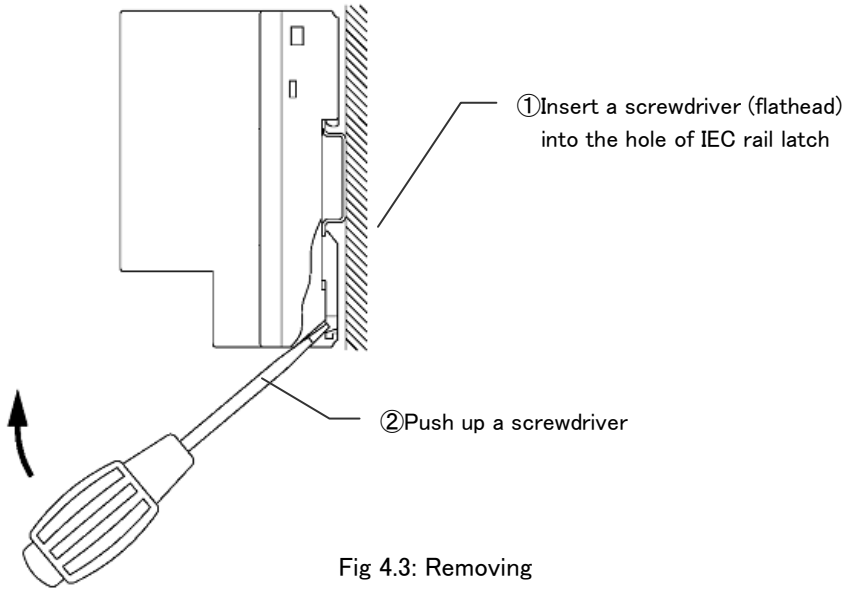


Fig 4.3: Removing

4.2 Bracket installation

Installation of BIF-MD and BIF-CON with the mounting bracket is shown as below.

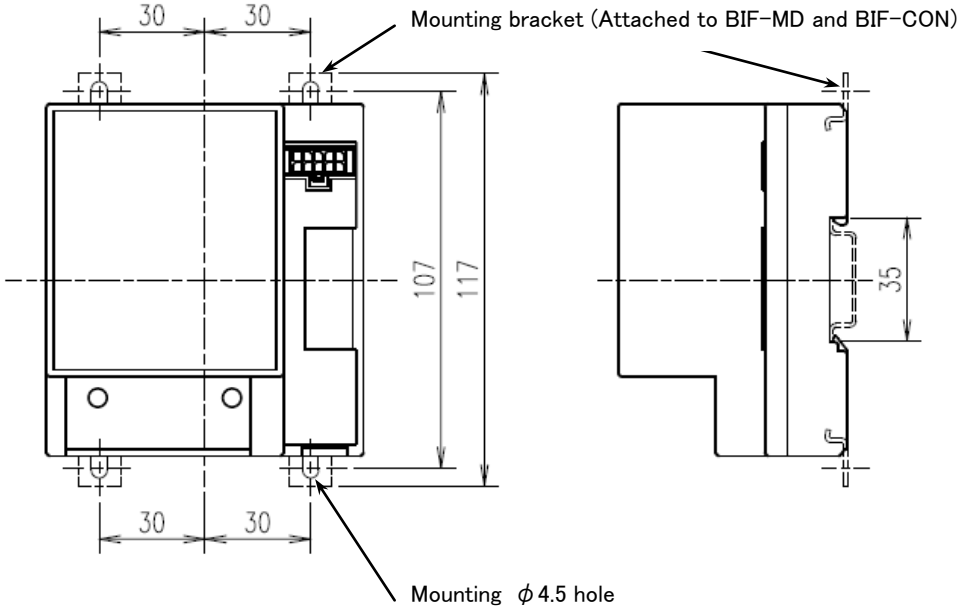


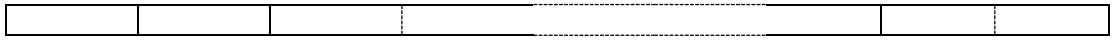
Fig 4.4: Mounting bracket Installation of BIF-MD, BIF-CON

5. Modbus Data Format

For details, please download and refer to MODBUS over Serial Line Specification & Implementation guide from the following URL;
http://www.ModBus.org/

5.1 Standard frame

The standard communications frame consists of:



Slave address	Function code	data	CRC

Slave address : 01～7FH
*When selecting slave address 0, a message is sent to all the instruments present on the network. When the slave receives it, the slave does not make a response.
Function code : 03H …… Read Holding Registers (maximum 250 bytes)
: 08H …… Diagnostics
: 10H …… Preset Multiple Registers
DATA : 8 bit HEX data
CRC : The Cyclical Redundancy Check (CRC) field is two bytes, containing a 16-bit binary value.

<NOTE>
A procedure for generating a CRC is:
1. Load a 16-bit register with FFFF hex. Call this the CRC register.
2. Exclusive OR the first 8-bit byte of the message with the low-order byte of the 16-bit CRC register, putting the result in the CRC register.
3. Shift the CRC register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.
4. (If the LSB was 0): Repeat Step 3 (another shift).
(If the LSB was 1): Exclusive OR the CRC register with the polynomial value 0xA001 (1010 0000 0000 0001).
5. Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
6. Repeat Steps 2 through 5 for the next 8-bit byte of the message. Continue doing this until all bytes have been processed.
7. The final content of the CRC register is the CRC value.
8. When the CRC is placed into the message, its upper and lower bytes must be swapped as described below.

5.2 Bit sequence

With RTU character framing, the bit sequence is:

＜Example＞With Parity Checking

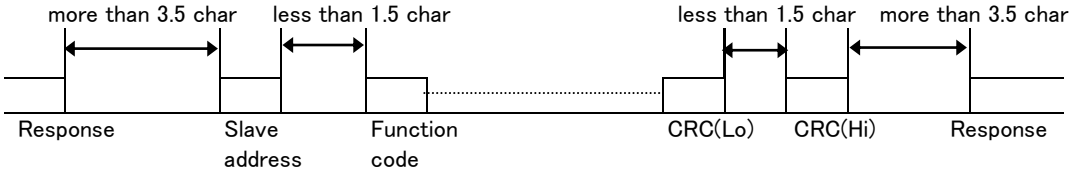
Start	1	2	3	4	5	6	7	8	Parity	Stop
	LSB							MSB		

＜Example＞Without Parity Checking

Start	1	2	3	4	5	6	7	8	Stop	Stop
	LSB							MSB		

5.3 Modbus Message RTU Framing

A Modbus message is placed by the transmitting device into a frame that has a known beginning and ending point.
This allows devices that receive a new frame to begin at the start of the message, and to know when the message is completed.
Partial messages must be detected and errors must be set as a result.
In RTU mode, message frames are separated by a silent interval of at least 3.5 character times.
The entire message frame must be transmitted as a continuous stream of characters.
If a silent interval of more than 1.5 character times occurs between two characters, the message frame is declared incomplete and should be discarded by the receiver.



5.4 Framing of Query and Response

<Read Holding Registers (Function code : 03H)>

Query framing

**H	03H	Hi	Lo	Hi	Lo	Lo	Hi
Slave address	Function Code	Starting address		quantity of registers		CRC	

- Slave address : 1～7FH
- Starting address : 2 bytes
- Quantity of registers : Maximum 125
- CRC : 2 bytes

Response framing (Maximum 255 bytes)

**H	03H	Byte count	Hi	Lo	Hi	Lo		Lo	Hi
Slave address	Function Code	data 1		data 2				CRC	

- Byte count of response data : maximum 250

<Example> In case of monitoring from instantaneous current in Phase 1 (0300H) to apparent power (0326H).
Slave address : 01H

Query framing

01H	03H	03H	00H	00H	27H	Lo	Hi
Slave address	Function Code	Starting address		quantity of registers		CRC	

Response framing

01H	03H	4EH	H	L	H	L		H	L	Lo	Hi
Slave Address	Function Code	Byte count	I1		I2			Apparent Power		CRC	

<Preset Multiple Registers (Function code :10H)>

Query framing (Maximum 255 bytes)

**H	10H	Hi	Lo	Hi	Lo		Hi	Lo	Hi	Lo		Lo	Hi
Slave address	Function Code	Starting address		quantity of registers		Byte count	data 1		data 2			CRC	

- Slave address : 0～7FH, 0 means broadcasting.
- Starting address : 2 bytes
- quantity of registers : Maximum 123
- Byte count : Maximum 246
- Preset data : Minimum 2 bytes
- CRC : 2 bytes

Response framing (If the slave address is 0 (broadcast), a response is not made.)

**H	10H	Hi	Lo	Hi	Lo	Lo	Hi
Slave address	Function Code	starting address		quantity of registers		CRC	

<Example> In case of setting from Date and time (YYMM) (20EH) to Contact output(211H).
Slave address : 01H

Query framing

01H	10H	02H	0EH	00H	04H	08H	H	L	H	L	H	L	H	L	Lo	Hi
Slave address	Function Code	starting address		quantity of registers		Byte count	YY	MM	DD	HH	MM	SS	Contact Output		CRC	

*BCD code

Response framing

01H	10H	02H	0EH	00H	04H	Lo	Hi
Slave address	Function Code	starting address		quantity of registers		CRC	

<Diagnostics (Function code :08H) (sub function code 00H)>

This function code is used for initial test of master's software.

Query framing

**H	08H	00H	00H	Hi	Lo	Lo	Hi
Slave address	Function Code	sub function code		data		CRC	

- ■ slave address :1～7FH
- ■ sub function code :00H
- ■ data :2 bytes
- ■ CRC :2 bytes

Response framing

**H	08H	00H	00H	Hi	Lo	Lo	Hi
Slave address	Function Code	sub function code		data		CRC	

- ■ data :same as the data of query

5.5 Modbus Exception Responses

ERROR	Meaning	Exception code	Display
Framing error	Query framing was incorrect.	No response is returned. Please retry with master software.	Modbus ERR. LED is turned ON (flashing) until receiving the correct query in case of no error.
Overrun error	1 byte data length was incorrect.		
Parity error	1 byte data was incorrect.		
CRC error	Framing data were incorrect.		
Illegal function	The function code received in the query was except 03h, 08h and 10h.	01	
Illegal data address	The data address received in the query is not an allowable address for the slave.	02	
Illegal data value	The data value received in the query is not an allowable data for the slave.	03	
Slave busy	Slave is busy on initial state or internal transmission *1 cable is not connected.	06	

*1 Addresses 02**h (0209h-02B9h) can be monitored even if internal transmission error has occurred.

Response framing

Slave address	function code *1	Exception code	Lo	Hi
**H	**H	**H	CRC	

*1 function code : In an exception response, the server sets the MSB of the function code to 1.

<Example>

function code in a query	function code in an exception response
03h	83h
08h	88h
10h	90h

⚠CAUTION

Mitsubishi Electric Corporation puts the maximum effort into making electric products better and more reliable, but generally electric products may incorrect-operate under the influence of a noise etc.
In order not to cause abnormalities to a system by the influence of a noise etc., please retry 3 times or more with master software in case of error reply or no reply.

5.6 Resister address

Table 5.6.1 Setting register

Address		Number of bytes	Access	Register Name		Range	Unit
Dec.	Hex.						
521	0209h	2	R/W	Demand time for power		0 to 1800 *1	s
522	020Ah	2	R/W	Demand time for current		0 to 1800 *1	s
523	020Bh	2	R/W	Reset memory		Refer to table 5.6.3	
524	020Ch	2	R/W	Reserve			
525	020Dh	2	R/W	Demand time for earth leakage		0 to 1800 *1	s
526	020Eh	2	R/W	Date and Time (Year and month.) (YY/MM, BCD code)		Year: 00 to 99, Month: 01 to 12,	
527	020Fh	2	R/W	Date and Time (Day and hour.) (DD/HH. BCD code)		Day: 01 to 31, Hour: 00 to 23,	
528	0210h	2	R/W	Date and Time (Minute and second.) (MM/SS. BCD code)		Minute 00 to 59, Second: 00 to 59,	
529	0211h	2	R/W	Contact output (ACB control)		Refer to table 5.6.5	
530	0212h	2	R/W	Reserve			
531	0213h	2	R/W	Reserve			
532	0214h	2	R/W	Alarm holding method		Auto reset: 0000h Self – Holding: 0001h	
533	0215h	2	R/W	Iep (earth leakage pre-alarm pickup current) *3		0 (non) to IΔn	mA
534	0216h	2	R/W	Tep (earth leakage pre-alarm delay time) *3		0(non) to 3000	ms
535	0217h	2	R	Ir	WS, WB	50 to 100	%
					WM (In = 250A to 315A)	0.625 x In to 1.0 x In	0.1A
					WM (In = 500A to 6300A)	0.625 x In to 1.0 x In	A
536	0218h	2	R	Ip2 (2nd additional pre-alarm pick-up current) *4		0(non) to 100	%
537	0219h	2	R	Tp2 (2nd additional pre-alarm time) *4		0(non) to 1350	0.1s
538	021Ah	2	R	Ip1 (pre-alarm pick-up current)		68 to 115	%
539	021Bh	2	R	Reserve			
540	021Ch	2	R	WS, WB: Iu (uninterrupted current)		0(non) to 120	%
				WM: IL (LTD pickup current)			
541	021Dh	2	R	TL (LTD time)		0(non) to 150	S
542	021Eh	2	R	Isd (STD pickup current)		0(non) to 1000	%
543	021Fh	2	R	Tsd (STD time)		0(non) to 500	ms
544	0220h	2	R	Ii (INST pickup current)		200 to 1600	%
545	0221h	2	R	Ig (GFR pickup current) *5		0(non) to 100	%
				IΔn (ER pickup current) *3		0(non) to 10	A
546	0222h	2	R	Tg (GFR time) *5		0(non) to 3000	ms
				Te (ER time) *3		0(non) to 3000	ms
547	0223h	2	R	Characteristic bit data		Refer to table 5.6.6	
548	0224h	2	R	NP (Neutral pole protection level)		50 to 100	%
592	0250h	2	R	In (CT rating)		250 to 6300	A
593	0251h	2	R	Contact input		Refer to table 5.6.4	
594	0252h	2	R	Alarm and trip information		Refer to table 5.6.2	
595	0253h	2	R	ETR Self diagnosis		Refer to table 5.6.7	
596	0254h	2	R	Main setting module type		WS: 1h, WB: 4h, WM: 5h	
597	0255h	2	R	Option setting module type		Non: 0h, AP: 1h, G1: 2h, E1: 3h	

*1 Data range: 0/10/20/30/40/50/60/120/180/240/300/360/420/480/540/600/660/720/780/840/900/1200/1800
*2 R/W: Read and write register.
R : Read only register.
*3 E1 is needed
*4 AP is needed.
*5 G1 is needed.
*Addresses 02**h (0209h-02B9h) can be monitored even if internal transmission error has occurred.

Table 5.6.2 Alarm and Trip information

Bit	Name	0	1
b0	AX (ACB ON/OFF)	OFF	ON
b1	Reserve	—	—
b2	PAL2 P.U. Alarm	Non	Alarm
b3	PAL2 OUT Alarm	Non	Alarm
b4	PAL1 P.U. Alarm	Non	Alarm
b5	PAL1 OUT Alarm	Non	Alarm
b6	OVER Alarm	Non	Alarm
b7	LTD Trip	Non	Trip
b8	STD Trip	Non	Trip
b9	INST Trip	Non	Trip
b10	EPAL Alarm	Non	Alarm
b11	GFR(ER) Trip(Alarm)	Non	Trip(Alarm)
b12	UVT Trip	Non	Trip
b13	Reserve	—	—
b14	TAL Alarm	Non	Alarm
b15	Reserve	—	—

Table 5.6.3 Reset memory

Bit	Name	0	1
b0	Alarm and Trip info.	No reset	Reset
b1	All items	No reset	Reset
b2	All max. and min. measurement	No reset	Reset
b3	Reserve	—	—
b4	Reserve	—	—
b5	Reserve	—	—
b6	Reserve	—	—
b7	Alarm and trip history	No reset	Reset
b8	Reserve	—	—
b9	Reserve	—	—
b10	Reserve	—	—
b11	Reserve	—	—
b12	Reserve	—	—
b13	Reserve	—	—
b14	Wh and varh	No reset	Reset
b15	Reserve	—	—

*1 “All items (b1)” is to reset all items of b0, b2, b7 and b14.

Table 5.6.4 Contact input

Bit	Name	0	1
b0	Input 1 *1	OFF	ON
b1	Input 2 *1	OFF	ON
b2	Input 3 *1	OFF	ON
b3	Reserve	—	—
b4	Reserve	—	—
b5	Reserve	—	—
b6	Reserve	—	—
b7	Reserve	—	—
b8	Position of ACB *1*2	—	Disconnected
b9		—	Connected
b10		—	Test
b11	Reserve	—	—
b12	Reserve	—	—
b13	Reserve	—	—
b14	Reserve	—	—
b15	Reserve	—	—

*1 BIF-CON is needed.
*2 BIF-CL is needed.

Table 5.6.5 Contact output

Bit	Name	0	1
b0	SHT ON (ACB OFF) *1	OFF	ON
b1	CC ON (ACB ON) *1	OFF	ON
b2	MD ON (Charge Spring) *1	OFF	ON
b3	Reserve	—	
b4	Reserve	—	
b5	Reserve	—	
b6	Reserve	—	
b7	Reserve	—	
b8	Reserve	—	
b9	Reserve	—	
b10	Reserve	—	
b11	Reserve	—	
b12	Reserve	—	
b13	Reserve	—	
b14	Reserve	—	
b15	Reserve	—	

*1 BIF-CON is needed.

Table 5.6.6 Characteristic bit data

Bit	Name	0	1
b0	Tg (Te) Alarm or Trip	Alarm	Trip
b1	I^2t of STD	OFF	ON
b2	MCR or INST	INST	MCR
b3	I^2t of PAL2 (AP)	OFF(Flat)	ON (I^2t)
b4	Reserve	—	—
b5	Reserve	—	—
b6	Reserve	—	—
b7	Position	—	—
b8	Reserve	—	—
b9	Reserve	—	—
b10	Reserve	—	—
b11	Reserve	—	—
b12	Reserve	—	—
b13	Reserve	—	—
b14	Reserve	—	—
b15	Reserve	—	—

Table 5.6.7 ETR Self diagnosis

ETR Err. Type	Err. code
A/D converter Err.	11H
EEPROM Err.	12H
Date and Time IC (RTC) Err.	13H
Main setting module Err.	21H
Option setting module Err.	22H
CT Connector Err.	23H
MCR switch Err.	24H
TAL sensor Err.	25H

***Some error mode may not be detected.**

Table 5.6.8 Trip history

Address		Number of bytes	Access	Register Name	Description	Unit
Dec.	Hex.					
598	0256h	2	R	Trip history 1 (fault cause)	Refer to table 5.6.10	
599	0257h	2	R	Trip history 1 (current)		*1 *2
600	0258h	2	R	Trip history 1 (year and month)	YYMM. BCD code	
601	0259h	2	R	Trip history 1 (day and hour)	DDHH. BCD code	
602	025Ah	2	R	Trip history 1 (minute and second.)	MMSS. BCD code	
603	025Bh	2	R	Trip history 2 (fault cause)	Refer to table 5.6.10	
604	025Ch	2	R	Trip history 2 (current)		*1 *2
605	025Dh	2	R	Trip history 2 (year and month)	YYMM. BCD code	
606	025Eh	2	R	Trip history 2 (day and hour)	DDHH. BCD code	
607	025Fh	2	R	Trip history 2 (minute and second)	MMSS. BCD code	
608	0260h	2	R	Trip history 3 (fault cause)	Refer to table 5.6.10	
609	0261h	2	R	Trip history 3 (current)		*1 *2
610	0262h	2	R	Trip history 3 (year and month)	YYMM. BCD code	
611	0263h	2	R	Trip history 3 (day and hour)	DDHH. BCD code	
612	0264h	2	R	Trip history 3 (minute and second)	MMSS. BCD code	
613	0265h	2	R	Trip history 4 (fault cause)	Refer to table 5.6.10	
614	0266h	2	R	Trip history 4 (current)		*1 *2
615	0267h	2	R	Trip history 4 (year and month)	YYMM. BCD code	
616	0268h	2	R	Trip history 4 (day and hour)	DDHH. BCD code	
617	0269h	2	R	Trip history 4 (minute and second)	MMSS. BCD code	
618	026Ah	2	R	Trip history 5 (fault cause)	Refer to table 5.6.10	
619	026Bh	2	R	Trip history 5 (current)		*1 *2
620	026Ch	2	R	Trip history 5 (year and month)	YYMM. BCD code	
621	026Dh	2	R	Trip history 5 (day and hour)	DDHH. BCD code	
622	026Eh	2	R	Trip history 5 (minute and second)	MMSS. BCD code	
623	026Fh	2	R	Trip history 6 (fault cause)	Refer to table 5.6.10	
624	0270h	2	R	Trip history 6 (current)		*1 *2
625	0271h	2	R	Trip history 6 (year and month)	YYMM. BCD code	
626	0272h	2	R	Trip history 6 (day and hour)	DDHH. BCD code	
627	0273h	2	R	Trip history 6 (minute and second)	MMSS. BCD code	
628	0274h	2	R	Trip history 7 (fault cause)	Refer to table 5.6.10	
629	0275h	2	R	Trip history 7 (current)		*1 *2
630	0276h	2	R	Trip history 7 (year and month)	YYMM. BCD code	
631	0277h	2	R	Trip history 7 (day and hour)	DDHH. BCD code	
632	0278h	2	R	Trip history 7 (minute and second)	MMSS. BCD code	
633	0279h	2	R	Trip history 8 (fault cause)	Refer to table 5.6.10	
634	027Ah	2	R	Trip history 8 (current)		*1 *2
635	027Bh	2	R	Trip history 8 (year and month)	YYMM. BCD code	
636	027Ch	2	R	Trip history 8 (day and hour)	DDHH. BCD code	
637	027Dh	2	R	Trip history 8 (minute and second)	MMSS. BCD code	
638	027Eh	2	R	Trip history 9 (fault cause)	Refer to table 5.6.10	
639	027Fh	2	R	Trip history 9 (current)		*1 *2
640	0280h	2	R	Trip history 9 (year and month)	YYMM. BCD code	
641	0281h	2	R	Trip history 9 (day and hour)	DDHH. BCD code	
642	0282h	2	R	Trip history 9 (minute and second)	MMSS. BCD code	
643	0283h	2	R	Trip history 10 (fault cause)	Refer to table 5.6.10	
644	0284h	2	R	Trip history 10 (current)		*1 *2
645	0285h	2	R	Trip history 10 (year and month)	YYMM. BCD code	
646	0286h	2	R	Trip history 10 (day and hour)	DDHH. BCD code	
647	0287h	2	R	Trip history 10 (minute and second)	MMSS. BCD code	

*1 In case of "LTD, STD, INST", Unit: 10A. In case of "GFR", Unit: 1A. In case of "ER", Unit: 0.1A.

*2 In case of UVT trip, there is no current information (current is 0).

*When power supply of power supply module (P1-P5) is off, trip and alarm history are not stored.

*Trip history 1 is the latest trip information. And trip history 10 is the oldest trip information.

*Addresses 02**h (0209h-02B9h) can be monitored even if internal transmission error has occurred.

Table 5.6.9 Alarm history

Address		Number of bytes	Access	Register Name	Range	Unit
Dec.	Hex.					
648	0288h	2	R	Alarm history 1(alarm cause)	Refer to table 5.6.11	
649	0289h	2	R	Reserve		
650	028Ah	2	R	Alarm history 1 (year and month)	YYMM. BCD code	
651	028Bh	2	R	Alarm history 1 (day and hour)	DDHH. BCD code	
652	028Ch	2	R	Alarm history 1 (minute and second)	MMSS. BCD code	
653	028Dh	2	R	Alarm history 2 (alarm cause)	Refer to table 5.6.11	
654	028Eh	2	R	Reserve		
655	028Fh	2	R	Alarm history 2 (year and month)	YYMM. BCD code	
656	0290h	2	R	Alarm history 2 (day and hour)	DDHH. BCD code	
657	0291h	2	R	Alarm history 2 (minute and second)	MMSS. BCD code	
658	0292h	2	R	Alarm history 3 (alarm cause)	Refer to table 5.6.11	
659	0293h	2	R	Reserve		
660	0294h	2	R	Alarm history 3 (year and month)	YYMM. BCD code	
661	0295h	2	R	Alarm history 3 (day and hour)	DDHH. BCD code	
662	0296h	2	R	Alarm history 3 (minute and second)	MMSS. BCD code	
663	0297h	2	R	Alarm history 4 (alarm cause)	Refer to table 5.6.11	
664	0298h	2	R	Reserve		
665	0299h	2	R	Alarm history 4 (year and month)	YYMM. BCD code	
666	029Ah	2	R	Alarm history 4 (day and hour)	DDHH. BCD code	
667	029Bh	2	R	Alarm history 4 (minute and second)	MMSS. BCD code	
668	029Ch	2	R	Alarm history 5 (alarm cause)	Refer to table 5.6.11	
669	029Dh	2	R	Reserve		
670	029Eh	2	R	Alarm history 5 (year and month)	YYMM. BCD code	
671	029Fh	2	R	Alarm history 5 (day and hour)	DDHH. BCD code	
672	02A0h	2	R	Alarm history 5 (minute and second)	MMSS. BCD code	
673	02A1h	2	R	Alarm history 6 (alarm cause)	Refer to table 5.6.11	
674	02A2h	2	R	Reserve		
675	02A3h	2	R	Alarm history 6 (year and month)	YYMM. BCD code	
676	02A4h	2	R	Alarm history 6 (day and hour)	DDHH. BCD code	
677	02A5h	2	R	Alarm history 6 (minute and second)	MMSS. BCD code	
678	02A6h	2	R	Alarm history 7 (alarm cause)	Refer to table 5.6.11	
679	02A7h	2	R	Reserve		
680	02A8h	2	R	Alarm history 7 (year and month)	YYMM. BCD code	
681	02A9h	2	R	Alarm history 7 (day and hour)	DDHH. BCD code	
682	02AAh	2	R	Alarm history 7 (minute and second)	MMSS. BCD code	
683	02ABh	2	R	Alarm history 8 (alarm cause)	Refer to table 5.6.11	
684	02ACh	2	R	Reserve		
685	02ADh	2	R	Alarm history 8 (year and month)	YYMM. BCD code	
686	02AEh	2	R	Alarm history 8 (day and hour)	DDHH. BCD code	
687	02AFh	2	R	Alarm history 8 (minute and second)	MMSS. BCD code	
688	02B0h	2	R	Alarm history 9 (alarm cause)	Refer to table 5.6.11	
689	02B1h	2	R	Reserve		
690	02B2h	2	R	Alarm history 9 (year and month)	YYMM. BCD code	
691	02B3h	2	R	Alarm history 9 (day and hour)	DDHH. BCD code	
692	02B4h	2	R	Alarm history 9 (minute and second)	MMSS. BCD code	
693	02B5h	2	R	Alarm history 10 (alarm cause)	Refer to table 5.6.11	
694	02B6h	2	R	Reserve		
695	02B7h	2	R	Alarm history 10 (year and month)	YYMM. BCD code	
696	02B8h	2	R	Alarm history 10 (day and hour)	DDHH. BCD code	
697	02B9h	2	R	Alarm history 10 (minute and second)	MMSS. BCD code	

＊When the alarm holding method is set to “Auto Reset”, all alarms are not monitored and are not stored in EEPROM.
When the alarm holding method is set to “Self-Holding”, all alarms except for PAL1 P.U., PAL2 P.U. and OVER can be monitored and can be stored in EEPROM.
Alarm holding method can be monitored and set by address 0214h.

*When power supply of power supply module (P1-P5) is off, trip and alarm history are not stored.

*Alarm history 1 is the latest alarm information. And alarm history 10 is the oldest alarm information.

*Addresses 02**h (0209h-02B9h) can be monitored even if internal transmission error has occurred.

Table 5.6.10 Trip history fault cause

Bit	Name	0	1
B0	Reserve	—	—
B1	Reserve	—	—
B2	Reserve	—	—
B3	Reserve	—	—
B4	Reserve	—	—
B5	Reserve	—	—
B6	Reserve	—	—
B7	LTD Trip	Non	Trip
B8	STD Trip	Non	Trip
B9	INST Trip	Non	Trip
B10	Reserve	—	—
B11	GFR/ER Trip	Non	Trip
B12	UVT Trip	Non	Trip
B13	Reserve	—	—
B14	Reserve	—	—
B15	Reserve	—	—

Table 5.6.11 Alarm history cause

Bit	Name	0	1
b0	Reserve	—	—
b1	Reserve	—	—
b2	Reserve	—	—
b3	PAL2 OUT Alarm	Non	Alarm
b4	Reserve	—	—
b5	PAL1 OUT Alarm	Non	Alarm
b6	Reserve	—	—
b7	Reserve	—	—
b8	Reserve	—	—
b9	Reserve	—	—
b10	EPAL Alarm	Non	Alarm
b11	GFR/ER Alarm	Non	Alarm
b12	Reserve	—	—
b13	Reserve	—	—
b14	TAL Alarm	Non	Alarm
b15	Reserve	—	—

*1 PAL2 P.U., PAL1 P.U., and OVER is not included in alarm history.

Table 5.6.12 analog measurement 1 register

Address		Number of bytes	Access	Register Name	Unit	Range
Dec.	Hex.					
768	0300h	2	R	Instantaneous current in Phase 1 (I1) *1	*4	Refer to table 2.4
769	0301h	2	R	Instantaneous current in Phase 2 (I2) *1		
770	0302h	2	R	Instantaneous current in Phase 3 (I3) *1		
771	0303h	2	R	Instantaneous current in Pole N (IN) *1,2		
772	0304h	2	R	Reserved		
773	0305h	2	R	Demand current in Phase 1 (I1) *1	*4	
774	0306h	2	R	Demand current in Phase 2 (I2) *1		
775	0307h	2	R	Demand current in Phase 3 (I3) *1		
776	0308h	2	R	Demand current in Pole N (IN) *1,2		
777	0309h	2	R	Reserved		
778	030Ah	2	R	Instantaneous voltage in Line 1-2 (V12)	V	
779	030Bh	2	R	Instantaneous voltage in Line 2-3 (V23)		
780	030Ch	2	R	Instantaneous voltage in Line 1-3 (V13)		
781	030Dh	2	R	Reserved		
782	030Eh	2	R	Instantaneous voltage in Phase 1-N (V1N) *2	V	
783	030Fh	2	R	Instantaneous voltage in Phase 2-N (V2N) *2		
784	0310h	2	R	Instantaneous voltage in Phase 3-N (V3N) *2		
785	0311h	2	R	Reserved		
786	0312h	2	R	Reserved		
787	0313h	2	R	Reserved		
788	0314h	2	R	Reserved		
789	0315h	2	R	Instantaneous power Factor *6	0.1%	
790	0316h	2	R	Instantaneous frequency	Hz	
791	0317h	2	R	Reserved		
792	0318h	2	R	Reserved		
793	0319h	2	R	Reserved		
794	031Ah	2	R	Instantaneous active power *6	*5	
795	031Bh	2	R	Reserved		
796	031Ch	2	R	Reserved		
797	031Dh	2	R	Reserved		
798	031Eh	2	R	Demand active power *6	*5	
799	031Fh	2	R	Reserved		
800	0320h	2	R	Reserved		
801	0321h	2	R	Reserved		
802	0322h	2	R	Instantaneous reactive power *6	*5	
803	0323h	2	R	Reserved		
804	0324h	2	R	Reserved		
805	0325h	2	R	Reserved		
806	0326h	2	R	Instantaneous apparent power	*5	
807	0327h	2	R	Demand reactive power *6	*5	
808	0328h	2	R	Demand apparent power	*5	
809	0329h	2	R	Instantaneous earth leakage (Ig) *1,3	0.1A	
810	032Ah	2	R	Demand earth leakage (Ig) *1,3	0.1A	
811	032Bh	2	R	Fault current *8	*7	

*1 Only data of current (from 300h to 308h) and earth leakage (032Ah, 032Bh) can be monitored without VT unit.
*2 In case of 3φ3W, N Pole measurements (303h, 308h, 30Eh to 310h) can not be monitored.
*3 Earth leakage (32Ah, 32Bh) can not be monitored without E1 module.
*4 *1 In case of "In=250 to 315", Unit: 0.1A. In case of "In=500 to 6300", Unit: 1A.
*5 In case of "In=250 to 630", Unit: 0.1kW, 0.1kvar, 0.1kVA. In case of "In=1000 to 6300", Unit: 1kW, 1kvar, 1kVA.
*6 Minus data is expressed as two's complement.
*7 In case of "LTD, STD, INST", Unit: 10A. In case of "GFR", Unit: 1A. In case of "ER", Unit: 0.1A.
Fault cause can be monitored with Alarm and trip information (0252h).
*8 In case of "UVT", Data: non (0).

Table 5.6.13 analog measurement 2 register

Address		Number of bytes	Access	Register Name	Unit	Range
Dec.	Hex.					
812	032Ch	2	R	Max. instantaneous current in Phase 1 (I1) *1	*3	Refer to table 2.4
813	032Dh	2	R	Max. instantaneous current in Phase 2 (I2) *1		
814	032Eh	2	R	Max. instantaneous current in Phase 3 (I3) *1		
815	032Fh	2	R	Max. instantaneous current in Pole N (IN) *1		
816	0330h	2	R	Reserved		
817	0331h	2	R	Max. demand current in Phase 1 (I1) *1	*3	
818	0332h	2	R	Max. demand current in Phase 2 (I2) *1		
819	0333h	2	R	Max. demand current in Phase 3 (I3) *1		
820	0334h	2	R	Max. demand current in Pole N (IN) *1		
821	0335h	2	R	Reserved		
822	0336h	2	R	Max. demand current in Max. Phase	*3	
823	0337h	2	R	Max. instantaneous voltage in Line 1-2 (V12)	V	
824	0338h	2	R	Max. instantaneous voltage in Line 2-3 (V23)		
825	0339h	2	R	Max. instantaneous voltage in Line 1-3 (V13)		
826	033Ah	2	R	Reserved		
827	033Bh	2	R	Max. instantaneous voltage in Max. Line		
828	033Ch	2	R	Max. instantaneous voltage in Phase 1-N (V1N)	V	
829	033Dh	2	R	Max. instantaneous voltage in Phase 2-N (V2N)		
830	033Eh	2	R	Max. instantaneous voltage in Phase 3-N (V1N)		
831	033Fh	2	R	Reserved		
832	0340h	2	R	Max. instantaneous voltage in Max. Phase	V	
833	0341h	2	R	Reserved		
834	0342h	2	R	Reserved		
835	0343h	2	R	Reserved		
836	0344h	2	R	Max. instantaneous power Factor *5	0.1%	
837	0345h	2	R	Reserved		
838	0346h	2	R	Reserved		
839	0347h	2	R	Reserved		
840	0348h	2	R	Reserved		
841	0349h	2	R	Max. instantaneous active power *5	*4	
842	034Ah	2	R	Reserved		
843	034Bh	2	R	Reserved		
844	034Ch	2	R	Reserved		
845	034Dh	2	R	Max. demand active power *5	*4	
846	034Eh	2	R	Reserved		
847	034Fh	2	R	Reserved		
848	0350h	2	R	Reserved		
849	0351h	2	R	Max. instantaneous reactive power *5	*4	
850	0352h	2	R	Reserved		
851	0353h	2	R	Reserved		
852	0354h	2	R	Reserved		
853	0355h	2	R	Max. instantaneous apparent power	*4	
854	0356h	2	R	Max. demand reactive power *5	*4	
855	0357h	2	R	Max. demand apparent power	*4	
856	0358h	2	R	Max. instantaneous earth leakage(Ig) *1,6	0.1A	
857	0359h	2	R	Max. demand earth leakage (Ig) *1,6	0.1A	

*1 Only data of current (from 32Ch to 336h) and earth leakage (0358h, 0359h) can be monitored without VT unit.
*2 In case of 3φ3W, N Pole measurements (32Fh, 334h, 33Ch to 33Eh) can not be monitored.
*3 In case of "In=250 to 315", Unit: 0.1A. In case of "In=500 to 6300", Unit: 1A.
*4 In case of "In=250 to 630", Unit: 0.1kW, 0.1kvar, 0.1kVA. In case of "In=1000 to 6300", Unit: 1kW, 1kvar, 1kVA.
*5 Minus data is expressed as two's complement.
*6 Earth leakage (0358h, 0359h) can not be monitored without E1 module.
*All max. items are saved in EEPROM of EX1 module every 2 hours.

Table 5.6.14 analog measurement 3 register

Address		Number of bytes	Access	Register Name	Unit	Range
Dec.	Hex.					
858	035Ah	2	R	Reserved		
859	035Bh	2	R	Reserved		
860	035Ch	2	R	Reserved		
861	035Dh	2	R	Reserved		
862	035Eh	2	R	Reserved		
863	035Fh	2	R	Reserved		
864	0360h	2	R	Reserved		
865	0361h	2	R	Reserved		
866	0362h	2	R	Reserved		
867	0363h	2	R	Reserved		
868	0364h	2	R	Reserved		
869	0365h	2	R	Reserved		
870	0366h	2	R	Reserved		
871	0367h	2	R	Reserved		
872	0368h	2	R	Reserved		
873	0369h	2	R	Reserved		
874	036Ah	2	R	Reserved		
875	036Bh	2	R	Reserved		
876	036Ch	2	R	Reserved		
877	036Dh	2	R	Reserved		
878	036Eh	2	R	Reserved		Refer to table 2.4
879	036Fh	2	R	Min. Instantaneous power Factor *1 2 3	0.1%	
880	0370h	2	R	Reserved		
881	0371h	2	R	Reserved		
882	0372h	2	R	Reserved		
883	0373h	2	R	Reserved		
884	0374h	2	R	Reserved		
885	0375h	2	R	Reserved		
886	0376h	2	R	Reserved		
887	0377h	2	R	Reserved		
888	0378h	2	R	Reserved		
889	0379h	2	R	Reserved		
890	037Ah	2	R	Reserved		
891	037Bh	2	R	Reserved		
892	037Ch	2	R	Reserved		
893	037Dh	2	R	Reserved		
894	037Eh	2	R	Reserved		
895	037Fh	2	R	Reserved		
896	0380h	2	R	Reserved		
897	0381h	2	R	Reserved		
898	0382h	2	R	Reserved		

*1 All above data can not be monitored without VT unit.

*2 Minus data is expressed as two's complement.

*3 All min. items are saved in EEPROM of EX1 module every 2 hours.

Table 5.6.15 Energy register

Address		Number of bytes	Access	Register Name	Unit	Range
Dec.	Hex.					
1280	0500h	2	R	Active energy	kWh	0 to 999
1281	0501h	2	R		MWh	0 to 999
1282	0502h	2	R	Reserved		
1283	0503h	2	R	Reserved		
1284	0504h	2	R	Reactive energy (Lag)	kvarh	0 to 999
1285	0505h	2	R		Mvarh	0 to 999
1286	0506h	2	R	Reserved		
1287	0507h	2	R	Reserved		
1288	0508h	2	R	Reactive energy (Lead)	kvarh	0 to 999
1289	0509h	2	R		Mvarh	0 to 999
1290	050Ah	2	R	Reserved		
1291	050Bh	2	R	Reserved		
1292	050Ch	2	R	Reserved		
1293	050Dh	2	R	Reserved		
1294	050Eh	2	R	Reserved		
1295	050Fh	2	R	Reserved		
1296	0510h	2	R	Reserved		
1297	0511h	2	R	Reserved		
1298	0512h	2	R	Reserved		
1299	0513h	2	R	Reserved		
1300	0514h	2	R	Reserved		
1301	0515h	2	R	Reserved		
1302	0516h	2	R	Reserved		
1303	0517h	2	R	Reserved		
1304	0518h	4	R	Active energy (4 bytes) *1	kWh	0 to 99999999
1306	051Ah	4	R	Reserved		
1308	051Ch	4	R	Reactive energy (4 bytes) *1	kvarh	0 to 99999999
1310	051Eh	4	R	Reserved		
1312	0520h	4	R	Reactive energy (4 bytes) *1	kvarh	0 to 99999999

*All above data can not be monitored without VT unit.

*The active and reactive energy are stored in the EEPROM of Extension module (EX1) when the power supply form Power supply module (P1-P5) is cut off.

*1 Addresses 0518h-0520h can be accessed only from the even number address.
If the byte count of start address 0518h and 051Ah etc. is 2, 3, 5, or 6-byte, the error code (illegal data address code :02h) is returned.

<Example> In case of monitoring active energy (0518H).
Slave address :01H

Query framing

01H	03H	05H	18H	00H	02H	Lo	Hi
Slave address	Function Code	Starting address		quantity of registers		CRC	

Response framing

01H	03H	04H	HH	HL	LH	LL	Lo	Hi
Slave Address	Function Code	Byte count	Active energy				CRC	

Table 5.6.16 Harmonics 1 register

Address		Number of bytes	Access	Register Name	Unit	RANGE
Dec.	Hex.					
2304	0900h	2	R	Total harmonics current in Phase 1 (I1)	*1	0 to 2xIn
2305	0901h	2	R	Total harmonics current in Phase 2 (I2)		
2306	0902h	2	R	Total harmonics current in Phase 3 (I3)		
2307	0903h	2	R	Total harmonics current in Pole N (IN)		
2308	0904h	2	R	Fundamental current in Phase 1 (I1)		
2309	0905h	2	R	Fundamental current in Phase 2 (I2)		
2310	0906h	2	R	Fundamental current in Phase 3 (I3)		
2311	0907h	2	R	Fundamental current in Pole N (IN)		
2312	0908h	2	R	3rd harmonics current in Phase 1 (I1)		
2313	0909h	2	R	3rd harmonics current in Phase 2 (I2)		
2314	090Ah	2	R	3rd harmonics current in Phase 3 (I3)		
2315	090Bh	2	R	3rd harmonics current in Pole N (IN)		
2316	090Ch	2	R	5th harmonics current in Phase 1 (I1)		
2317	090Dh	2	R	5th harmonics current in Phase 2 (I2)		
2318	090Eh	2	R	5th harmonics current in Phase 3 (I3)		
2319	090Fh	2	R	5th harmonics current in Pole N (IN)		
2320	0910h	2	R	7th harmonics current in Phase 1 (I1)		
2321	0911h	2	R	7th harmonics current in Phase 2 (I2)		
2322	0912h	2	R	7th harmonics current in Phase 3 (I3)		
2323	0913h	2	R	7th harmonics current in Pole N (IN)		
2324	0914h	2	R	9th harmonics current in Phase 1 (I1)		
2325	0915h	2	R	9th harmonics current in Phase 2 (I2)		
2326	0916h	2	R	9th harmonics current in Phase 3 (I3)		
2327	0917h	2	R	9th harmonics current in Pole N (IN)		
2328	0918h	2	R	11th harmonics current in Phase 1 (I1)		
2329	0919h	2	R	11th harmonics current in Phase 2 (I2)		
2330	091Ah	2	R	11th harmonics current in Phase 3 (I3)		
2331	091Bh	2	R	11th harmonics current in Pole N (IN)		
2332	091Ch	2	R	13th harmonics current in Phase 1 (I1)		
2333	091Dh	2	R	13th harmonics current in Phase 2 (I2)		
2334	091Eh	2	R	13th harmonics current in Phase 3 (I3)		
2335	091Fh	2	R	13th harmonics current in Pole N (IN)		
2336	0920h	2	R	15th harmonics current in Phase 1 (I1)		
2337	0921h	2	R	15th harmonics current in Phase 2 (I2)		
2338	0922h	2	R	15th harmonics current in Phase 3 (I3)		
2339	0923h	2	R	15th harmonics current in Pole N (IN)		
2340	0924h	2	R	17th harmonics current in Phase 1 (I1)		
2341	0925h	2	R	17th harmonics current in Phase 2 (I2)		
2342	0926h	2	R	17th harmonics current in Phase 3 (I3)		
2343	0927h	2	R	17th harmonics current in Pole N (IN)		
2344	0928h	2	R	19th harmonics current in Phase 1 (I1)		
2345	0929h	2	R	19th harmonics current in Phase 2 (I2)		
2346	092Ah	2	R	19th harmonics current in Phase 3 (I3)		
2347	092Bh	2	R	19th harmonics current in Pole N (IN)		

*1 In case of “In=250 to 315”, Unit: 0.1A. In case of “In=500 to 6300”, Unit: 1A.

*All above data can not be monitored without VT unit.

Table 5.6.17 Harmonics 2 register

Address		Number of bytes	Access	Register Name	Unit	RANGE
Dec.	Hex.					
3072	0C00h	2	R	THD (total harmonics distortion) current in Phase 1 (I1)	0.1%	0 to 2000 (200%)
3073	0C01h	2	R	THD (total harmonics distortion) current in Phase 1 (I2)		
3074	0C02h	2	R	THD (total harmonics distortion) current in Phase 1 (I3)		
3075	0C03h	2	R	THD (total harmonics distortion) current in Pole N (IN)		
3076	0C04h	2	R	3rd harmonics ratio current in Phase 1 (I1)		
3077	0C05h	2	R	3rd harmonics ratio current in Phase 2 (I2)		
3078	0C06h	2	R	3rd harmonics ratio current in Phase 3 (I3)		
3079	0C07h	2	R	3rd harmonics ratio current in Pole N (IN)		
3080	0C08h	2	R	5th harmonics ratio current in Phase 1 (I1)		
3081	0C09h	2	R	5th harmonics ratio current in Phase 2 (I2)		
3082	0C0Ah	2	R	5th harmonics ratio current in Phase 3 (I3)		
3083	0C0Bh	2	R	5th harmonics ratio current in Pole N (IN)		
3084	0C0Ch	2	R	7th harmonics ratio current in Phase 1 (I1)		
3085	0C0Dh	2	R	7th harmonics ratio current in Phase 2 (I2)		
3086	0C0Eh	2	R	7th harmonics ratio current in Phase 3 (I3)		
3087	0C0Fh	2	R	7th harmonics ratio current in Pole N (IN)		
3088	0C10h	2	R	9th harmonics ratio current in Phase 1 (I1)		
3089	0C11h	2	R	9th harmonics ratio current in Phase 2 (I2)		
3090	0C12h	2	R	9th harmonics ratio current in Phase 3 (I3)		
3091	0C13h	2	R	9th harmonics ratio current in Pole N (IN)		
3092	0C14h	2	R	11th harmonics ratio current in Phase 1 (I1)		
3093	0C15h	2	R	11th harmonics ratio current in Phase 2 (I2)		
3094	0C16h	2	R	11th harmonics ratio current in Phase 3 (I3)		
3095	0C17h	2	R	11th harmonics ratio current in Pole N (IN)		
3096	0C18h	2	R	13th harmonics ratio current in Phase 1 (I1)		
3097	0C19h	2	R	13th harmonics ratio current in Phase 2 (I2)		
3098	0C1Ah	2	R	13th harmonics ratio current in Phase 3 (I3)		
3099	0C1Bh	2	R	13th harmonics ratio current in Pole N (IN)		
3100	0C1Ch	2	R	15th harmonics ratio current in Phase 1 (I1)		
3101	0C1Dh	2	R	15th harmonics ratio current in Phase 2 (I2)		
3102	0C1Eh	2	R	15th harmonics ratio current in Phase 3 (I3)		
3103	0C1Fh	2	R	15th harmonics ratio current in Pole N (IN)		
3104	0C20h	2	R	17th harmonics ratio current in Phase 1 (I1)		
3105	0C21h	2	R	17th harmonics ratio current in Phase 2 (I2)		
3106	0C22h	2	R	17th harmonics ratio current in Phase 3 (I3)		
3107	0C23h	2	R	17th harmonics ratio current in Pole N (IN)		
3108	0C24h	2	R	19th harmonics ratio current in Phase 1 (I1)		
3109	0C25h	2	R	19th harmonics ratio current in Phase 2 (I2)		
3110	0C26h	2	R	19th harmonics ratio current in Phase 3 (I3)		
3111	0C27h	2	R	19th harmonics ratio current in Pole N (IN)		

*All above data can not be monitored without VT unit.

Table 5.6.18 Harmonics 3 register

Address		Number of bytes	Access	Register Name	Unit	RANGE
Dec.	Hex.					
3840	0F00h	2	R	Max. total harmonics current in Max. Phase	*1	0 to 2xIn
3841	0F01h	2	R	Max. fundamental current in Max. Phase		
3842	0F02h	2	R	Max. 3rd harmonics current in Max. Phase		
3843	0F03h	2	R	Max. 5th harmonics current in Max. Phase		
3844	0F04h	2	R	Max. 7th harmonics current in Max. Phase		
3845	0F05h	2	R	Max. 9th harmonics current in Max. Phase		
3846	0F06h	2	R	Max. 11th harmonics current in Max. Phase		
3847	0F07h	2	R	Max. 13th harmonics current in Max. Phase		
3848	0F08h	2	R	Max. 15th harmonics current in Max. Phase		
3849	0F09h	2	R	Max. 17th harmonics current in Max. Phase		
3850	0F0Ah	2	R	Max. 19th harmonics current in Max. Phase		
4608	1200h	2	R	Max. THD (total harmonics distortion) current in Max. Phase	0.1%	0 to 2000 (200%)
4609	1201h	2	R	Max. 3rd harmonics ratio current in Max. Phase		
4610	1202h	2	R	Max. 5th harmonics ratio current in Max. Phase		
4611	1203h	2	R	Max. 7th harmonics ratio current in Max. Phase		
4612	1204h	2	R	Max. 9th harmonics ratio current in Max. Phase		
4613	1205h	2	R	Max. 11th harmonics ratio current in Max. Phase		
4614	1206h	2	R	Max. 13th harmonics ratio current in Max. Phase		
4615	1207h	2	R	Max. 15th harmonics ratio current in Max. Phase		
4616	1208h	2	R	Max. 17th harmonics ratio current in Max. Phase		
4617	1209h	2	R	Max. 19th harmonics ratio current in Max. Phase		

*1 In case of “In=250 to 315”, Unit: 0.1A. In case of “In=500 to 6300”, Unit: 1A.

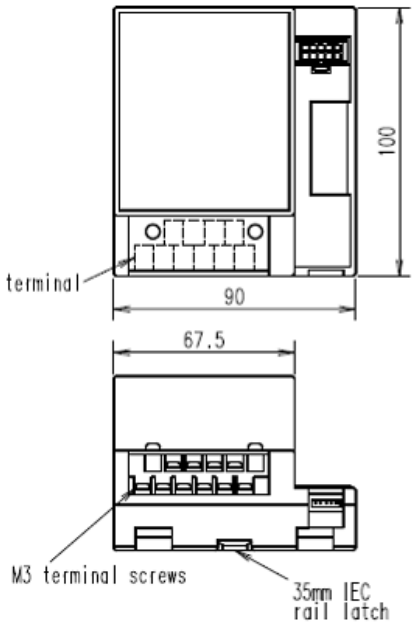
*All above data can not be monitored without VT unit.

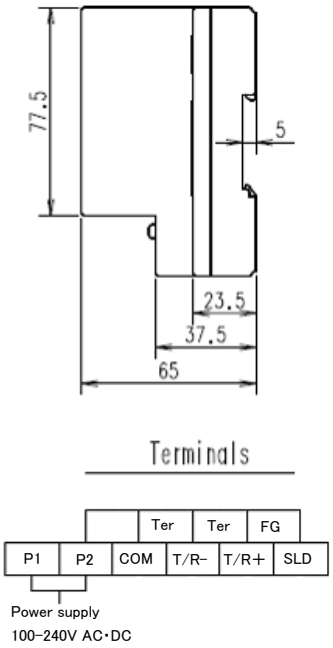
*All maximum items are saved in EEPROM of EX1 module every 2 hours.

*Max. means maximum value from past when the item is reset to present.
Max. ratio (Max. THD) is defined as a value when the RMS is maximum.

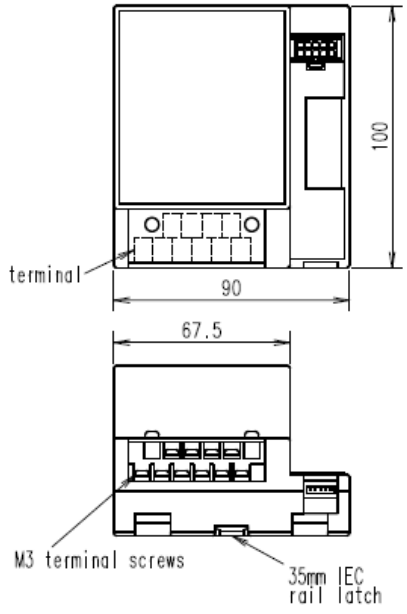
6. Outline dimensions

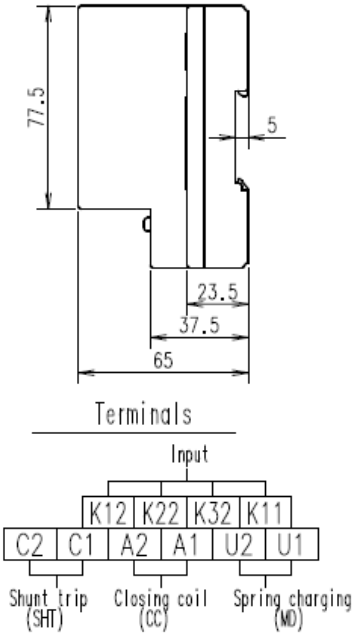
●BIF-MD





●BIF-CON





7. SERVICE NETWORK

Country/Region	Corporation Name	Address	Telephone
Australia	Mitsubishi Electric Australia Pty. Ltd.	348 Victoria Road, Rydalmere, N.S.W. 2116, Australia	+61-2-9684-7777
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	ELECTRO MECH AUTOMATION& ENGINEERING LTD.	Purana Paltan Lane, (VIP Road), Rokeya Mansion(6th floor), Room#702,Dhaka-1000, Bangladesh	+880-28-321-791
Belarus	Tehnikon	Oktyabrskaya 19, Off. 705, BY-220030 Minsk, Belarus	+375(0)17/210 46 26
Belgium	Koning & Hartman B.V.	Woluwelaan 31, BE-1800 Vilvoorde, Belgium	+32(0)2/2570240
Cambodia	DHINIMEX CO.,LTD	#245, St. Tep Phan, Phnom Penh, Cambodia	+855-23-997-725
Chile	Rhona S.A.	Vte. Agua Santa 4211 Casilla 30-D (P.O. Box) Vina del Mar, Chile	+56-32-2-320-600
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	Mitsubishi Electric Automation (China) Ltd. GuangZhou Branch	Room 1609, North Tower, The Hub Center, No.1068, Xing Gang East Road, Haizhu District, Guang Zhou, China 510335	+86-20-8923-6730
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	SIMAP	Jana Derku 1671, SK - 91101 Trencin, Slovakia	+ 421(0)32 743 04 72
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	Mitsubishi Electric Vietnam Co., Ltd. Hanoi Branch	6th Floor, Detech Tower, 8 Ton That Thuyet Street, My Dinh 2 Ward, Nam Tu Liem District, Hanoi City, Vietnam	+84-4-3937-8075

MITSUBISHI Low-Voltage Air Circuit Breakers type AE
三菱低压空气断路器

Modbus Interface unit (BIF-MD)
Modbus 接口模块（BIF-MD）

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