



Energy Measuring Unit

MODEL

EMU4-BD1-MB

EMU4-HD1-MB

User's Manual (Details)

- Before operating the instrument, you should first read thoroughly this operation manual for safe operation and optimized performance of the product.
Deliver this user's manual to the end user.

Energy Measuring Unit

Model EMU4-BD1-MB
EMU4-HD1-MB

User's Manual (Details)





Safety precautions

Thank you for purchasing the Energy Measuring Unit.

- This manual describes setup and usage for the Energy Measuring Unit. Before using the product, please read this manual carefully to ensure correct use. Especially, in the case of where this unit is to be installed, please read "1. Precautions for Use" to ensure correct use.
- Make sure that the end users read this manual and then keep the manual in a safe place for future reference.
- Make sure to deliver this manual to the end-user.
- If you are considering using this unit for special purpose such as nuclear power plants, aerospace, medical care or passenger vehicles please refer to our sales representative.(For details, please see at the end of this manual.)

- Notations in this manual

Use the following marks in this manual.

Mark	Meaning of the icons
 Danger	Indicates that incorrect handling may result in death or severe injury, ignoring this marking.
 Caution	Indicates that incorrect handling may result in injury or property damage, ignoring this marking.
 Supplement	Indicates that precautions to avoid a malfunction and to work the unit properly.
	Indicates that the pages described that related matters.

- Checking package contents

This following items for this device and included in package. Check that no items are missing.

(1) Energy Measuring unit x1 (2) User's Manual (Digest) x1

This unit cannot be used for deal and proof of electric energy measurement stipulated in the measurement law. Please use the certified watt-hour meter to be used for deal and proof of electric energy measurement stipulated.

Features

[EMU4-BD1-MB]

- This Energy Measuring unit can measure various types of electric quantity such as voltage, current, electric power and electric energy.
- The measured data can be sent to the high-end device, such as a monitoring device by MODBUS RTU communication function.

[EMU4-HD1-MB]

- This Energy Measuring unit can measure various types of electric quantity such as voltage, current, electric power and electric energy.
- The measured data can be sent to the high-end device, such as a monitoring device by MODBUS RTU communication function.
- This Energy Measuring unit has one external input terminal, which can switch between pulse input and contact input.
Production quantity and water, gas, air (other than electricity) can be measured in the pulse input setting.
Monitoring of condition and alarm, measurement of operating time and electric energy during operation can be done in the contact input setting.

MODBUS is a registered trademark of SCHNEIDER ELECTRIC USA, INC in the United States.

Table of Content

Safety precautions	1
Features	1
Table of Content	2
1. Precautions for Use	3
Precautions for Operating Environment and Conditions	3
Matters concerning the precaution before use	3
Installation and Wiring Precautions	3
Precautions for Use	4
Maintenance Precautions	5
Storage Precautions	5
Disposal Precautions	5
About packaging materials and this manual	5
2. Disclaimer	6
3. Name and function of each part	6
4. Attaching and removing the unit	8
5. Procedure for wiring	10
Wiring for EMU4-BD1-MB	10
Wiring for EMU4-HD1-MB	11
Installation of EMU-CT5/CT50/CT100/CT250-A	15
Installation of EMU-CT400/CT600-A	16
Installation of 5A current sensors (EMU2-CT5).....	17
Installation of current sensors for direct connection (EMU-CT50/CT100/CT250).....	17
Installation of current sensors for direct connection (EMU-CT400/CT600).....	18
System configuration example of MODBUS communication.....	19
6. Operating mode	21
7. Setting method	22
Procedures for setting.....	22
Setting menu 1: Phase wire system, primary voltage, sensor type, primary current, demand time, etc.	24
Setting menu 2: MODBUS communication.....	28
Setting menu 3: Contact / pulse input/output, equivalent CO ₂ , harmonic, operating time, etc.	31
Setting menu 4: Upper / lower limit alarm setting, alarm delay time, alarm reset, etc.	32
Setting menu 5: Setting related to logging unit.....	34
Confirmation menu 1 - 5: Confirmation of setting values in setting menu 1 - 5.....	34
Initialization of related items by change of setting	35
Clock setting and logging data clear	36
Change of date format	37
How to use test mode	38
Test menu 1: Discrimination support function for improper connection	39
Test menu 2: Communication test.....	41
Test menu 3: Pulse output test.....	42
Test menu 4: Alarm output test.....	42
8. Operation	43
Operation procedure in operating mode.....	43
Measured item indication in operating mode.....	46
How to use upper/lower limit alarm function.....	48
Operations of alarm reset	49
Preset and all data reset.....	50
9. Device operation	51
Measured items.....	51
Restrictions of measured data.....	53
10. Reference	55
In case you think the unit is in failure	55
About error number.....	55
After-sales service.....	57
Q&A	57
11. Requirement for the compliance with EMC Directives	59
12. Specifications	60
Common specifications	60
Specifications of MODBUS communication	62
13. Option devices	64
14. External dimensions	72
15. Index	73
16. Appendix	74

1. Precautions for Use

Precautions for Operating Environment and Conditions

- This unit is premised on being used in pollution degree 2* environment. When used in higher pollution degree, protect this unit from pollution on another device side to be incorporated.
- Over voltage category of measuring circuit in this unit is CAT II*, and that of auxiliary power circuit (MA, MB) is CAT II*.
- Do not use this product in the places listed below. Failure to follow the instruction may cause malfunctions and a life decrease of product.
 - Places the Ambient temperature exceeds the range -5 - +55°C.
 - Places the average daily temperature exceeds +35°C.
 - Places the Relative humidity exceeds the range 30-85% or places with dewfall.
 - Vibration and impact exceed the specifications.
 - Dust, corrosive gas, saline and oil smoke exist.
 - Places exposed to direct sunlight.
 - Places exposed to rain or water drop.
 - Places in strong electromagnetic field or places large amounts of external noise exist.
 - Places metal fragments or conductive substance are flying.
 - Altitude exceeds 2000m.

< For prevention of electric shock >

- This unit is designed to be housed within another device for prevention of electric shock. House this unit within the device such as the grounded control panel before use.
- To prevent persons with little knowledge about electric equipment from electric shock, panel must be taken either following measure.
 - Lock the panel so that only those who get an education about electric equipment and have sufficient knowledge can unlock, or shut off power supply automatically by opening the panel.
 - Cover the dangerous part of this unit. (Required protection code is higher than IP2X.)

*: For the definition of the pollution degree and the over voltage category, refer to EN61010-1/2010.

Matters concerning the precaution before use

- Use the unit in the specified usage environment and conditions.
- The setting of this unit (phase system, primary voltage, primary current, and sensor type) is necessary before use it.

Installation and Wiring Precautions

Make sure to read this manual carefully before Installation and Wiring.

Caution

<Precautions for Electric work>

- Any person who is involved in the installation and the wiring of this unit should be fully competent to do this work.
- Work under the electric outage condition when installing and wiring. Failure to do so may cause electric shock, a failure of the unit, a fire etc.
- When tapping or wiring, take care not to entering any foreign objects such as chips and wire pieces into this unit.
- Check the connection diagram when wiring. Wrong wiring may cause failure of the unit, a fire or electric shock.
- For protection against noise, **transmission lines and input/output lines shall not be placed close to or bound together with the power lines and high-voltage lines.**
- The wires to be connected to this unit shall be placed in a duct or fixed together by cramping. If the electric wires are not placed in the duct or cramped together, loosen wires or their movement or careless stretch may cause a breakage of the unit or wire or a malfunction due to poor contact of electric wires.
- If transmission lines and input/output lines are placed close to or bound together with the power lines and high-voltage lines, keep distance as below between them.

Condition	Distance
Power line 600V or less	300mm or longer
Other power line	600mm or longer

<Connection of terminal block>

- Strip the wires with proper length. Overlong stripping length may cause short to next wire. Shorter stripping length may cause contact failure.
- Take care not to short to next terminal by a filament. (Do not plate the wires with solder.)
- Do not connect three or more wires to one terminal of a terminal block for preventing loose contact and wires dropout.
- Use appropriate size of electric wires. If inappropriate size of electric wire is used, it may cause a fire due to generated heat.
- Circuits connected to a auxiliary power circuit (MA, MB) need to be used the over current protection device (fuse, circuit breaker, etc.) to prevent shorting connecting wires. (Select an appropriate rating to prevent burnout of the wires.)
- Tighten the screw within the specified torque. Over tightening can damage the screw and/or terminal.
- After tightening the screws, be sure to check all the screws tightened. Loose screw may cause malfunction of the unit, a fire or electric shock.
- Be sure to attach the terminal cover to prevent electric shock.
- Do not directly touch any conductive part of the unit. Doing so can cause electric shock, failure or malfunction of the unit.
- If the wires connected to this unit are strongly pulled off, it may cause a malfunction or a breakage to the unit or the wire.

<Connection with the current sensor>

- When using this product, make sure to use it in combination with current sensor (EMU-CT***, EMU-CT***-A, EMU2-CT5 and EMU2-CT5-4W). This product cannot connect with the secondary side (5A) of current transformer. Please not to exceed the rating of this product for input of current sensor. For further details, please refer to current sensor manual to maintain the functionality and the accuracy of this product.
- The dedicated current sensor (EMU-CT***, EMU-CT***-A,) is used only for low voltage circuit. It cannot be used for a high voltage circuit. EMU2-CT5, EMU2-CT5-4W and EMU-CT5-A should be used with the secondary side (5A) of transformer transfixed. If it is connected with a high-voltage circuit by mistake, it may cause a burnout of the device and a fire. It is critically dangerous. For the allowable maximum voltage of current sensor, refer to "13. Option devices" "(1) Specifications" in this manual.
- The dedicated current sensor has a polarity (directionality). Be careful about it when installing the unit.

<Connection of frame GND terminal>

- Do not exceed the specified voltage when doing an insulation resistance test and a commercial frequency withstand voltage test. Do not connect to frame GND terminal during the insulation resistance test and pressure test.
- Use the crimp-type terminal appropriated for the size of electric wires. If inappropriate crimp-type terminal is used, a wire breakage or a contact failure may occur, which may cause a device malfunction, a failure, a burnout or a fire.
- Frame GND terminal must be grounded according to the D-type ground (ground resistance is not exceed 100Ω).

Precautions for Use

- **This unit cannot be used for deal and proof of electric energy measurement stipulated in the measurement law.**
- Before operating the product, check that active bare wire and so on does not exist around the product. If any bare wire exists, stop the operation immediately, and take an appropriate action such as isolation protection.
- In the event of a power outage during the setting, the unit is not set correctly. Please set again after power recovery.

Danger

- Do not touch the live part. It may cause electric shock, electric burn injury or damage of the device.
- Work under the electric outage condition when installing and wiring.

Caution

- Do not disassemble or modify this unit. It may cause failure, malfunction, injury or fire.
- Use this unit within the ratings specified in this manual. If it is used outside the ratings, it may cause not only malfunction or failure but also fire burnout.

Maintenance Precautions

- Use a soft dry cloth to clean off dirt of the unit surface. Do not let a chemical cloth remain on the surface for an extended period of time nor wipe the surface with thinner or benzene.
- Check for the following items to use this unit properly for long time.
 - (1) Daily maintenance
 - (a) No damage on this unit
 - (b) No abnormality with LCD indicators
 - (c) No abnormal noise, smell or heat
 - (2) Periodical maintenance (Once every 6 months to 1 year)
 - No looseness with installation and wire connection



Do periodical maintenance under the electric outage condition. Failure to do so may cause electric shock, failure of the unit or a fire. Tighten the terminal regularly to prevent a fire.

Storage Precautions

- To store this unit, turn off the power and remove wires, and put it in a plastic bag.
- For long-time storage, avoid the following places. Failure to follow the instruction may cause a failure and reduced life of the unit.
 - Places the Ambient temperature exceeds the range -10 - +60°C.
 - Places the average daily temperature exceeds +35°C.
 - Places the Relative humidity exceeds the range 30-85% or places with dewfall.
 - Vibration and impact exceed the specifications.
 - Dust, corrosive gas, saline and oil smoke exist.
 - Places metal fragments or conductive substance are flying.
 - Places exposed to rain, water drop or direct sunlight.

Disposal Precautions

When disposing of this unit, treat it as industrial waste.

About packaging materials and this manual

For reduction of environment load, packaging materials are produced with cardboard, and this manual is printed on recycled paper.

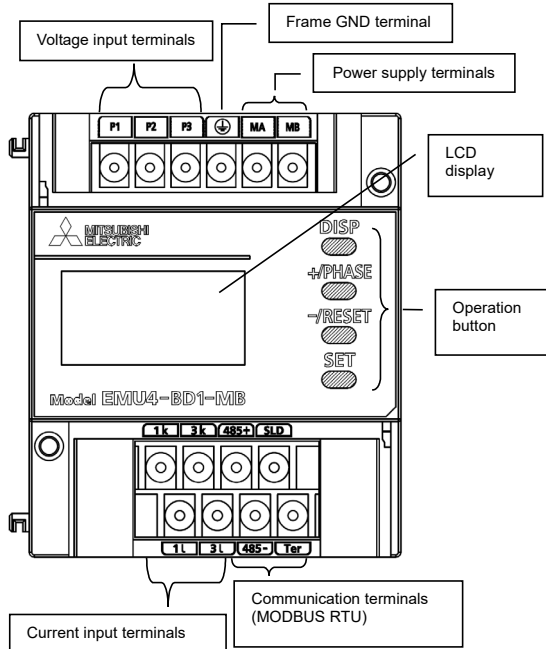
2. Disclaimer

- It is prohibited to reprint or copy all contents of this document in any form without our permission.
- The contents of this document will be updated to follow revisions to software and hardware, however under unavoidable circumstances it may not be synchronized.

3. Name and function of each part

Name of each part

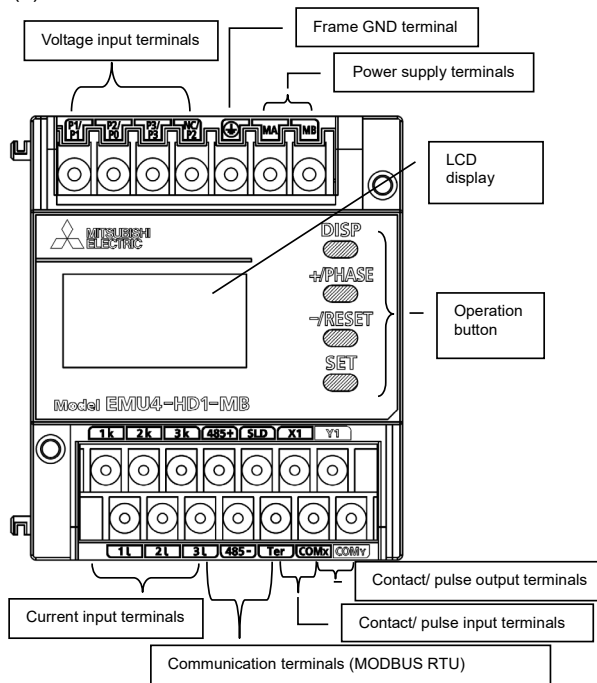
(1) EMU4-BD1-MB



Sign and function of the terminal block

Terminal symbols	Function	Description
P1, P2, P3	Input voltage	Connect the voltage input wire for the measuring circuit.
⊕	Frame GND (FG)	Connect to ground (D type ground).
MA, MB	Auxiliary power	Connect the auxiliary power supply.
1k, 1L, 3k, 3L	Input current	Connect the secondary output of the dedicated current sensor connected to the measurement circuit's current wire.
485+, 485-	MODBUS communication	Connect the communication wire (MODBUS RTU).
SLD		Connect to ground (D type ground).
Ter		Connect with "485-" terminal (the unit at end of the link) P.15.

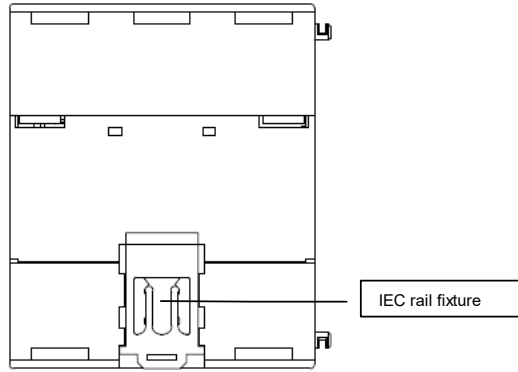
(2) EMU4-HD1-MB



Sign and function of the terminal block

Terminal symbols	Function	Description
P1/P1, P2/P0, P3/P3, NC/P2	Input voltage	Connect the voltage input wire of the measuring circuit.
⊕	Frame GND (FG)	Connect to ground. (D-type ground)
MA, MB	Auxiliary power	Connect the auxiliary power supply.
1k, 1L, 2k, 2L, 3k, 3L	Input current	Connect the secondary output of the dedicated current sensor connected to the measurement circuit's current wire.
485+, 485-	MODBUS communication	Connect the communication wire (MODBUS RTU).
SLD		Connect to ground. (D-type ground)
Ter		Connect with "485-" terminals (the unit at end of the link) P.15.
X1, COMx	Pulse input/ contact input	Connect pulse input/contact input wires.
Y1, COMy	Pulse output/ contact output	Connect pulse output/contact output wires.

· Back view



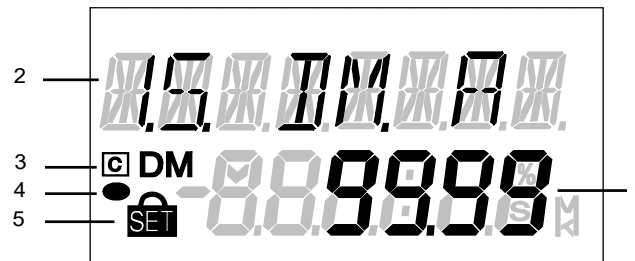
· Function of operation buttons

Control buttons have many functions as below. (How to change mode page 17.)

Meaning of symbol: ○ (Press), □ (Press more than 1 sec), ⊙ (Press more than 2 sec), — (Press both at the same time)

Mode	Operation	Name of Button				Event	
		SET	-/RESET	+ /PHASE	DISP		
Operating Mode					○	Change measured items	
						○	Change phase
					○		Change harmonic order (at harmonic display)
				○			Clear alarm (at alarm keeping)
			⊙				Transition to confirmation mode
			⊙	⊙			Transition to setting mode
			⊙	⊙			Transition to preset display
Setting mode / Confirmation mode	Contact display		⊙			Clear contact latch	
	Integrated value display		⊙	⊙		Transition to reset display of all data	
		⊙					Enter setting menu
	Menu display		○	○		Moving up or down of menu number (Move at fast speed when pressing more than 1sec)	
			□	□			Change of setting items (forward)
	Setting mode / Setting display		○			Transition to setting menu number (at final setting item)	
			○	○		Moving up or down of setting value (Move at fast speed when pressing more than 1sec)	
			□	□		Change setting items (backward)	
	Confirmation mode	Confirmation mode / Setting display				○	Transition to setting menu number (at beginning setting item)
			□				Go back to setting menu
Confirmation display of setting reflection			○			Change setting items (forward)	
					○	Transition to setting menu number (at final setting item)	
						○	Change setting items (backward)
				○	Transition to setting menu number (at beginning setting item)		
		○	○		Transition to setting menu		
		○			At "END" display, memorize changed setting and transition to operating mode		
					At "CANCEL" display, annul changed setting and transition to operating mode		
			○	○	Moving up or down of setting value		
		⊙		⊙	Reset setting values to factory default (only effective at CANCEL display)		

· Functions of LCD



No.	Indicator	Description
1	Measured value	Display measured value digitally.
2	Measured item	Display measured item displayed on indicator 1.
3	Communication	Light when connecting communication unit.
4	Energy Measurement	Light when measuring electric energy (Light off: Not measuring, Lighting: Measuring)
5	Setting	Indicator lights on setting mode. Indicator lights on confirmation mode.

4. Attaching and removing the unit

⚠ Caution

Any person who is involved in the installation and the wiring of this unit should be fully competent to do this work.

There are two installation methods, surface mounting and panel mounting

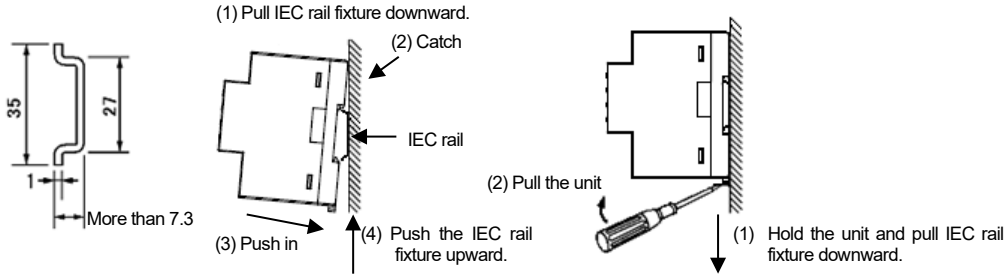
• Surface mounting

(1) How to attach to the IEC rail

Applicable IEC rail

Attaching

Removing

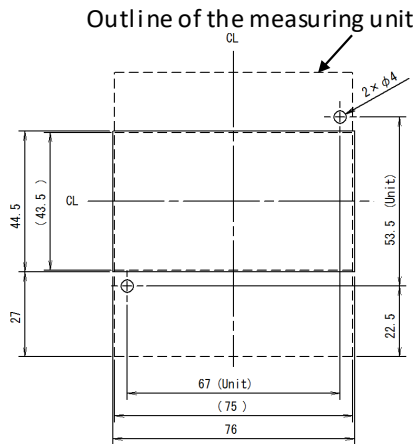


*1: When showing the display part by cutting the panel face in mounting the IEC rail, cut the panel at where it is more than 50mm away from the fulcrum of the open/close of the door.

• Plate mounting

(1) Screw mounting (Measuring unit)

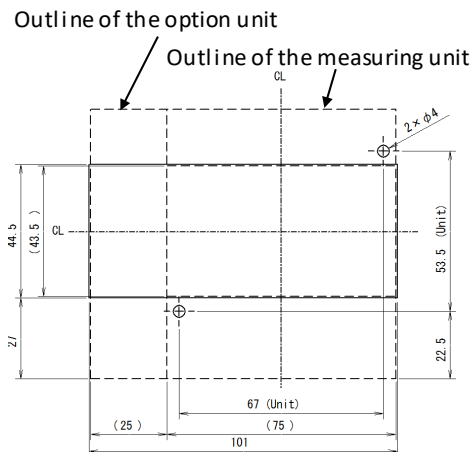
Dimensions of hole panel(76×44.5)



- * Panel cut dimensions are made larger than the product considering tolerance in panel cut.
- * If you want to prevent dust and other intrusion the gap of panel cut, cut the panel according to the product to be mounted.

(2) Screw mounting (Measuring unit + optional unit)

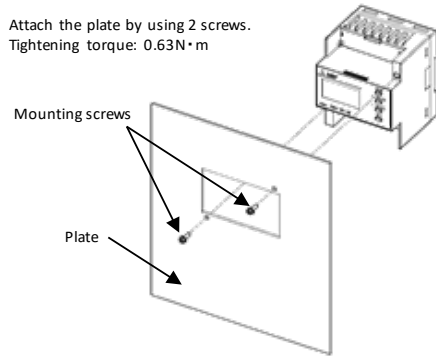
Dimensions of hole panel(101×44.5)



- * Panel cut dimensions are made larger than the product considering tolerance in panel cut.
- * If you want to prevent dust and other intrusion the gap of panel cut, cut the panel according to the product to be mounted.

Attaching

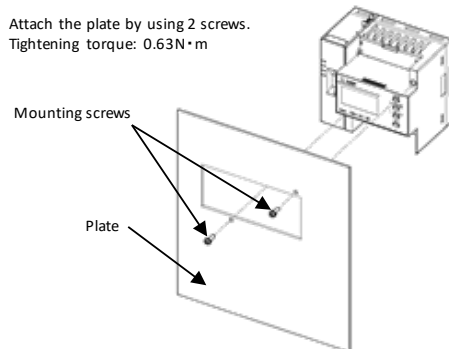
Attach the plate by using 2 screws.
Tightening torque: 0.63N·m



Recommended screws	cross recessed head screw with captive washer and flat washer M3×10 2pcs
--------------------	--

Attaching

Attach the plate by using 2 screws.
Tightening torque: 0.63N·m

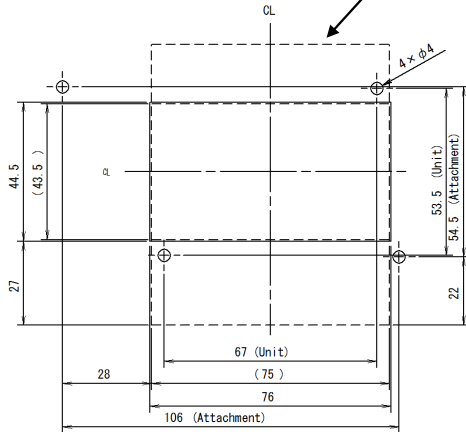


Recommended screws	cross recessed head screw with captive washer and flat washer M3×10 2pcs
--------------------	--

(3) Screw mounting (When using the measuring unit and the attachment for panel mounting)

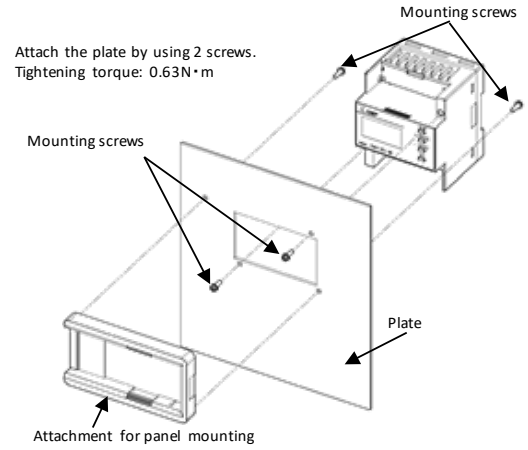
Dimensions of hole panel (76×44.5)

Outline of the measuring unit



- * Panel cut dimensions are made larger than the product considering tolerance in panel cut.
- * If you want to prevent dust and other intrusion the gap of panel cut, cut the panel according to the product to be mounted.

Attaching

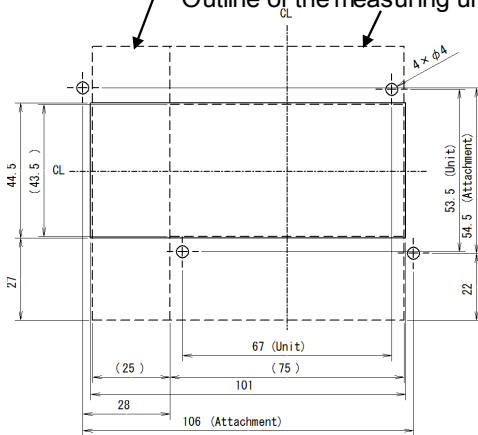


- * Please screw up the panel mounting attachment where there are high levels of vibration.
- * The screws (mounting screws and screws for panel mounting attachment) are supplied with panel mounting attachment.

(4) Screw mounting (Measuring unit + optional unit, when using the attachment for panel mounting)

Dimensions of hole panel (101×44.5)

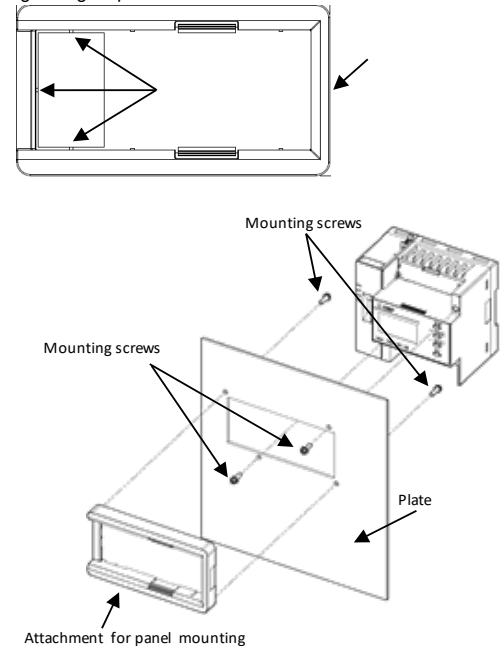
Outline of the option unit
Outline of the measuring unit



- * Panel cut dimensions are made larger than the product considering tolerance in panel cut.
- * If you want to prevent dust and other intrusion the gap of panel cut, cut the panel according to the product to be mounted.

Attaching

Attach the plate by using 2 screws, then install the attachment on the plate (Use the attachment to cut the three points as below).
Tightening torque: 0.63N·m



- * Please screw up the panel mounting attachment where there are high levels of vibration.
- * The screws (mounting screws and screws for panel mounting attachment) are supplied with panel mounting attachment.

5. Procedure for wiring

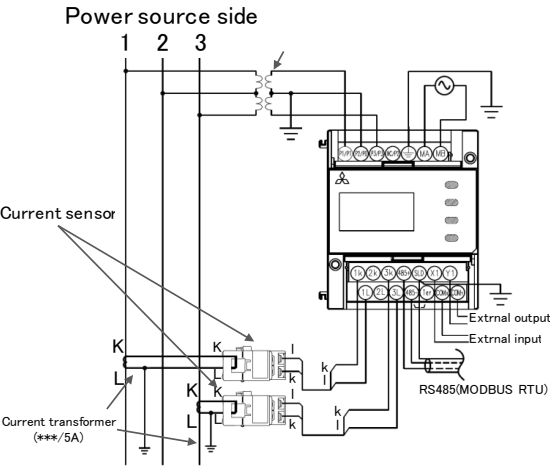
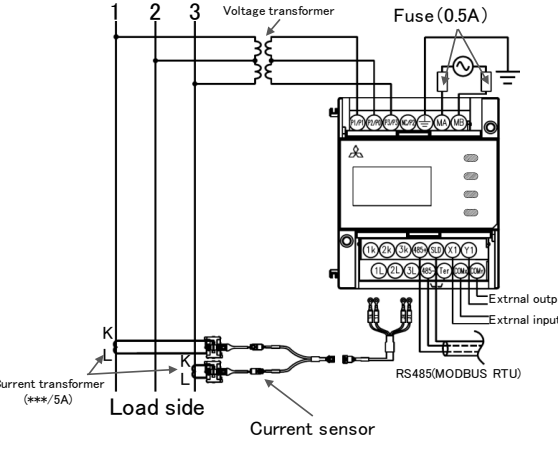
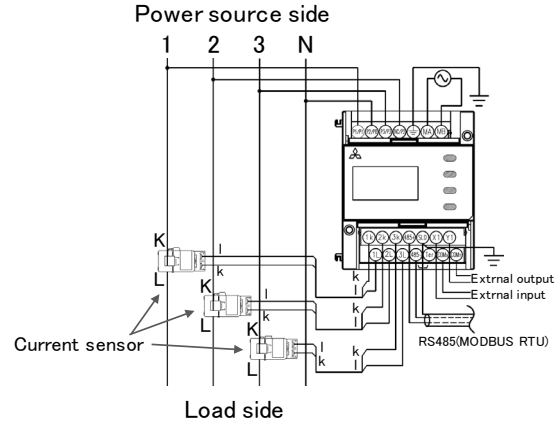
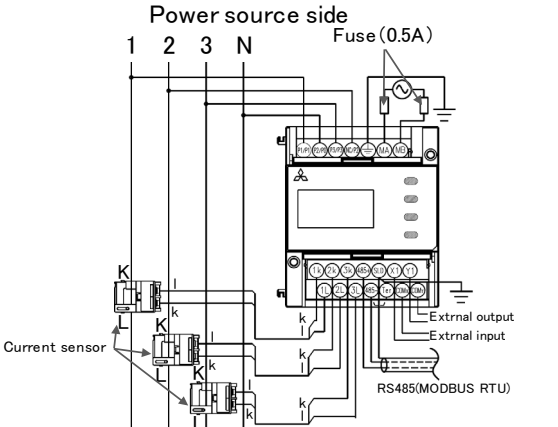
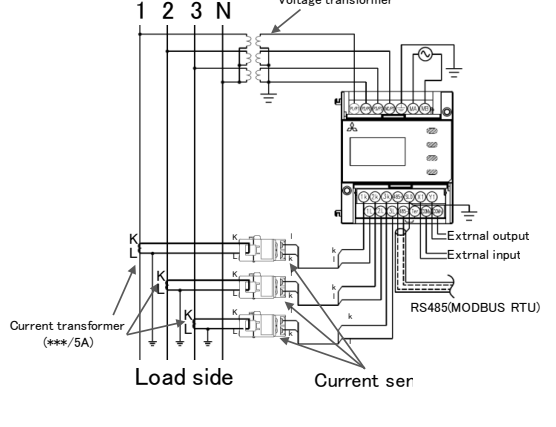
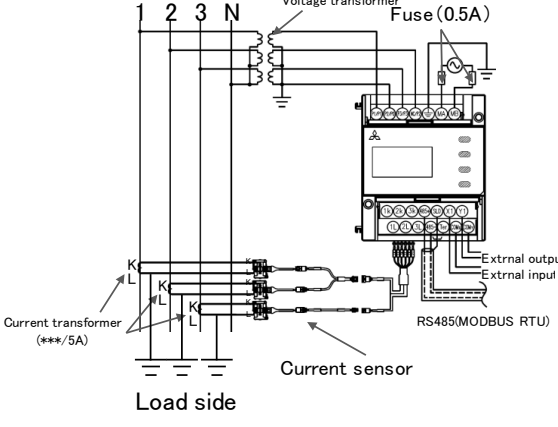
The dedicated current sensor (EMU-CT***, EMU-CT***-A, EMU2-CT5, EMU2-CT5-4W or EMU-CT5-A) is required to measure the current circuit. ***: 50/100/250/400/600.


Please do not use EMU-CT*** type sensor and EMU-CT***-A type sensor with mixture.

Wiring for EMU4-BD1-MB

When UL compliance is unnecessary		When UL compliance is necessary	
Usable current sensor		Usable current sensor	
Models	Support	Models	Support
EMU-CT50	○	EMU-CT50	○
EMU-CT100	○	EMU-CT100	○
EMU-CT250	○	EMU-CT250	○
EMU-CT400	○	EMU-CT400	×
EMU-CT600	○	EMU-CT600	×
EMU-CT5-A	○	EMU-CT5-A	×
EMU-CT50-A	○	EMU-CT50-A	×
EMU-CT100-A	○	EMU-CT100-A	×
EMU-CT250-A	○	EMU-CT250-A	×
EMU-CT400-A	○	EMU-CT400-A	○
EMU-CT600-A	○	EMU-CT600-A	○
EMU2-CT5	○	EMU2-CT5	○
EMU2-CT5-4W	× ^{*1}	EMU2-CT5-4W	× ^{*1}
			Connection with dedicated cable
remark Connection with general wire		remark Connection with general wire	
remark Connection with dedicated cable		remark Connection with dedicated cable	
* ¹ : EMU2-CT5-4W is only used 3phase-4wire system.		* ¹ : EMU2-CT5-4W is only used 3phase-4wire system.	
1P2W	•For low voltage circuit. 	•For low voltage circuit. 	
	•For low voltage circuit. 	•For low voltage circuit. 	

When UL compliance is unnecessary		When UL compliance is necessary	
Usable current sensor		Usable current sensor	
Models	Support	Models	Support
EMU-CT50	○	EMU-CT50	○
EMU-CT100	○	EMU-CT100	○
EMU-CT250	○	EMU-CT250	○
EMU-CT400	○	EMU-CT400	×
EMU-CT600	○	EMU-CT600	×
EMU-CT5-A	○	EMU-CT5-A	×
EMU-CT50-A	○	EMU-CT50-A	×
EMU-CT100-A	○	EMU-CT100-A	×
EMU-CT250-A	○	EMU-CT250-A	×
EMU-CT400-A	○	EMU-CT400-A	○
EMU-CT600-A	○	EMU-CT600-A	○
EMU2-CT5	○	EMU2-CT5	○
EMU2-CT5-4W	○	EMU2-CT5-4W	○
Connection with general wire Connection with dedicated cable		Connection with general wire Connection with dedicated cable	
1P2W	•For low voltage circuit. 	•For low voltage circuit. 	
	Power source side 1 2 Load side K k RS485(MODBUS RTU) External output External input	Power source side 1 2 Fuse(0.5A) Load side K k RS485(MODBUS RTU) External output External input	
1P3W 3P3W	•For low voltage circuit. 	•For low voltage circuit. 	
	Power source side 1 N 3 1 2 3 Load side K k RS485(MODBUS RTU) External output External input	Power source side 1 N 3 1 2 3 Fuse(0.5A) Load side K k RS485(MODBUS RTU) External output External input	

	When UL compliance is unnecessary	When UL compliance is necessary
<p>3P3W</p>	<p>• For high voltage circuit.</p>  <p>Power source side 1 2 3</p> <p>Current sensor</p> <p>Current transformer (***/5A)</p> <p>Load side</p> <p>External output External input RS485(MODBUS RTU)</p>	<p>• For high voltage circuit.</p>  <p>Power source side 1 2 3 Voltage transformer Fuse (0.5A)</p> <p>Current transformer (***/5A)</p> <p>Load side</p> <p>Current sensor</p> <p>External output External input RS485(MODBUS RTU)</p>
<p>3P4W</p>	<p>• For low voltage circuit.</p>  <p>Power source side 1 2 3 N</p> <p>Current sensor</p> <p>Load side</p> <p>External output External input RS485(MODBUS RTU)</p>	<p>• For low voltage circuit.</p>  <p>Power source side 1 2 3 N Fuse (0.5A)</p> <p>Current sensor</p> <p>Load side</p> <p>External output External input RS485(MODBUS RTU)</p>
<p>3P4W</p>	<p>• For high voltage circuit.</p>  <p>Power source side 1 2 3 N Voltage transformer</p> <p>Current transformer (***/5A)</p> <p>Load side</p> <p>Current sensor</p> <p>External output External input RS485(MODBUS RTU)</p>	<p>• For high voltage circuit.</p>  <p>Power source side 1 2 3 N Voltage transformer Fuse (0.5A)</p> <p>Current transformer (***/5A)</p> <p>Load side</p> <p>Current sensor</p> <p>External output External input RS485(MODBUS RTU)</p>

 Caution	<ul style="list-style-type: none"> For protection against noise, transmission lines and input/output lines shall not be placed close to or bound together with the power lines and high-voltage lines. Keep distance as below between them. (except for the terminal block) 	
	Condition	distance
	Power line 600V or less	300mm or longer
	Other power line	600mm or longer
<ul style="list-style-type: none"> For the actual usage, connect the frame GND terminal to ground (D-type ground). Connect it directly to the ground terminal. Do not connect to frame GND terminal during the insulation resistance test and pressure test. 		

- Use appropriate crimp-type terminal. Appropriate crimp-type terminal is as below.
- Use electric wires as below, and tighten the terminal screws by the torque as below.

[EMU4-BD1-MB]

	Applicable wire	Tightening torque	Recommended crimp-type terminal
Auxiliary power, voltage input terminals	Single : AWG24-16(0.2~1.25mm ²) Stranded : AWG24-16(φ0.5~1.2mm)	0.8~1.0N·m	For M3 screw of external diameter below 5.6mm
Current input, input and output terminals	Single : AWG22-16(0.3~1.25mm ²) Stranded : AWG22-16(φ0.5~1.2mm)	0.5~0.6N·m	For M3 screw of external diameter below 5.6mm

[EMU4-HD1-MB]

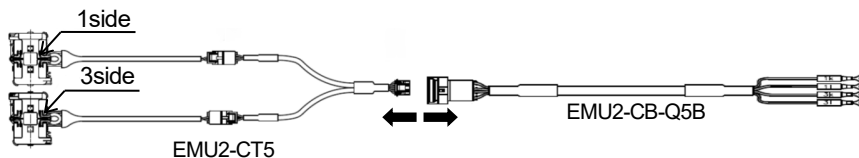
	Applicable wire	Tightening torque	Recommended crimp-type terminal
Auxiliary power, voltage input terminals	Single : AWG26-14(0.12~2.0mm ²) Stranded : AWG26-14(φ0.5~1.6mm)	0.8~1.0N·m	For M3.5 screw of external diameter below 5.6mm
Current input, input and output terminals	Single : AWG22-16(0.3~1.25mm ²) Stranded : AWG22-16(φ0.5~1.2mm)	0.5~0.6N·m	For M3 screw of external diameter below 5.6mm

- Make sure that before connecting the cable, the orientation of the current sensor is correct for attachment. K to L is the correct direction. K: power source side, L: load side
- EMU-C***, EMU-CT***-A are extendable up to 50m.

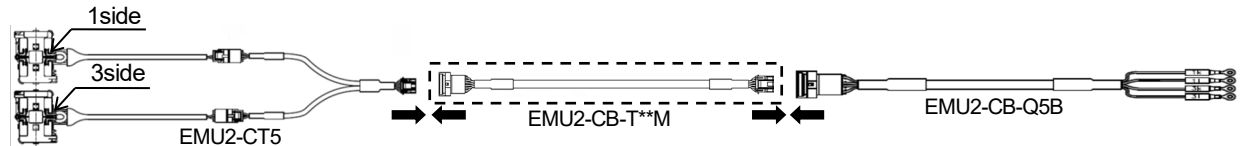
- EMU2-CT5/EMN2-CT5-4W is extensible in the following ways

1. EMU2-CT5 is extends by EMU2-CB-T**M(standard type).

(a) Remove a connector.

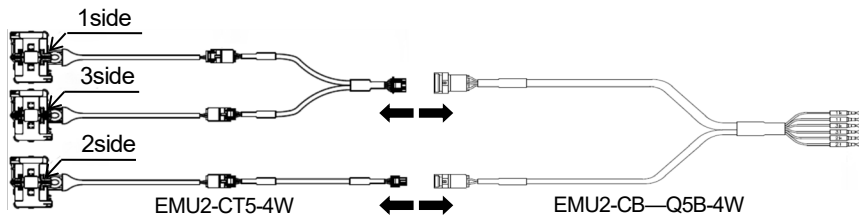


(b) Connect EMU2-CB-T**M for extension.

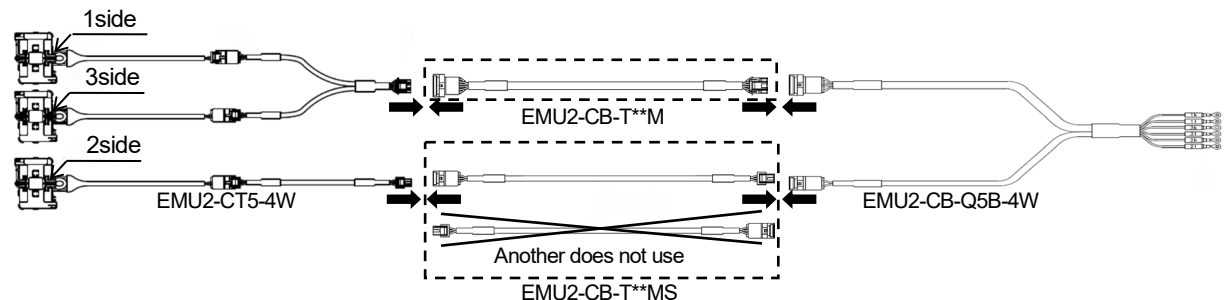


2. EMU2-CT5-4W is extends by EMU2-CB-T**M(standard type) and EMU2-CB-T**MS (separate type).

(a) Remove a connector.



(b) Connect EMU2-CB-T**M(standard type) and EMU2-CB-T**MS for extension.

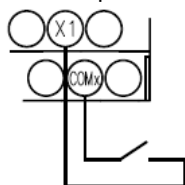


3. EMU2-CT5, EMU2-CT5-4W are extendable up to 11 m, using together with the extension cable. To extend the wire further, use the current transformer(CT) for split-type instrument in combination, extending the secondary wiring on current transformer(CT) side.

- EMU-CT***, EMU-CT***-A(***: 50/100/250/400/600.) is used only for low voltage circuit. It cannot be used for a high voltage circuit. EMU2-CT5 and EMU2-CT5-4W should be used with the secondary side (5A) of transformer transixed. (For the maximum operating voltage of each current sensor, refer to "13. Option devices")
- Do not ground the secondary side of the current sensor.

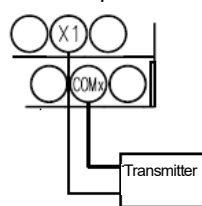
- Maximum voltage of the circuit connected to this unit directly is 260V for EMU4-BD1-MB, or 277 / 480V for EMU4-HD1-MB. For the circuit over this voltage, use the transformer. Using the transformer, primary voltage is configurable up to 6600V. (Primary voltage of VT can be set up to 6600V, and secondary voltage of VT can be set up to 220V as optional setting.)
- For MODBUS communication wiring, recommended to have the extra length wires about 200mm (When extended to B / NET transmission from MODBUS communication, use of MODBUS communication wiring is possible).
- When screwing the terminals at both ends of the terminal block, be careful not to touch the projection of the terminal block cover.
- In case using external input and/or external output, refer to the following.

External input: For the case of contact input



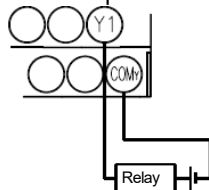
No-voltage a-contact
Use an appropriate type for
5V DC 7mA switching.

External input: For the case of pulse input



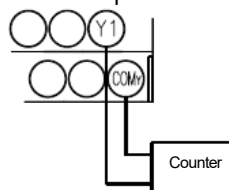
No-voltage a-contact, Open collector
Use an appropriate type for
5V DC 7mA switching.
Please connect GND side to
COMX1 when output of
transmitter is open collector pulse.

External output: For the case of contact output



No-voltage a-contact
35V DC 75mA or,
24V AC 75mA (power factor : 1)

External output: For the case of pulse output

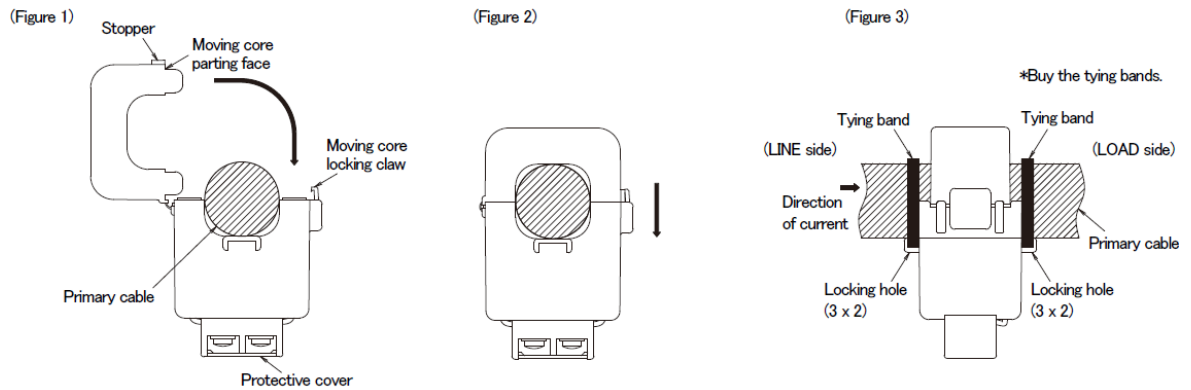


No-voltage a-contact
35V DC 75mA or,
24V AC 75mA (power factor : 1)

- Wiring length at pulse input (Reference)
Describe the pulse wiring length for each wire diameter.
※Polyethylene insulating vinyl sheath cable GPEV wire.

Diameter [mm]	Resistivity [Ω /km]	Wiring length [m]
0.5	94	300
0.65	56.8	500
0.9	29.2	800
1.2	16.5	1000

- 1) Press the locking claw of the moving core, please open the moving core by removing the engagement (Figure 1). Before inserting the cable, check the symbols K and L to fit the current sensor in the correct direction. (The direction from the power supply side to the load side is indicated with →.) (Figure 3)
- 2) After checking that the core parting faces are free from dirt, close the moving core. Push down the moving core until the stoppers are securely locked. (Locking claw of the moving core is applied to the stopper, you hear click.) (Figure 2)
- 3) Pass the tying bands into the current sensor locking holes to secure the sensor with the cable.(Figure 3)



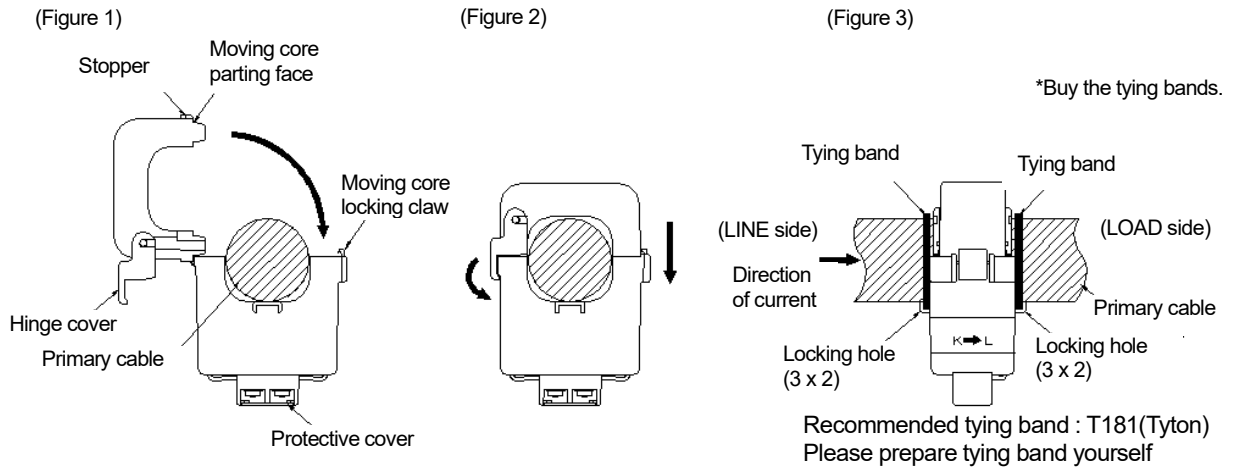
✓ Supplementary

- Make sure that before connecting the cable, the orientation of the current sensor is correct for attachment. K to L is the correct direction. K: power source side, L: load side.
- Do not bend the moving core in a direction other than the operation direction (shown in Fig. 1). The current sensor may be damaged.
- Refer to the table below for appropriate size of electric wires.

		EMU-CT5-A	EMU-CT50-A	EMU-CT100-A	EMU-CT250-A
Usable wires size (reference)	IV cable	38 mm ² or less	38 mm ² or less	60 mm ² or less	200 mm ² or less
	CV cable	22 mm ² or less	22 mm ² or less	60 mm ² or less	150 mm ² or less

Size of electric wires conforms to what is described in the catalog of general PVC insulated wires. Thickness of external PVC insulation is different for different wire. Check with the external dimension diagram of this product and make sure the wire can go through the given space.

- 1) Press the locking claw of the moving core, please open the moving core by removing the engagement (Figure 1). At this time, the hinge cover opens automatically. Before inserting the cable, check the symbols K and L to fit the current sensor in the correct direction. (The direction from the power supply side to the load side is indicated with →.) (Figure 3)
- 2) After checking that the core parting faces are free from dirt, close the moving core. Push down the moving core until the stoppers are securely locked. (Locking claw of the moving core is applied to the stopper, you hear click.) After the stopper is securely locked, close the hinge cover. (Figure 2)
- 3) Pass the tying bands into the current sensor locking holes to secure the sensor with the cable.(Figure 3)



✓ Supplementary

- Make sure that before connecting the cable, the orientation of the current sensor is correct for attachment. K to L is the correct direction. K: power source side, L: load side.
- Do not bend the moving core in a direction other than the operation direction (shown in Fig. 1). The current sensor may be damaged.
- Refer to the table below for appropriate size of electric wires.

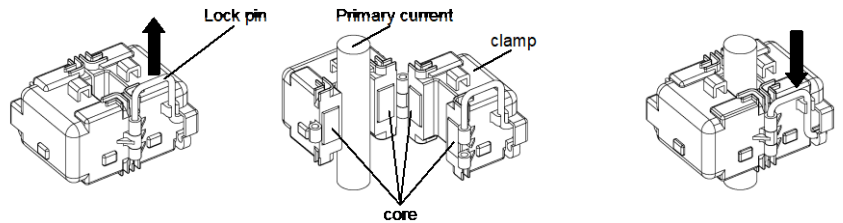
		EMU-CT400-A	EMU-CT600-A
Usable wires size (reference)	IV cable	500 mm ² or less	500 mm ² or less
	CV cable	400 mm ² or less	400 mm ² or less

Size of electric wires conforms to what is described in the catalog of general PVC insulated wires. Thickness of external PVC insulation is different for different wire. Check with the external dimension diagram of this product and make sure the wire can go through the given space.

Installation of 5A current sensors (EMU2-CT5)

• Install the current sensor to the cable of the circuit to be measured by the following method.

1. Please let me slide a lock pin in the direction of an arrow.
2. It lets an electric wire pass in a clamp, and close a clamp again.
3. Please hold a clamp in the fully close state with a finger, and push in until a lock pin is locked.

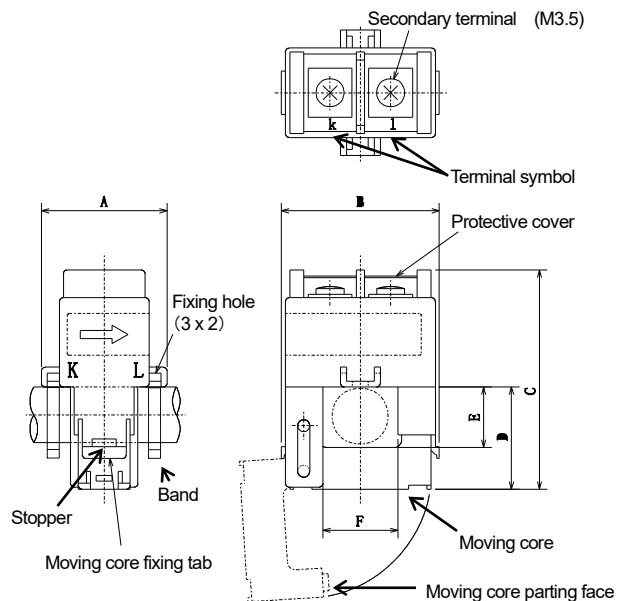


<p>Caution</p>	<ul style="list-style-type: none"> • A lock pin is metal. Keep in mind that the contact to a charge part has failure of an electric shock accident and equipment and fear of a fire. • There is a possibility of damaging if a shock is given to a core portion. Keep in mind that it influences a performance directly. • A core unites, and if a detailed thing also has a bite lump of a foreign substance, since a performance is influenced directly, it should be careful of a field that a measurement value decreases etc. • If impossible power is applied where a clamp is opened, there is fear of breakage. Normal measurement cannot be performed if a direction is mistaken. • A thing $W=2.6\text{mm}$ or less should be used for the union band used when it fixes the electric wire and sensor to penetrate. When it fixes, a union band is fixed to one place of the hole for current sensor fixation with a through cable. Be careful not to fasten too much by the grade which stops lightly (a total of four hole) 	
-----------------------	---	--

Installation of current sensors for direct connection (EMU-CT50/CT100/CT250)

• Install the current sensor to the cable of the circuit to be measured by the following method.

1. Check the configuration of the circuit to be connected, and connect all of the cables.
 - For the connection of the potential transformer, see the instruction manual for the potential transformer.
2. Draw the cable of the circuit to be measured through the center hole of the current sensor.
 - Before drawing the cable through the hole, check the installation direction of the current sensor. There is an arrow indicating K→L.
3. To fix the current sensor, draw a band through the fixing hole located on both sides of the sensor, and lightly fix them together with the cable.
 - See the instruction manual for current sensors.
 - Avoid excessive tightening.
 - Use 2 bands to tie both sides.
4. Cut off the excess length of the bands by nipper or the like.

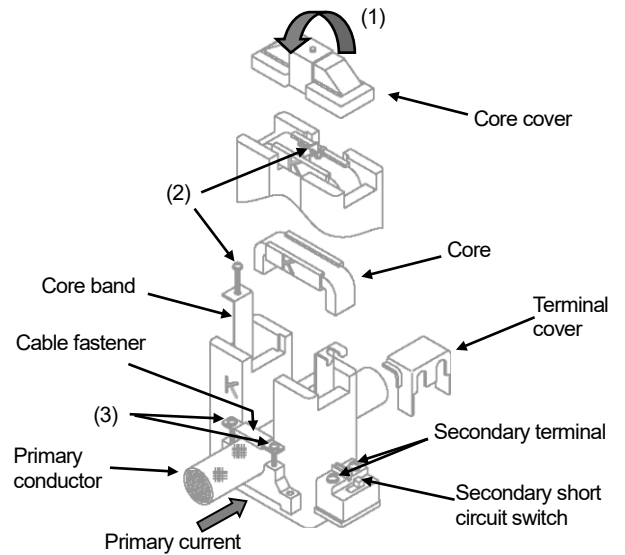


<p>Caution</p>	<p>• Electric wire size which can be penetrated (reference) should refer to the following table.</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th></th> <th>EMU-CT50</th> <th>EMU-CT100</th> <th>EMU-CT250</th> </tr> </thead> <tbody> <tr> <td>IV line</td> <td>[60mm²]</td> <td>[60mm²]</td> <td>[150mm²]</td> </tr> <tr> <td>CV line</td> <td>[38mm²]</td> <td>[38mm²]</td> <td>[150mm²] (*1)</td> </tr> </tbody> </table> <p>*1: 100mm² is recommended</p>		EMU-CT50	EMU-CT100	EMU-CT250	IV line	[60mm ²]	[60mm ²]	[150mm ²]	CV line	[38mm ²]	[38mm ²]	[150mm ²] (*1)
	EMU-CT50	EMU-CT100	EMU-CT250										
IV line	[60mm ²]	[60mm ²]	[150mm ²]										
CV line	[38mm ²]	[38mm ²]	[150mm ²] (*1)										

Installation of current sensors for direct connection (EMU-CT400/CT600)

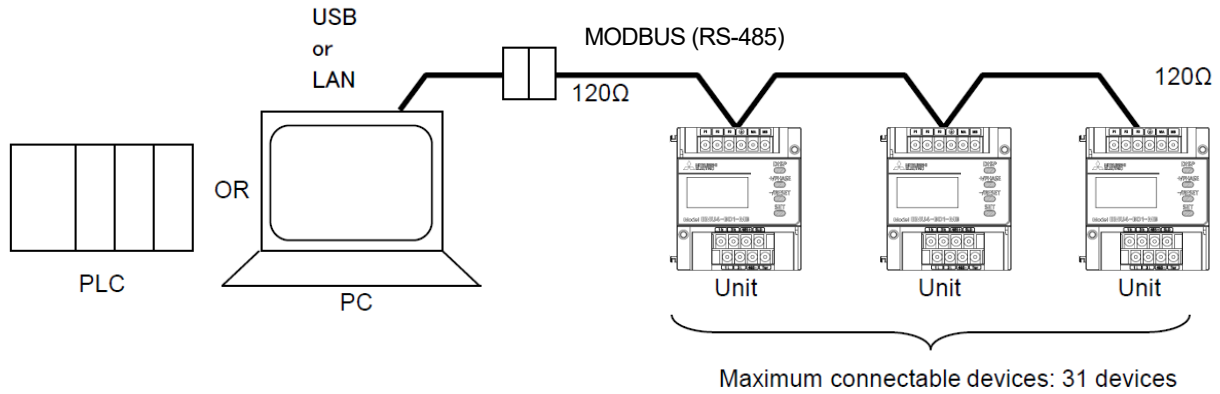
• Install the current sensor to the cable of the circuit to be measured by the following method.

1. Take off the band (1) to the direction such as arrow indicating, and remove core cover.
2. Take off the terminal cover, and turn the secondary short circuit switch to "Short".
3. Loosen screw (2), and take off the core by opening the core band.
4. After loosening screw (3) and drawing the cable through main body, fix the cable using cable fastener by fastening screw (3). Pay attention not to bend the cable fastener.
5. Making uniform the direction of "K" side of core and "K" of main body, put back the core and fasten the core band by screw (2).
6. Fasten the core cover, and fix by the band (1).
7. After connecting secondary terminal and multi-circuit electric measuring unit, turning the secondary short circuit switch to "Open", and fasten the terminal cover.



- Before drawing the cable through the hole, check the installation direction of the current sensor. There is an arrow indicating K→L.
K: Power supply side L: A load side is shown.

System configuration example of MODBUS communication

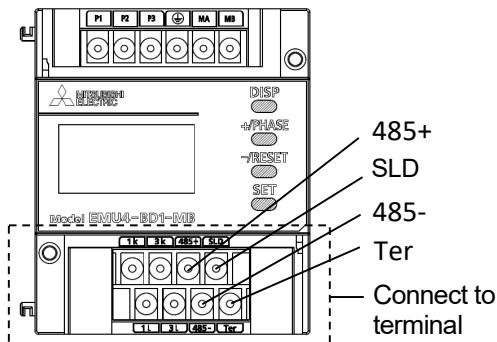


• Connection of MODBUS communication terminals:

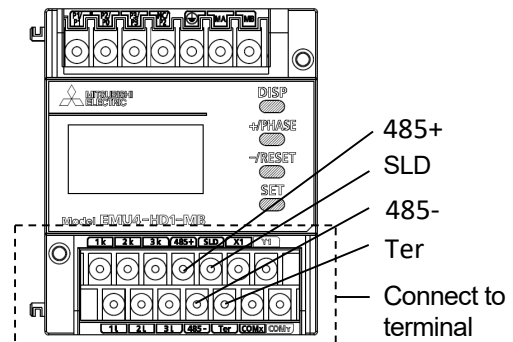
1. Use the twisted shielded pair cable for transmission lines. (Recommended cable page 62.)
2. About the terminal resistance of the MODBUS transmission line
 - Please get terminal resistance of 120 Ω to the apparatus of transmission line both ends. (Termination resistances of 120 Ω can be used by short-circuiting “485-” and “Ter” terminals.)
 - When you are connected to the PLC on transmission line one, please get terminal resistance of 110 Ω in the PLC side. (Please refer to Page16, “•Wiring for MODBUSUNIT(QJ71MB91) and EMU4-BD1-MB or EMU4-HD1-MB ” for the details.)
 - When you are connected to the GOT on transmission line one, please get terminal resistance of 110 Ω in the GOT side. (Please refer to Page16, “•Wiring for GOT (GOT1000, GOT2000) and EMU4-BD1-MB or EMU4-HD1-MB ” for the details.)
3. Connect to ground by using thick wires to decrease impedance.
4. MODBUS transmission lines shall not be placed close to or bound together with the high-voltage lines.
5. Ground the “SLD” terminal at one end.

• wiring terminal

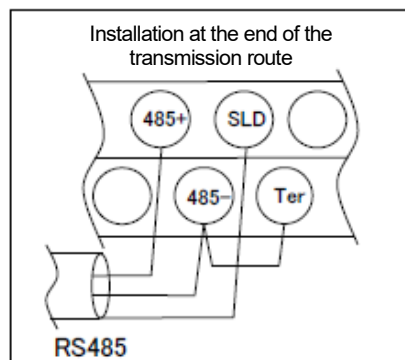
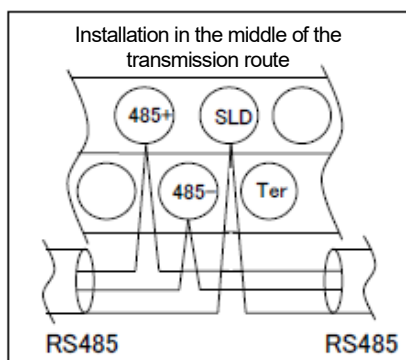
<EMU4-BD1-MB>



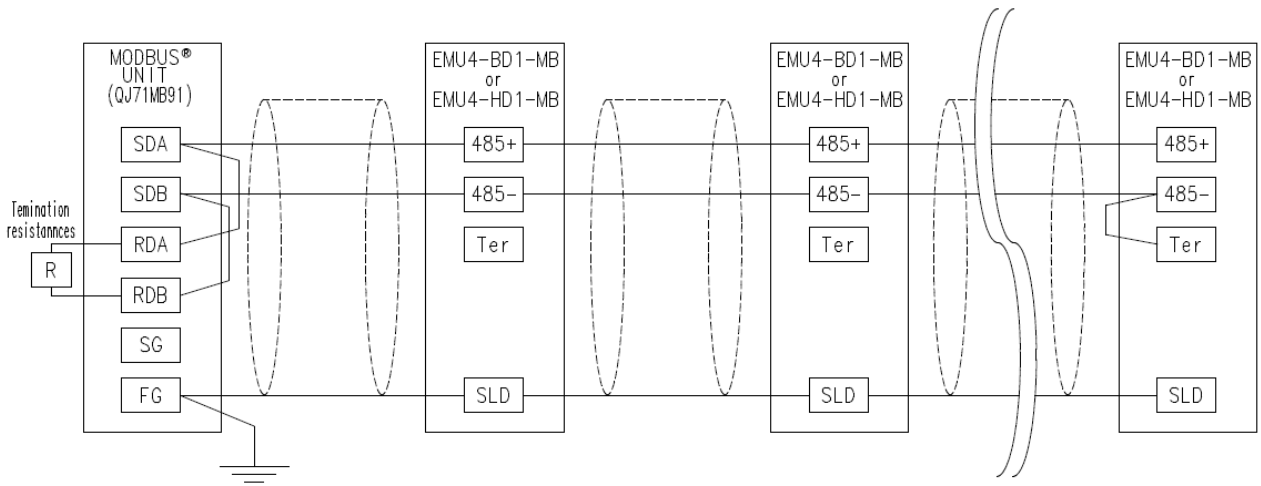
<EMU4-HD1-MB>



• Procedure for wiring

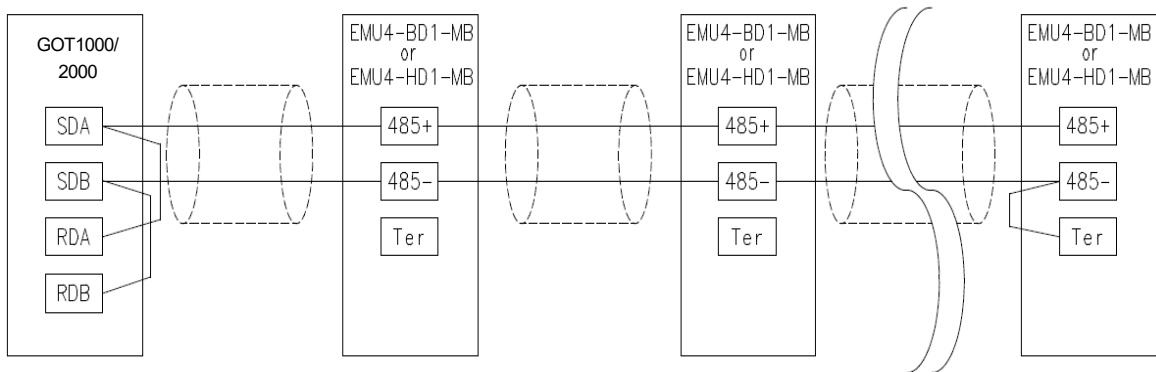


• Wiring for MODBUSUNIT(QJ71MB91, QJ71C24N) and EMU4-BD1-MB or EMU4-HD1-MB



Note) The terminal resistance of the MODBUS unit (QJ71MB91) side, please connect "110Ω 1/2W".
 For details, please refer to "Mitsubishi frequent use sequencer MELSEC-Q Series (QJ71MB91) MODBUS interface unit (details)."

•Wiring for GOT (GOT1000, GOT2000) and EMU4-BD1-MB or EMU4-HD1-MB



Note) Please set the terminal resistance of the GOT(GOT1000, GOT2000) "110 Ω".

Please of the setting method refer to " GOT1000 Series Connection Manual(Microcomputer, MODBUS Products, Peripherals) for GT Works3" "GOT2000 Series Connection Manual (Microcomputers, MODBUS Products, Peripherals) For GT Works3 Version1"

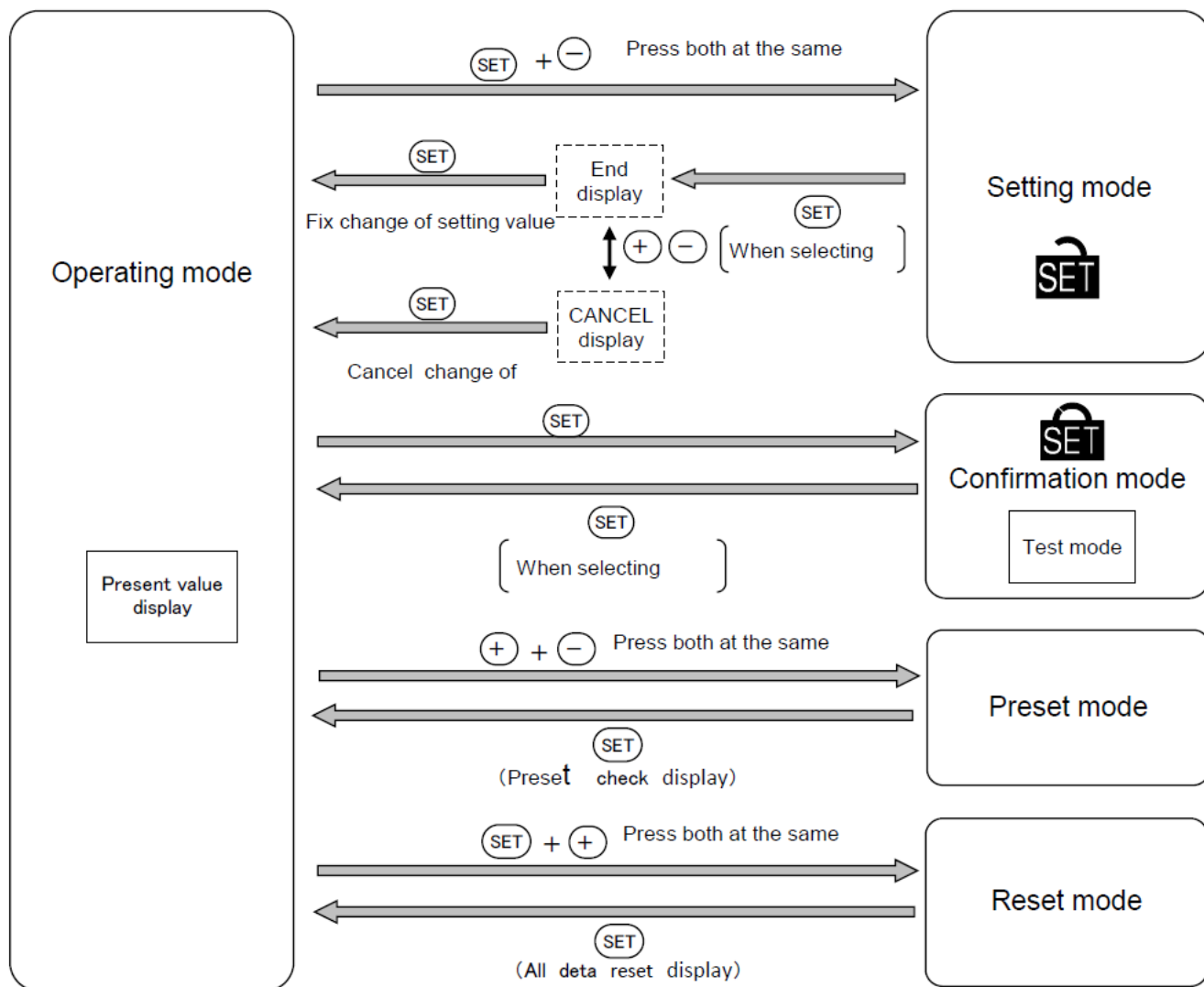
6. Operating mode

This unit has the operating modes. Switch these modes according to the purposes. The operating mode is displayed immediately after the auxiliary power loading.

Mode	Function	Reference
Operating mode	Display measured value digitally. It can display the condition of contact input (*1) and present time (*2) other than the present value of the measured values.	page 43
Setting mode	Set basic setting for phase wire method, primary voltage, primary current, and sensor type and alarm monitoring for alarm output elements.	page 22
Confirmation mode (Test mode)	Mode to confirm the setting value for each setting item. (The Setting cannot be changed in this mode, so it can be prevented setting change by human error.) In addition, this unit has the test function that can be used for such as set up of an equipment. <ul style="list-style-type: none"> Discrimination support display for incorrect wiring: Display useful to discriminate for incorrect wiring such as phase angle display of voltage, current. Pulse, Alarm test: Switch pulse output contact and alarm contact without measurement (voltage and current) input. Communication test: Send back fixed numerical data without measurement (voltage and current) input. 	page 34 page 38
Reset mode / Preset mode	Reset: Integrated values (electric energy, operating time, etc.) can be zeroed. Preset: Preset of electric energy and reactive energy.	page 50

*1: EMU4-HD1-MB only.

*2: Only when connecting logging unit.



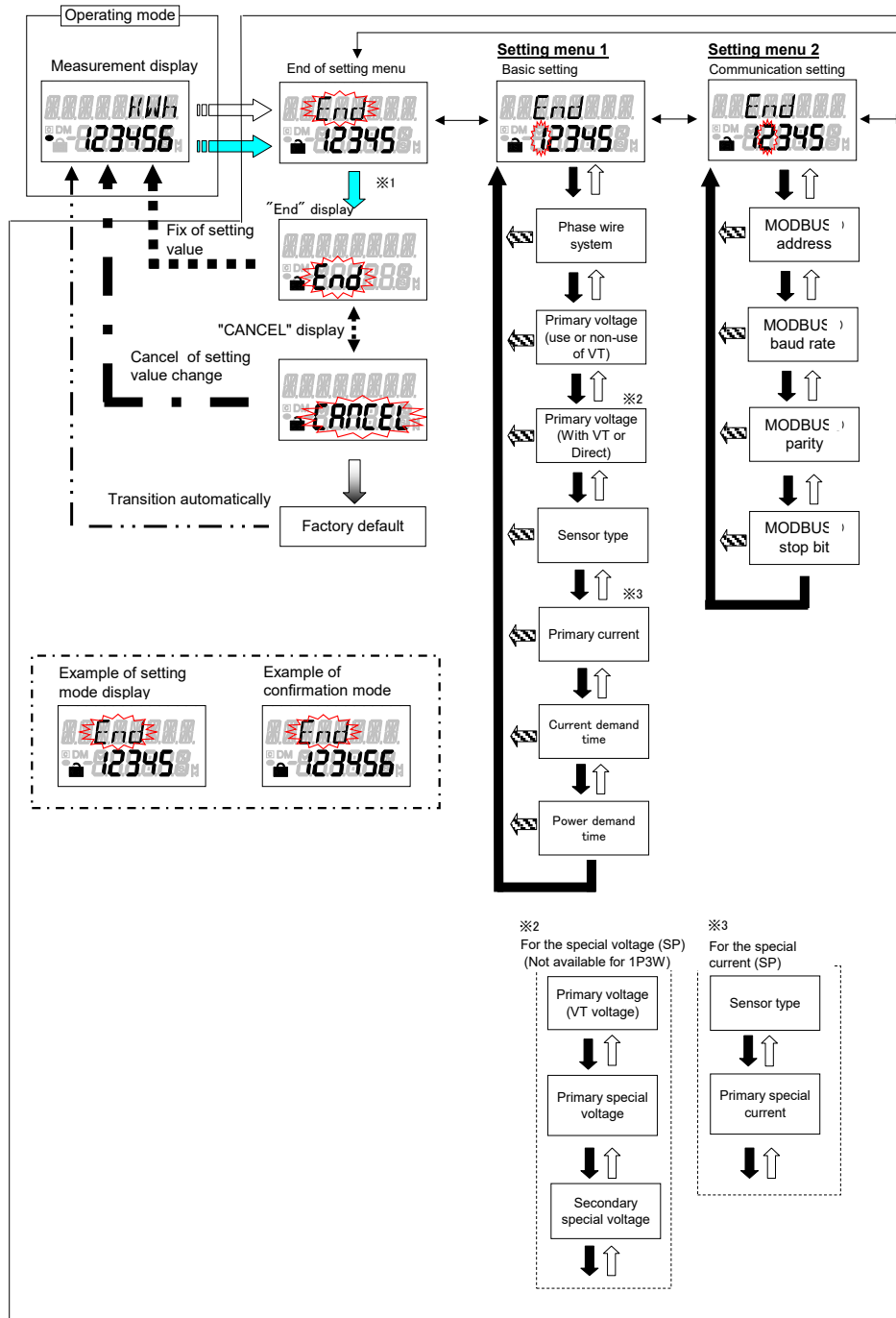
7. Setting method

Procedures for setting

Set items such as phase wire system, primary voltage, and primary current in the setting mode to measure and monitor. Under normal use, it shall be sufficient to set the setting menu 1 (Basic setting) only. For details, refer to after the following page.

<How to set>

- (1) Go into the setting mode by pressing both **SET** and **- / RESET** at the same time for 2 sec.
- (2) Select the setting menu number by pressing **+ / PHASE** or **- / RESET**.
- (3) Determine the setting menu number by pressing **SET**.
- (4) Set each setting item.
- (5) After all setting are done, select "End" on the setting menu and press **SET**.
- (6) When prompted for End display, select "End" and press **SET**.

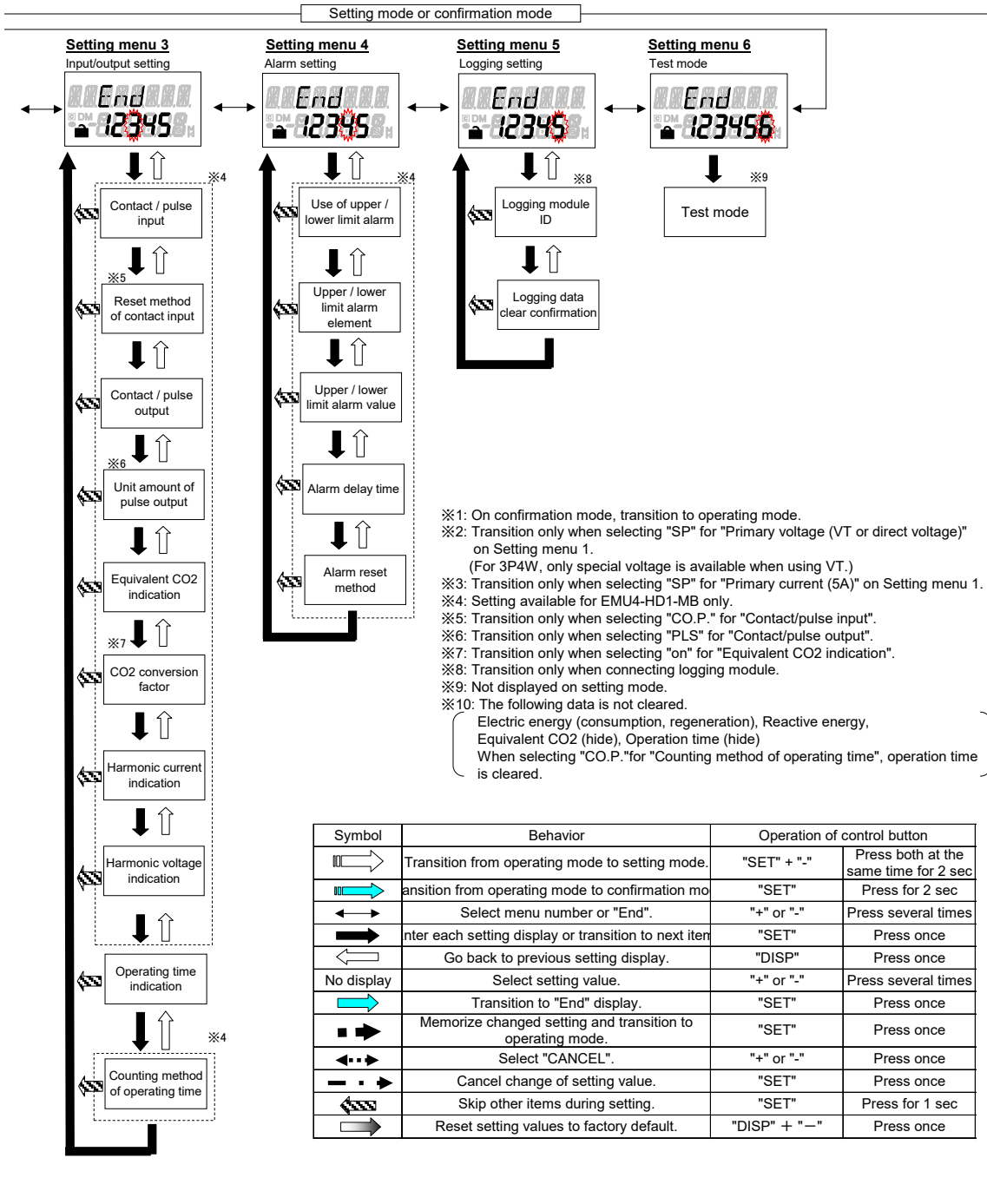


- Setting menu 5 related to the logging Unit is shifted to Setting mode from Operating mode, and Please go in a procedure to set only Setting menu 5. page 34
- If you change setting, related setting items and measured data are initialized. Please check them beforehand. page 31

Procedures for setting

Basic operations in setting

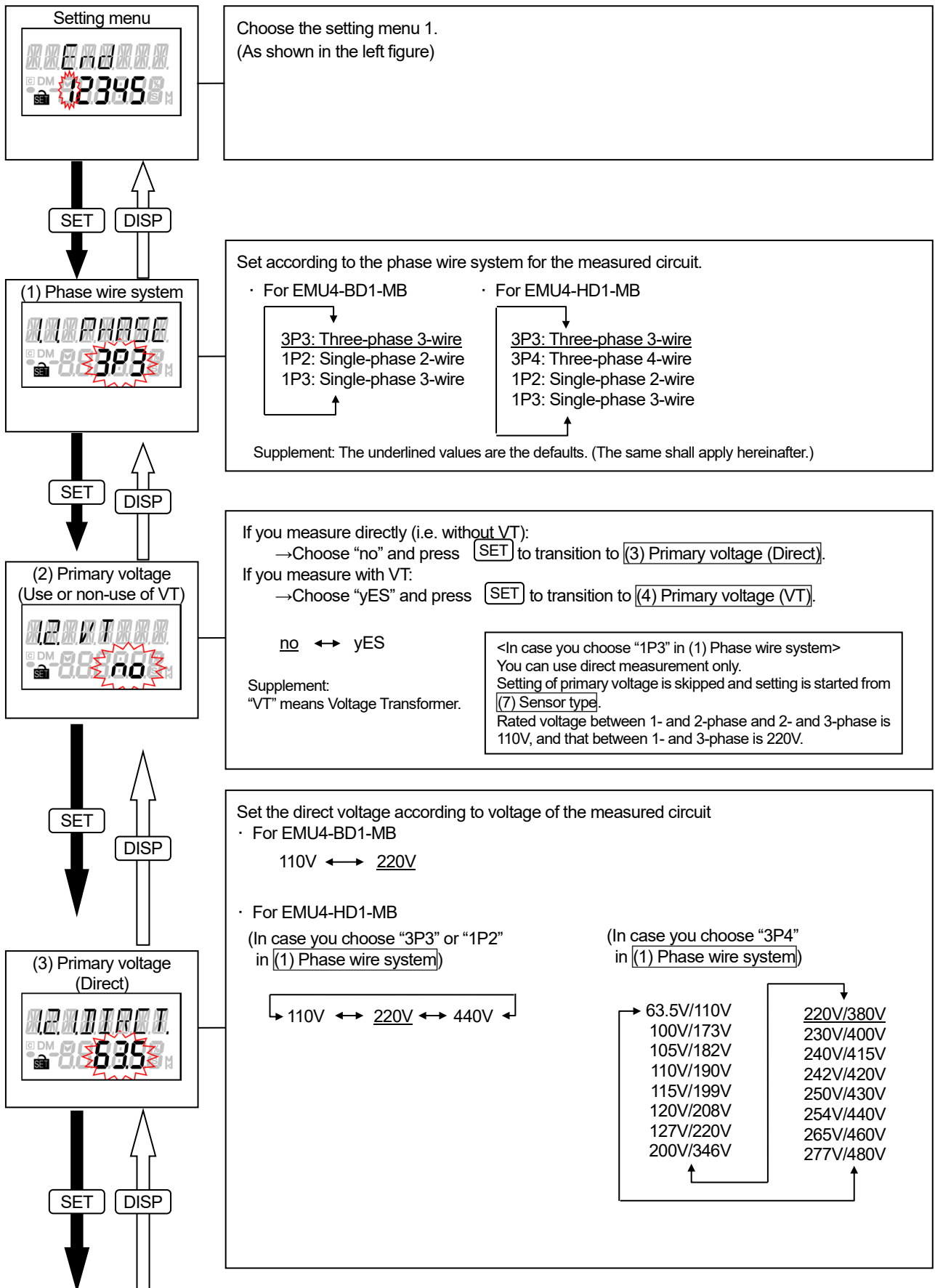
Function	Operation	Supplement
Choose setting value	Press [+ / PHASE] or [- / RESET] .	Press for more than one second to fast-forward
confirm setting value	Press [SET] .	After setting value is confirmed, transition to next item.
Go back the previous setting item	Press [DISP] .	Setting value of the last item before return is effective.
Go back to setting menu during setting	Press [SET] for one second.	

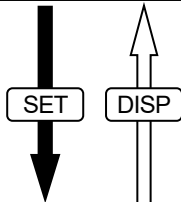
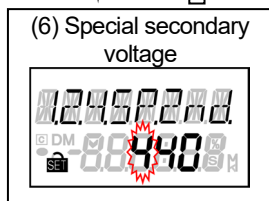
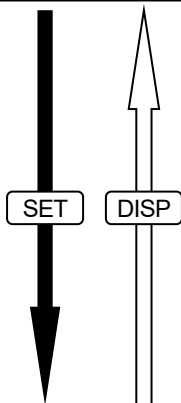
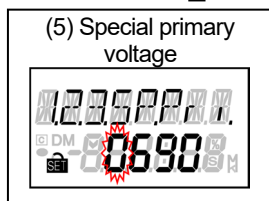
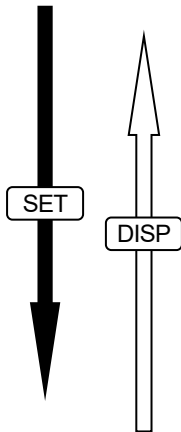
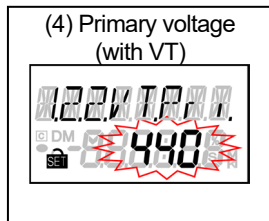


Setting menu 1: Phase wire system, primary voltage, sensor type, primary current, demand time, etc.

In this menu, set phase wire system, primary voltage, sensor type, primary current, demand time, etc.

In operating mode, press both **SET** and **- / RESET** at the same time for more than two seconds to transition to setting mode and enable the following operations.





Set the primary voltage of combined VT

- For EMU4-BD1-MB

→ 440V ↔ 690V ↔ 1100V ↔ 2200V ↔ 3300V ↔ 6600V ↔ SP ←

- For EMU4-HD1-MB

→ 690V ↔ 1100V ↔ 2200V ↔ 3300V ↔ 6600V ↔ SP ←

Caution:

If there is no values above you want to set to, choose "SP" to enable the special primary voltage and the special secondary voltage.

In case you choose "3P4" (three-phase 4-wire system) in (1) Phase wire system, the special voltage is only available.

If you choose "SP", transition to (5) Special primary voltage.

If you choose the value except for "SP", transition to (7) Sensor type.
(In this case, secondary voltage is fixed to 110V.)

Set the special primary voltage of combined VT.

- Setting range: 1V to 6600V

Default value is 440V (for EMU4-BD1-MB), or 690V (for EMU4-HD1-MB).

Setting of special primary voltage

- Press **+ / PHASE** or **- / RESET** to choose the value at flashing digit.
- Press **SET** for the setting digit (flashing digit) to shift to lower.
- Press **DISP** for the setting digit (flashing digit) to shift to upper.
- You can set the upper three digit of the value to the range of 1V to 6600V.
Caution: In case you set the value except for between 1V and 6600V, indicate the error (E005).
When indicating the error, press **SET** to check the setting values and set the new value again.
- Press **SET** at the lowest digit to transition to (6) Special secondary voltage.
The values set the upper fourth digit and lowers to are rounded down. After setting value flashes three times, transition to (6) Special secondary voltage.

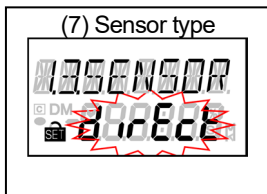
Set the special secondary voltage of combined VT.

- Setting range: 1V to 220V

Default value is 110V (for three phase 3-wire system and single-phase 2-wire system), or 64V (for three-phase 4-wire system).

Setting of special secondary voltage

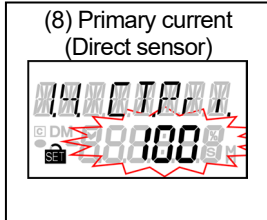
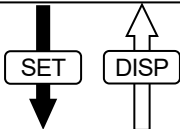
- Press **+ / PHASE** or **- / RESET** to choose the value at flashing digit.
- Press **SET** for the setting digit (flashing digit) to shift to lower.
- Press **DISP** for the setting digit (flashing digit) to shift to upper.
- You can set the value to the range of 1V to 220V.
Caution: In case you set the value except for between 1V and 220V, indicate the error (E005).
When indicating the error, press **SET** to check the setting values and set the new value again.
- Press **SET** at the lowest digit to transition to (7) Sensor type.



Set the type of combined current sensor.

If you use direct sensor, choose "dirEct" and press **SET** to transition to "(8) Primary current (Direct)".
If you use 5A sensor, choose "5A" and press **SET** to transition to "(9) Primary current (5A sensor)".

dirEct ↔ 5A

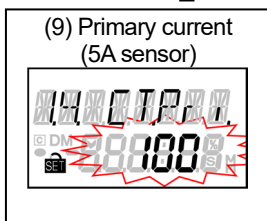
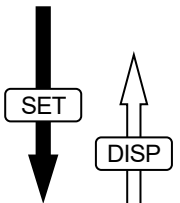


Set the primary current of combined CT (for direct sensor).

50A ↔ 100A ↔ 250A ↔ 400A ↔ 600A

After you choose the value, transition to "(11) Current demand time".

Direct sensor model: EMU-CT***, EMU-CT***-A (***: 50,100,250,400,600)



Set the primary current of combined CT (for 5A sensor).

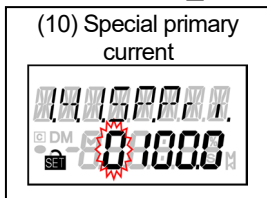
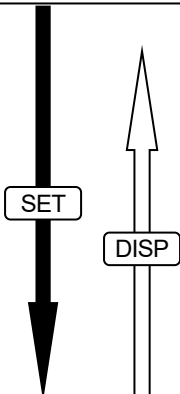
5A	40A	250A	1250A
6A	50A	300A	1500A
7.5A	60A	400A	1600A
8A	75A	500A	2000A
10A	80A	600A	2500A
12A	100A	750A	3000A
15A	120A	800A	4000A
20A	150A	1000A	5000A
25A	200A	1200A	6000A
30A			SP

Supplement: If there is no values above you want to set to, choose "SP" to enable the special primary current.

If you choose "SP", transition to "(10) Special primary current".

If you choose the value except for "SP", transition to "(11) Current demand time".

5A sensor model: EMU2-CT5(4W), EMU-CT5-A.



Set the special primary current of combined CT.

· Setting range: 5A to 6000A (Default: 100.0A)

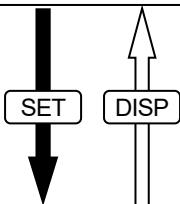
Setting of special primary current

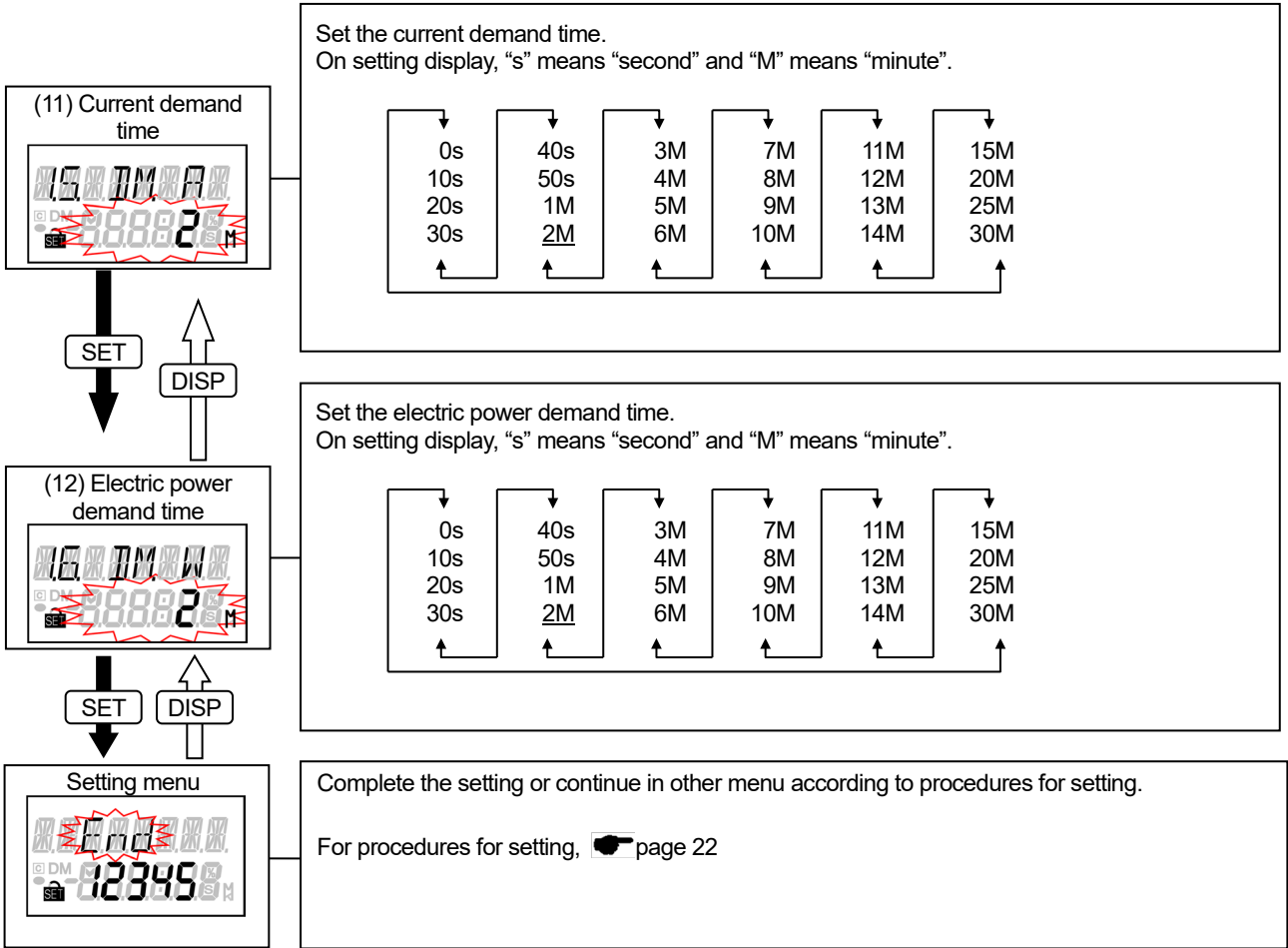
- Press **+ / PHASE** or **- / RESET** to choose the value at flashing digit.
- Press **SET** for the setting digit (flashing digit) to shift to lower.
- Press **DISP** for the setting digit (flashing digit) to shift to upper.
- You can set the value in the range from 5A to 6000A.

If the value is less than 10A, you can set upper two digits of it.
If the value is 10A or more, you can set upper three digits of it.

Caution: In case you set the value except for the range from 5A and 6000A, indicate the error (E005). When indicating the error, press **SET** to check the setting values and set the new value again.

- Press **SET** at the lowest digit to transition to "(11) Current demand time".

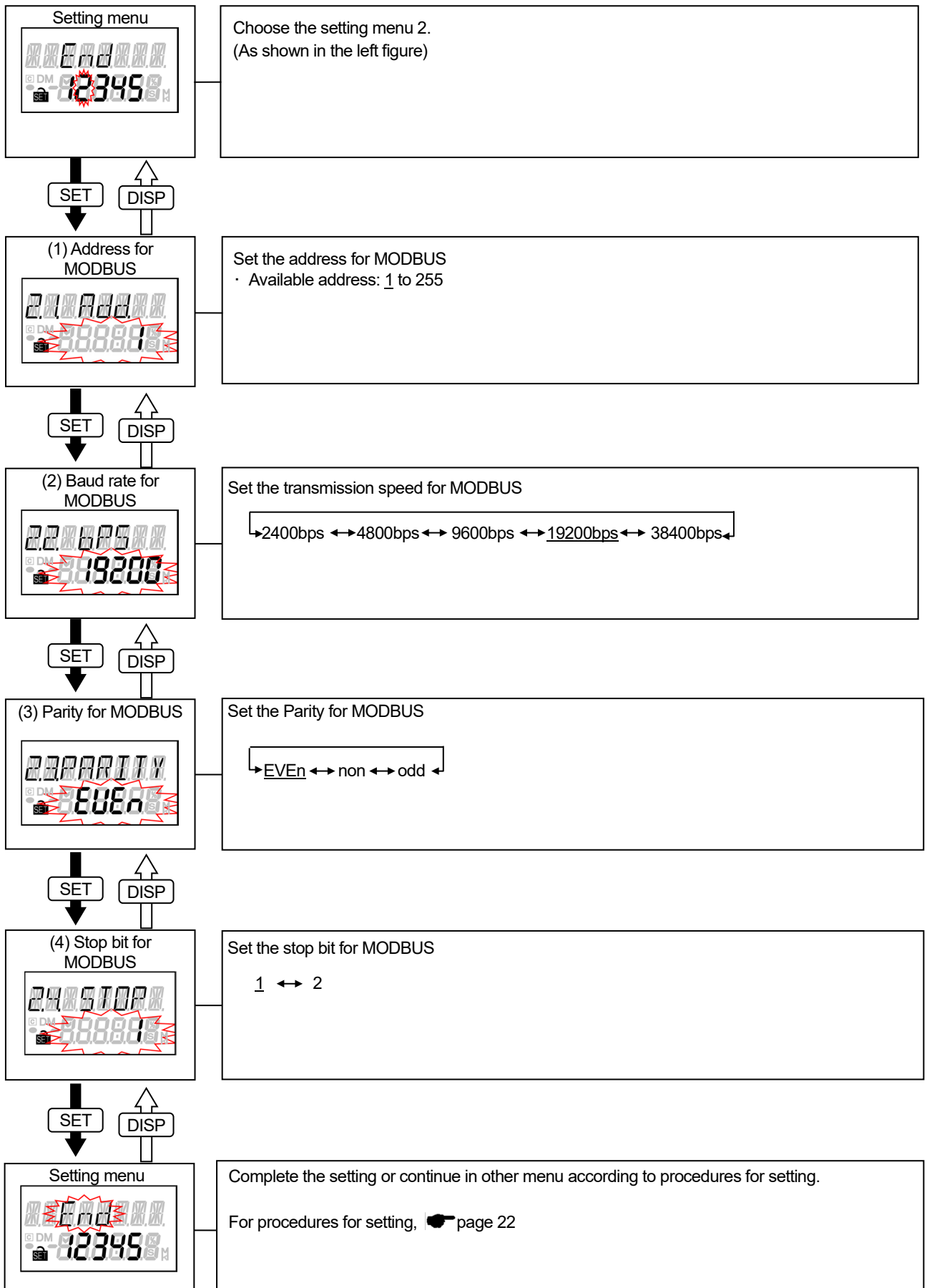




Setting menu 2: MODBUS communication

In this menu, set address, baud rate, parity and stop bit for MODBUS communication.

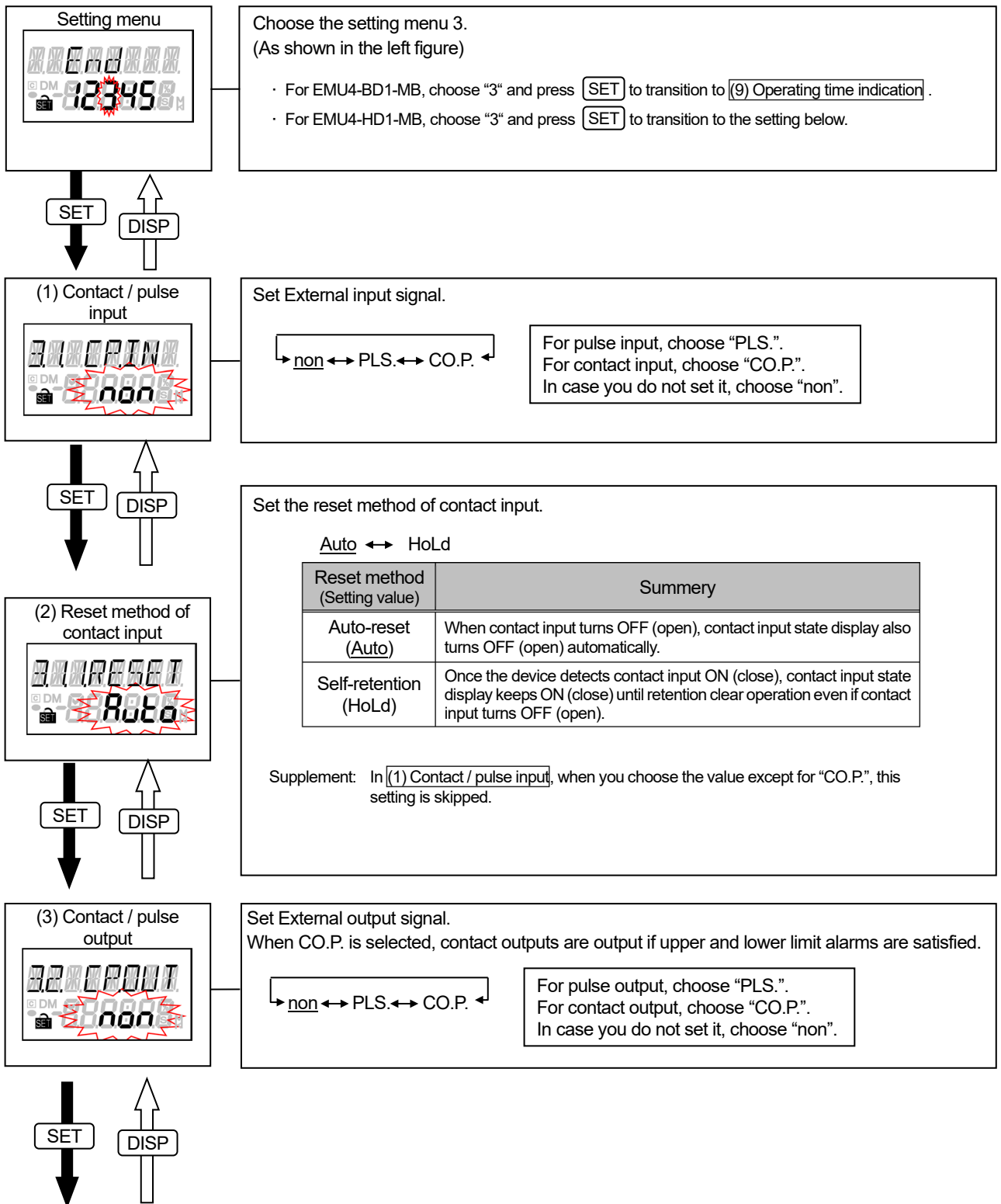
In operating mode, press both **SET** and **- / RESET** at the same time for more than two seconds to transition to setting mode and enable the following operations.



Setting menu 3: Contact / pulse input/output, equivalent CO₂, harmonic, operating time, etc.

In this menu, set contact / pulse input/output, equivalent CO₂, harmonic, operating time, etc.

In operating mode, press both **SET** and **- / RESET** at the same time for more than two seconds to transition to setting mode and enable the following operations.



Set the unit amount per pulse of pulse output.
 Selectable unit amount is as follows depending on the full load power:

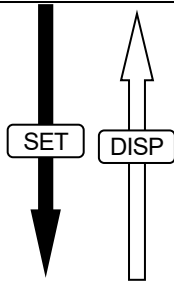
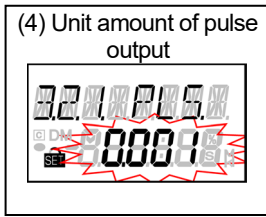
$$\text{Full load power [kW]} = \frac{\alpha \times (\text{VT primary voltage}) \times (\text{CT primary current})}{1000}$$

α: 1 Single-phase, 2-wire
 2 Single-phase, 3-wire
 $\sqrt{3}$ Three-phase, 3-wire
 3 Three-phase, 4-wire

*1: VT primary voltage in single-phase 3-wire system is regarded as 110V.

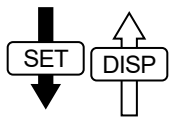
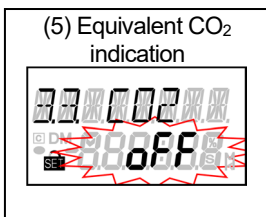
*2: Using direct connection, replace VT primary voltage with direct voltage in calculation above.

*3: In three-phase 4-wire system, replace VT primary voltage or direct voltage with phase voltage in calculation above.



Full load power [kW]	Selectable unit amount per pulse [kWh/pulse]				Default value
	1	0.1	0.01	0.001	
less than 12	1	0.1	0.01	0.001	<u>0.001</u>
12 or more and less than 120	10	1	0.1	0.01	<u>0.01</u>
120 or more and less than 1200	100	10	1	0.1	<u>0.1</u>
1200 or more and less than 12000	1000	100	10	1	<u>1</u>
12000 or more and less than 120000	10000	1000	100	10	<u>10</u>
120000 or more	100000	10000	1000	100	<u>100</u>

Supplement: In (3) Contact / pulse output, when you choose the value except for "PLS.", this setting is skipped.



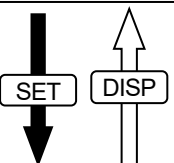
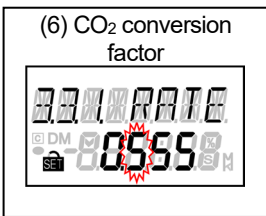
Set whether the equivalent CO₂ is indicated or not.

oFF ↔ on

(Do not indicate) (Indicate)

CO₂ equivalent is the integration of the value obtained by multiplying electric energy and CO₂ conversion factor.

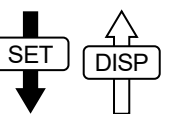
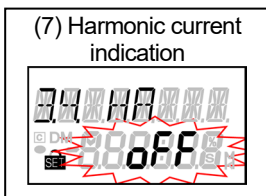
- If you need this indication, choose "on" and press **SET** to transition to the setting below.
- If you do not need this indication, choose "oFF" and press **SET** to transition to (7) Harmonic current indication.



Set the CO₂ conversion factor
 (Default value: 0.555kg - CO₂ / kWh)

Setting of CO₂ conversion factor

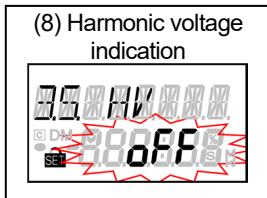
- Press **+ / PHASE** or **- / RESET** to choose the value at flashing digit.
- Press **SET** for the setting digit (flashing digit) to shift to lower.
- Press **DISP** for the setting digit (flashing digit) to shift to upper.
- You can set the value to the range of 0.000 to 0.999 (kg - CO₂ / kWh).
- Press **SET** at the lowest digit to transition to (7) Harmonic current indication.



Set whether the harmonic current is indicated or not.

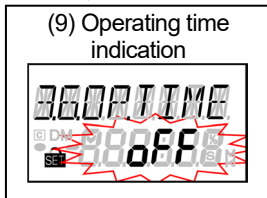
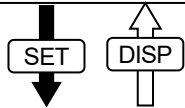
oFF ↔ on

(Do not indicate) (Indicate)



Set whether the harmonic voltage is indicated or not.

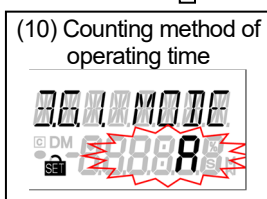
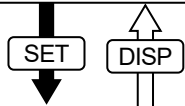
oFF ↔ on
(Do not indicate) (Indicate)



Set whether the operating time is indicated or not.
(Operating time is integrated while this setting is "oFF".)

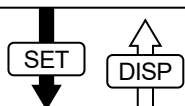
oFF ↔ on
(Do not indicate) (Indicate)

- For EMU4-BD1-MB, choose "oFF" or "on" and press **SET** to transition to setting menu. (Operating time is the time integrated while the current measurement.)
- For EMU4-HD1-MB, choose "oFF" or "on" and press **SET** to transition to the setting below.



Set the counting method of operating time.
When "A" is selected, operating time is the time integrated while the current measurement.
When "CO.P." is selected, operating time is the time integrated while external input is "ON".

A ↔ CO.P.
(By current) (By contact input)



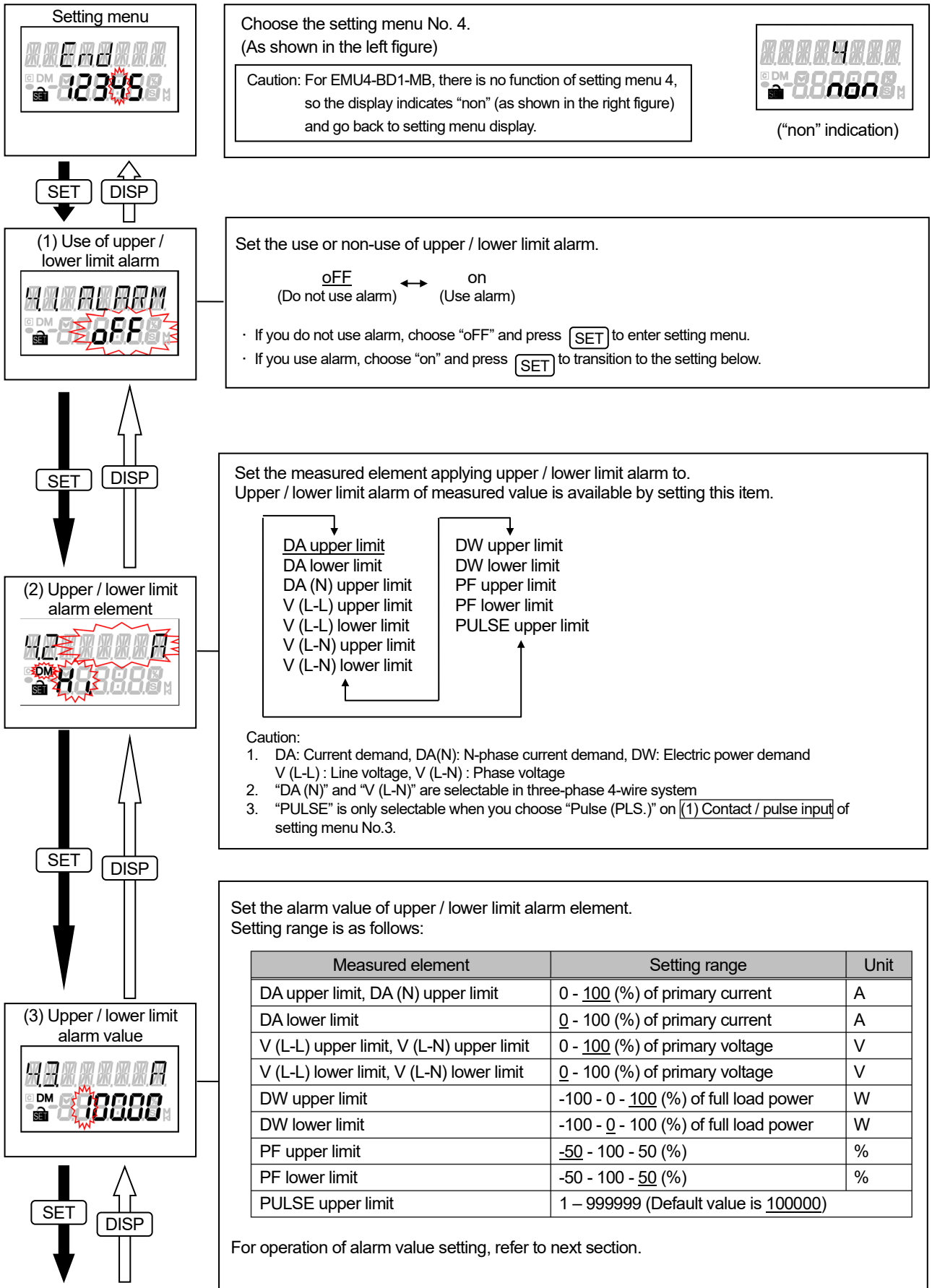
Complete the setting or continue in other menu according to procedures for setting.

For procedures for setting, page 22

Setting menu 4: Upper / lower limit alarm setting, alarm delay time, alarm reset, etc.

In this menu, set the upper / lower alarm, alarm delay time, reset method of alarm clear, etc.

In operating mode, press both **[SET]** and **[- / RESET]** at the same time for more than two seconds to transition to setting mode and enable the following operations.



Operations in alarm value setting display are as follows:

Setting of "Upper / lower limit alarm value"

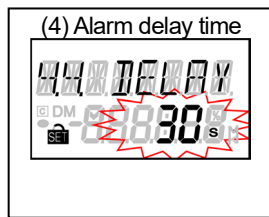
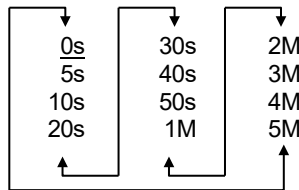
- Press **[+ / PHASE]** or **[- / RESET]** to choose the value at flashing digit.
- Press **[SET]** for the setting digit (flashing digit) to shift to lower.
- Press **[DISP]** for the setting digit (flashing digit) to shift to upper.
- Setting range is different for each alarm element. (refer to previous section)
 Caution: In case the value is set to outside-set-value, indicate the error (E005)
 When indicating the error, press **[SET]** to check the setting values and set the new value again.
- Press **[SET]** at the lowest digit to transition to **(4) Alarm delay time**.

Set the delay time from fulfilling alarm occurring condition.

Set the alarm delay time if you want to avoid the alarm caused by such as instant overload and noise.

Once setting, the alarm does not occur unless the time of exceeding the upper / lower limit alarm value is over the specified delay time.

In setting display, "s" means "second" and "M" means "minute".




[SET] **[DISP]**




[SET] **[DISP]**



Set the alarm reset method in alarm occurrence.

Alarm reset method (Setting value)	Summary (For details,  page 55)
Auto-reset (Auto)	Reset the alarm automatically when alarm occurring condition is gone.
Self-retention (HoLd)	The alarm is held even after alarm occurring condition is gone. Button operation is necessary to clear the alarm.

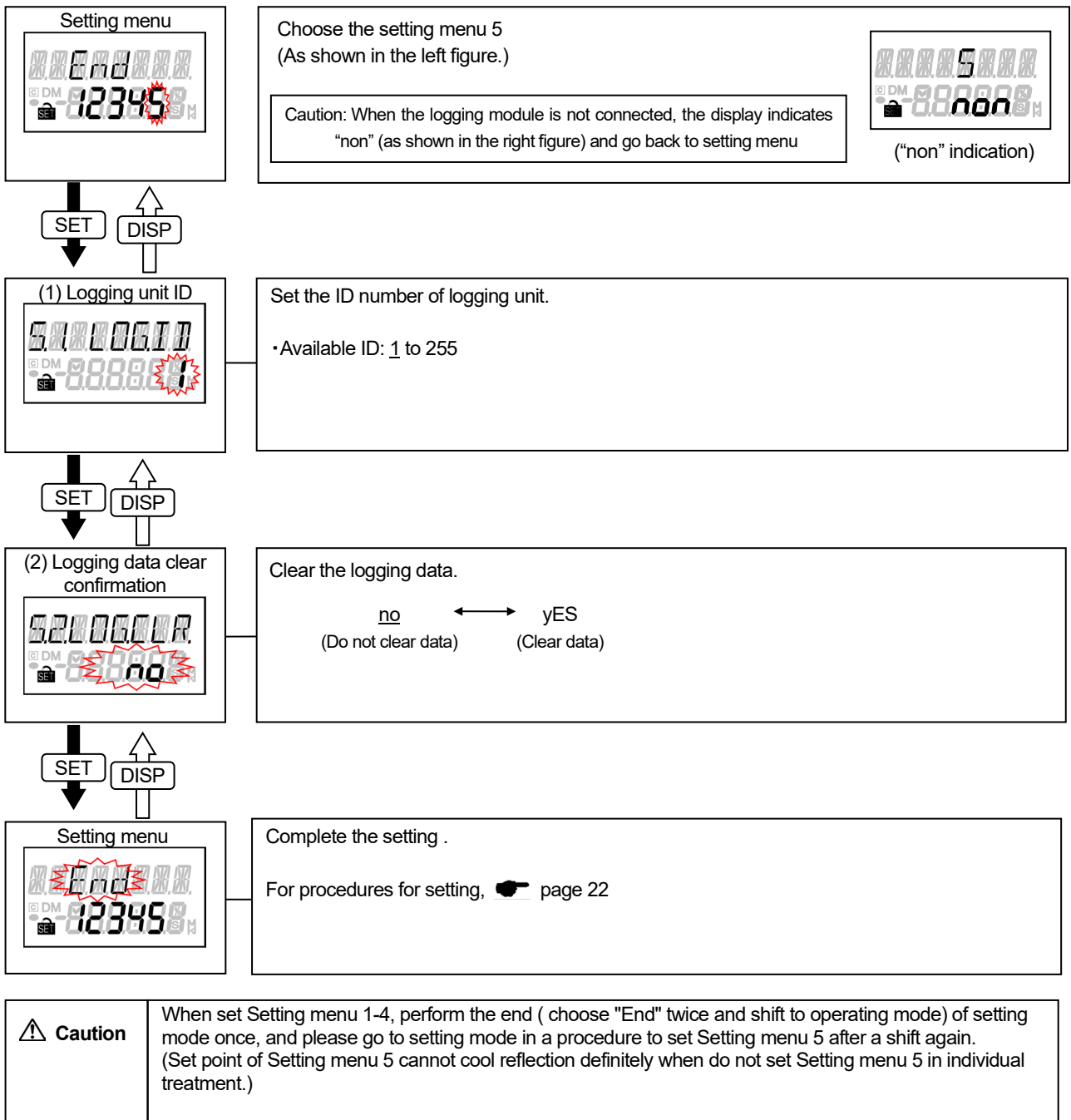
Complete the setting or continue in other menu according to procedures for setting.

For procedures for setting,  page 22

Setting menu 5: Setting related to logging unit

In this menu, set the logging unit ID or logging data clear.


In operating mode, press both **SET** and **- / RESET** at the same time for more than two seconds to transition to setting mode and enable the following operations.



Confirmation menu 1 - 5: Confirmation of setting values in setting menu 1 - 5

In operating mode, press **SET** for more than two seconds to transition to confirmation mode and enable operation.

Transition of display and operation is as same as those of setting menu 1 - 5.

For setting menu 1 - 5,  p.24 - 34

(Caution: Change of setting is not available in confirmation mode.)

Initialization of related items by change of setting

Setting item	Changed setting value																															
	Menu 1					Menu 2				Menu 3						Menu 4				Menu 5												
	Phase wire system	Use of VT	Direct voltage	Primary voltage (Special primary voltage)	Secondary voltage	Sensor type	Primary current (Special primary current)	Electric power demand time	Current demand time	Modbus address	Modbus baud rate	Modbus parity	Modbus stop bit	Contact/pulse input	Contact reset status	Contact/pulse output	Pulse output unit	With or without CO2 indication	Equivalent CO2 setting	Harmonic current indication setting	Harmonic voltage indication setting	Operating time indication setting	Operating time measured item setting	Use of upper/lower limit alarm	Upper/lower limit alarm element	Upper/lower limit alarm value	Alarm delay time	Alarm reset method	Logging unit ID	Logging date clear confirmation		
Initialized item	Phase wire system	●																														
	Use of VT	●																														
	Direct voltage	●																														
	Primary voltage (Special primary voltage)	●																														
	Secondary voltage	●																														
	Sensor type	○																														
	Primary current (Special primary current)	○					○																									
	Electric power demand time																															
	Current demand time																															
	Modbus address																															
	Modbus baud rate																															
	Modbus parity																															
	Modbus stop bit																															
	Contact/pulse input																															
	Contact reset status																															
	Contact/pulse output																															
	Pulse output unit																															
	With or without CO2 indication																															
	Equivalent CO2 setting																															
	Harmonic current indication setting																															
	Harmonic voltage indication setting																															
	Operating time indication setting																															
	Operating time measured item setting																															
	Use of upper/lower limit alarm	○	○	○	○	○	○	○							□																	
	Upper/lower limit alarm element	○	○	○	○	○	○	○							□																	
	Upper/lower limit alarm value	○	○	○	○	○	○	○							□																	
	Alarm delay time																															
	Alarm reset method																															
	Logging unit ID																															
	Logging date clear confirmation																															

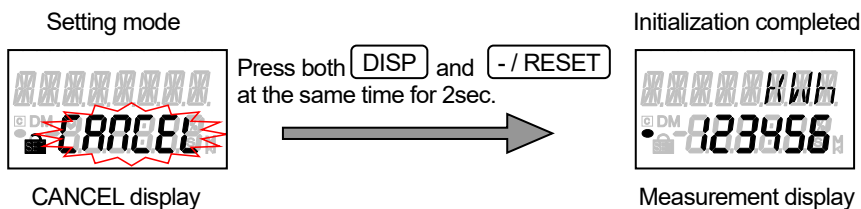
Symbol	Meaning
○	Initialized
●	Change to default value corresponding to phase wire system
□	Initialized when the upper limit of pulse count is set and input method is changed from pulse to contact.
None	Not initialized

All settings are reset to factory default by the following operation.

Settings are only initialized. Integrated values (such as electric energy, reactive energy and operating time) are not changed.

Enter CANCEL display in setting mode and operate as follows to initialize all settings.

For entering CANCEL display, refer to procedures for setting. (▶ page 18)

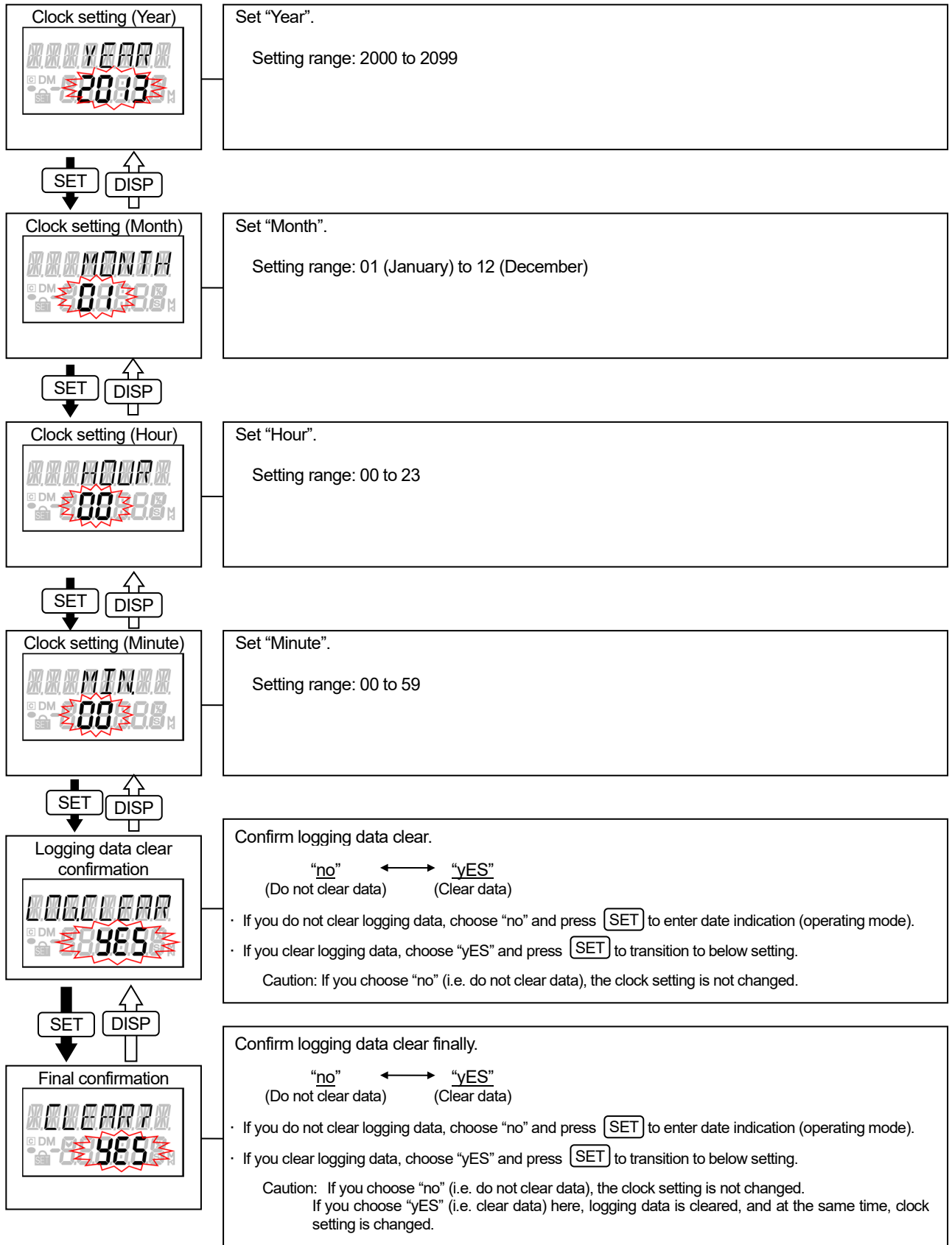


Clock setting and logging data clear

When connecting logging unit, you can set the clock of it.

On the date indication in operating mode, press both **+ / PHASE** and **- / RESET** at the same time for more than two seconds to transition to clock setting and enable the following operations.

*Caution: The date is not indicated in operating mode when the logging unit is not connected.

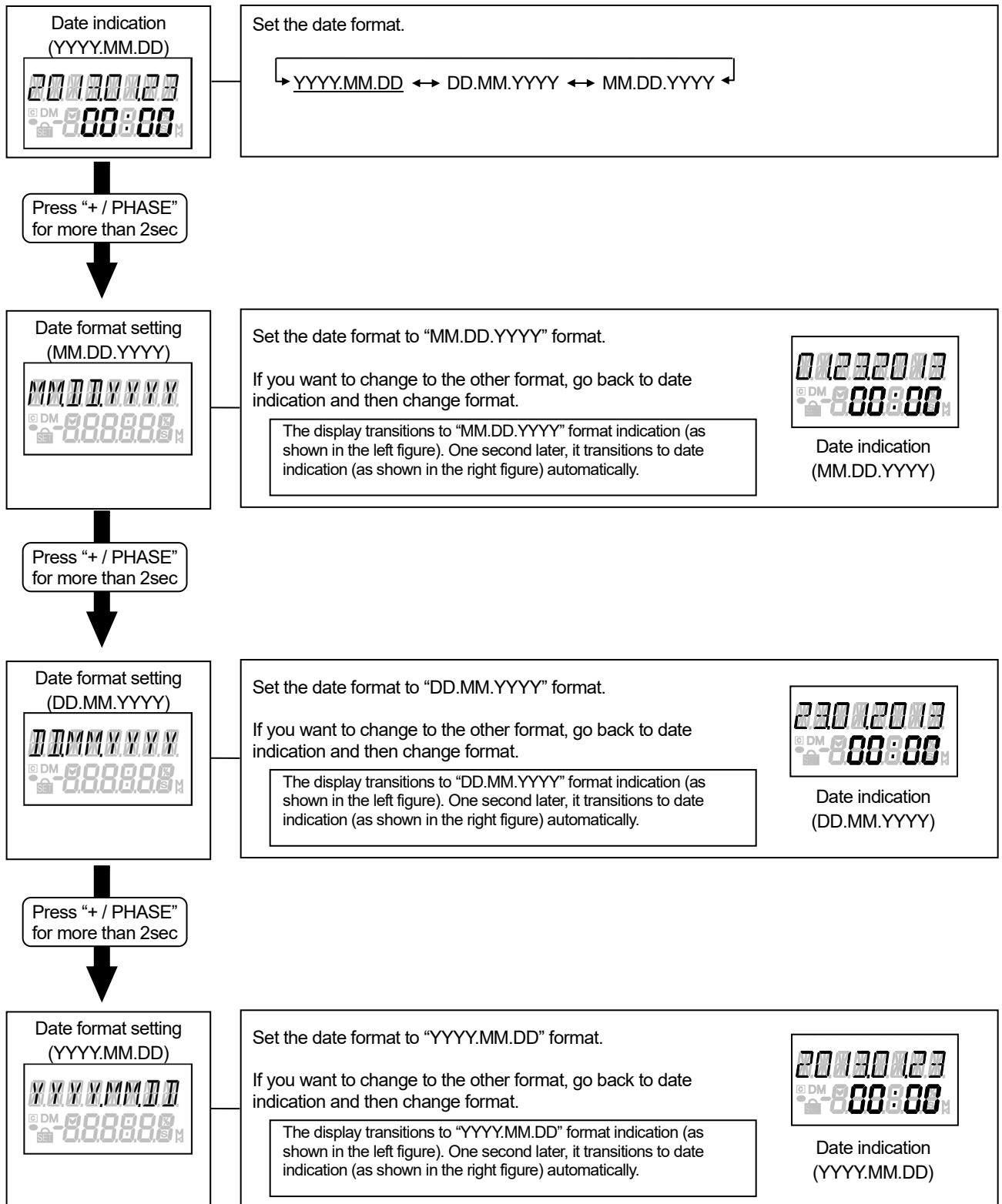


Change of date format

In date format setting, you can choose from “YYYY.MM.DD”, “MM.DD.YYYY” or “DD.MM.YYYY” format.

On the date indication in operating mode, press **+ / PHASE** for more than two seconds to transition to date format setting and enable the following operations.

*Caution: The date is not indicated in operating mode when the logging unit is not connected.



How to use test mode

Test mode has the functions which you can utilize in such as the launch of equipment.
The functions in test mode are as follows:

Test menu	Details
1. Discrimination support function for improper connection	Indicate phase angle of current and voltage, electric power, voltage and current of each phase. You can discriminate easily whether the input connection for measurement (voltage and current) is proper or not by checking each indicated values.
2. Communication test	For the device with communication function, it can send back the fixed numerical data without the input of measurement (voltage and current). Use for such as the opposing test to host system.
3. Pulse output test	For EMU4-HD1-MB, you can check the pulse output without the input of measurement (voltage and current). Use for such as the check of the connection to the receiving device.
4. Alarm output test	For EMU4-HD1-MB, you can check the alarm output without the input of measurement (voltage and current). Use for such as the check of the connection to the receiving device.

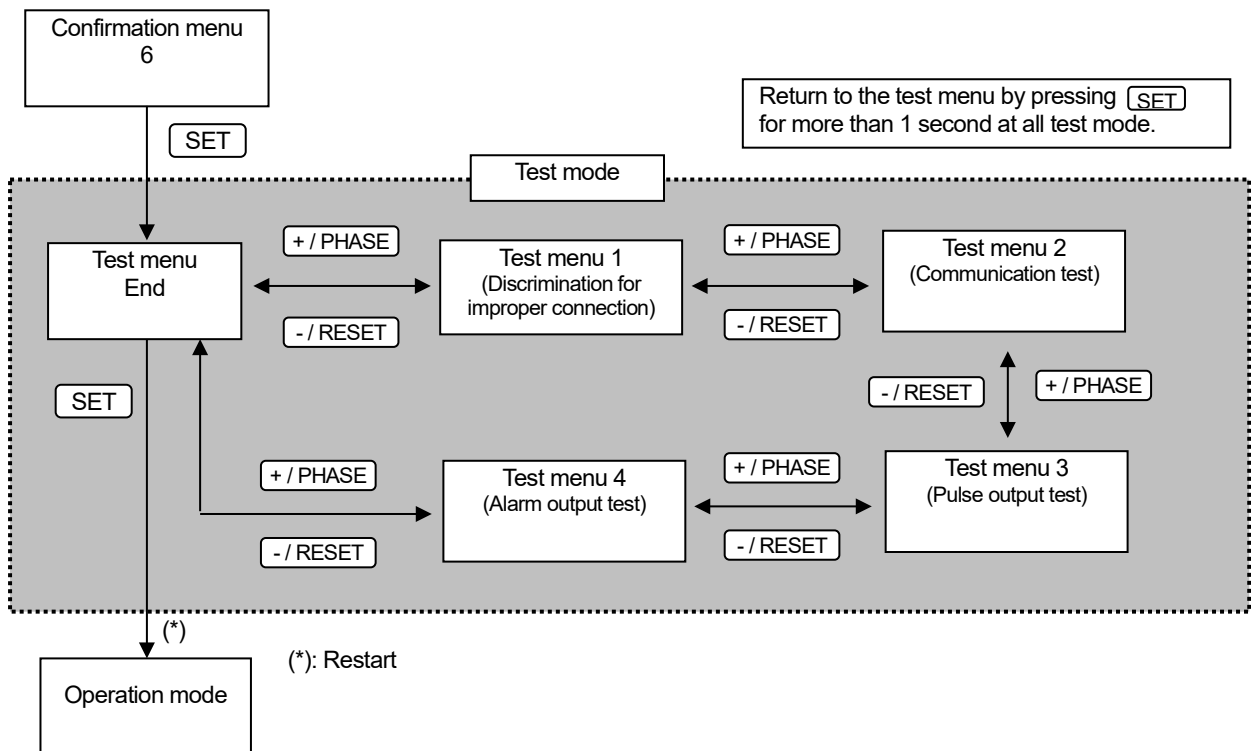
How to test

- (1) Press **SET** for two seconds to enter confirmation mode.
- (2) Press **+ / PHASE** or **- / RESET** to choose confirmation menu 6.
(As shown in the right figure)
- (3) Press **SET** to enter test mode
- (4) Test for the each menu.



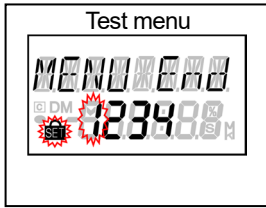
(Confirmation menu 6)

Diagram for test mode

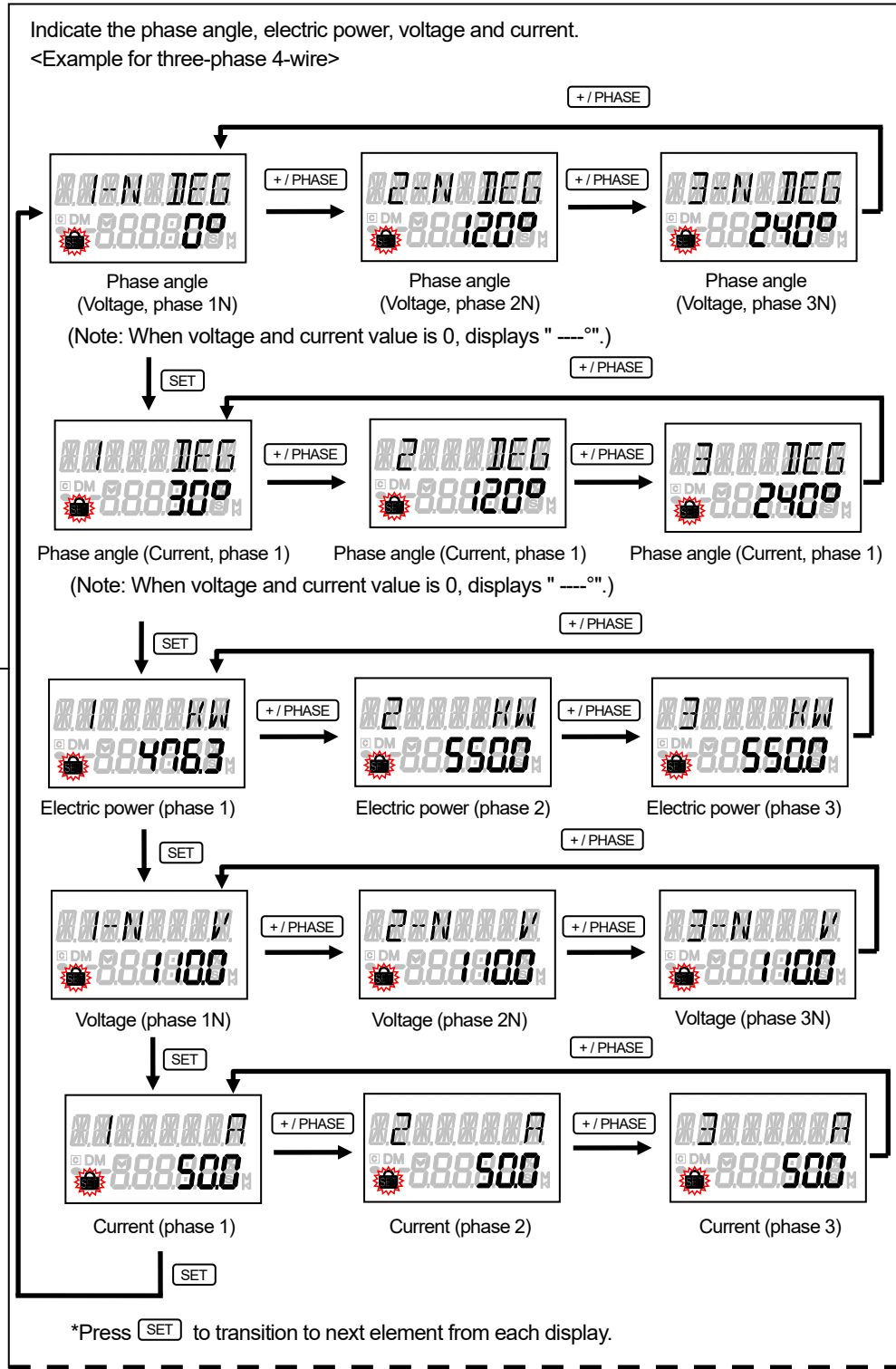


Test menu 1: Discrimination support function for improper connection

In configuration mode, choose menu "6" to enter test mode. (You cannot enter from setting mode.)
 In test mode, the following operations can be possible.



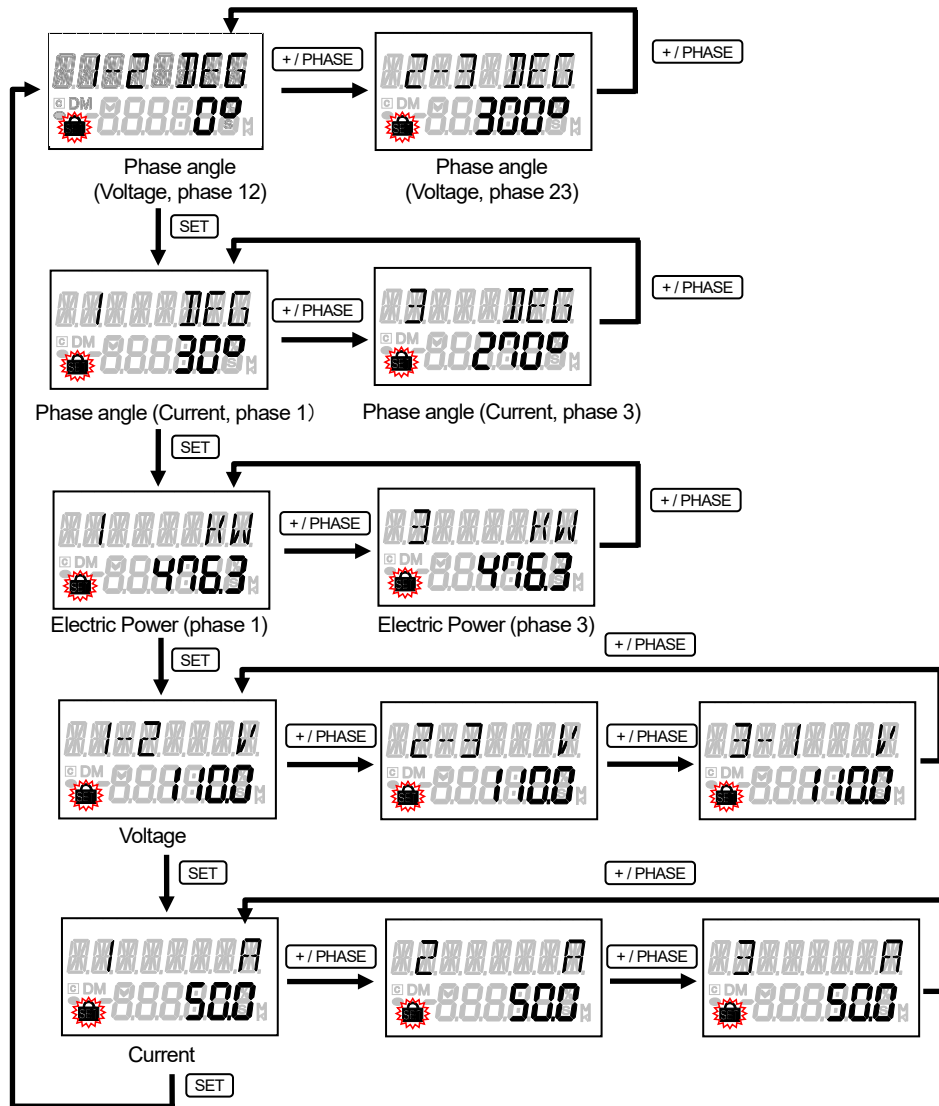
Choose the test menu 1.
 (As shown in the left figure)



(1) Discrimination support function for improper connection

Indicate the phase angle, electric power, voltage and current.

<Example for three-phase 3-wire>



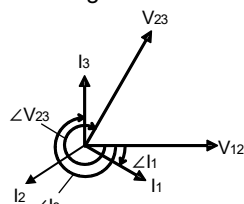
(1) Discrimination support function for improper connection

Press "SET" for more than 1sec

*Press [SET] to transition to next element from each display.

• About phase angle

The phase angle is indicated in a clockwise direction from V_{12} , as baseline (0 degree).



$\angle V_{23}$: Phase angle between V_{23} and V_{12}

$\angle I_1$: Phase angle between I_1 and V_{12}

$\angle I_3$: Phase angle between I_3 and V_{12}

• Display example of discrimination support function for improper connection

Please refer to appendix1 for display examples of connection pattern.

(Note: When the electric power value is minus indication, Please confirm the connection of current sensor.)

<If you continue other test menu>

→ Choose other test menu number and press [SET]

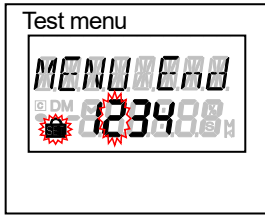
<If you finish the test mode>

→ Choose "End" and press [SET] to return to operating mode.

Test menu

Test menu 2: Communication test

In test mode, the following operations can be possible.



Choose the test menu 2.
(As shown in the left figure)

SET

(2) Communication test

Test the communication.
(You can monitor non-zero values without voltage or current input.)

- Monitored value in communication
 - Monitoring the fixed value determined by the set value (phase wire system, primary voltage, primary current) is possible.
- Display



• Indication is made according to the setting of indication pattern, etc. as with operating mode.

- Button operation

Operation	Function
Press DISP	Change element
Press + / PHASE	Change phase
Press - / RESET	Change degree(indication of harmonic only)
Press SET for more than 1sec	Return to test menu

Press "SET"
for more than 1sec

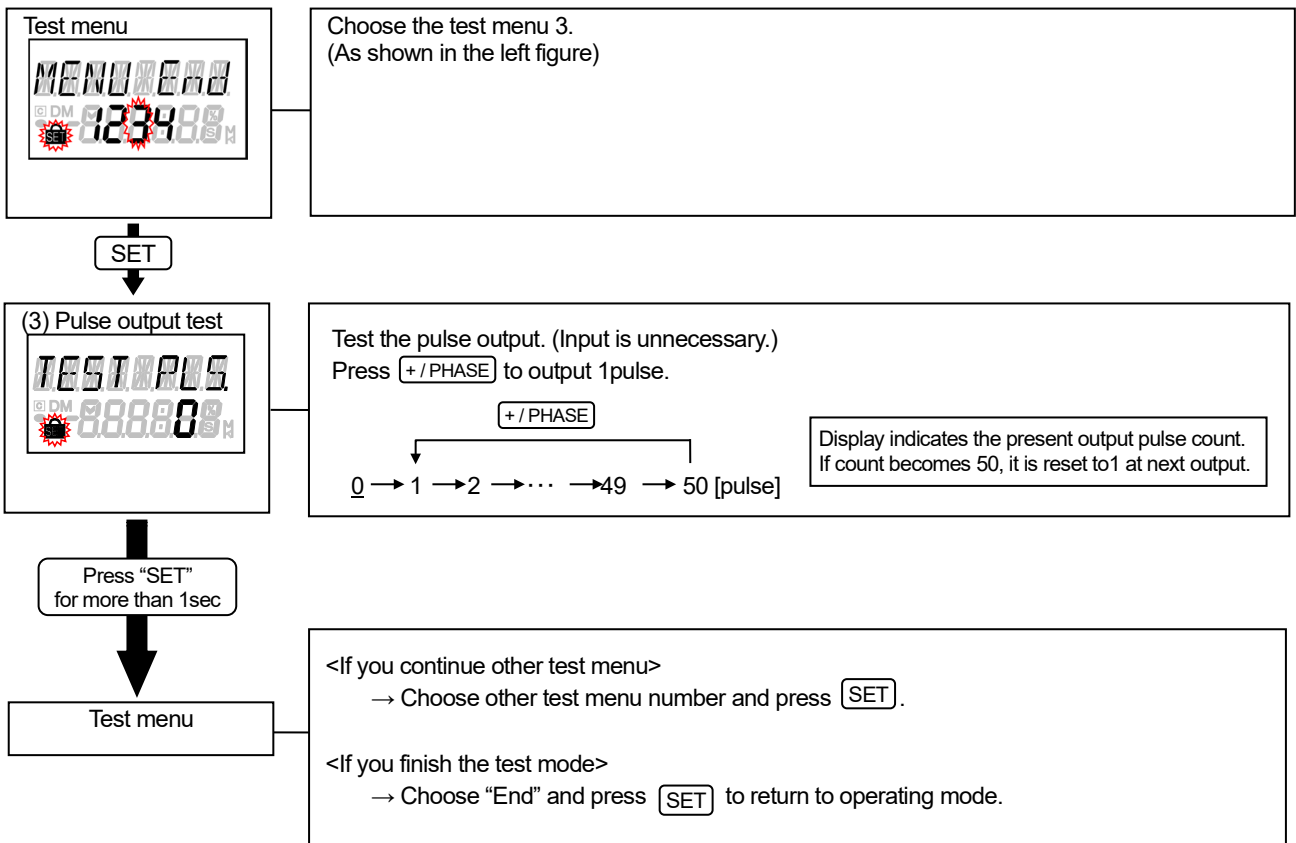
Test menu

<If you continue other test menu>
→ Choose other test menu number and press **SET**.

<If you finish the test mode>
→ Choose "End" and press **SET** to return to operating mode.

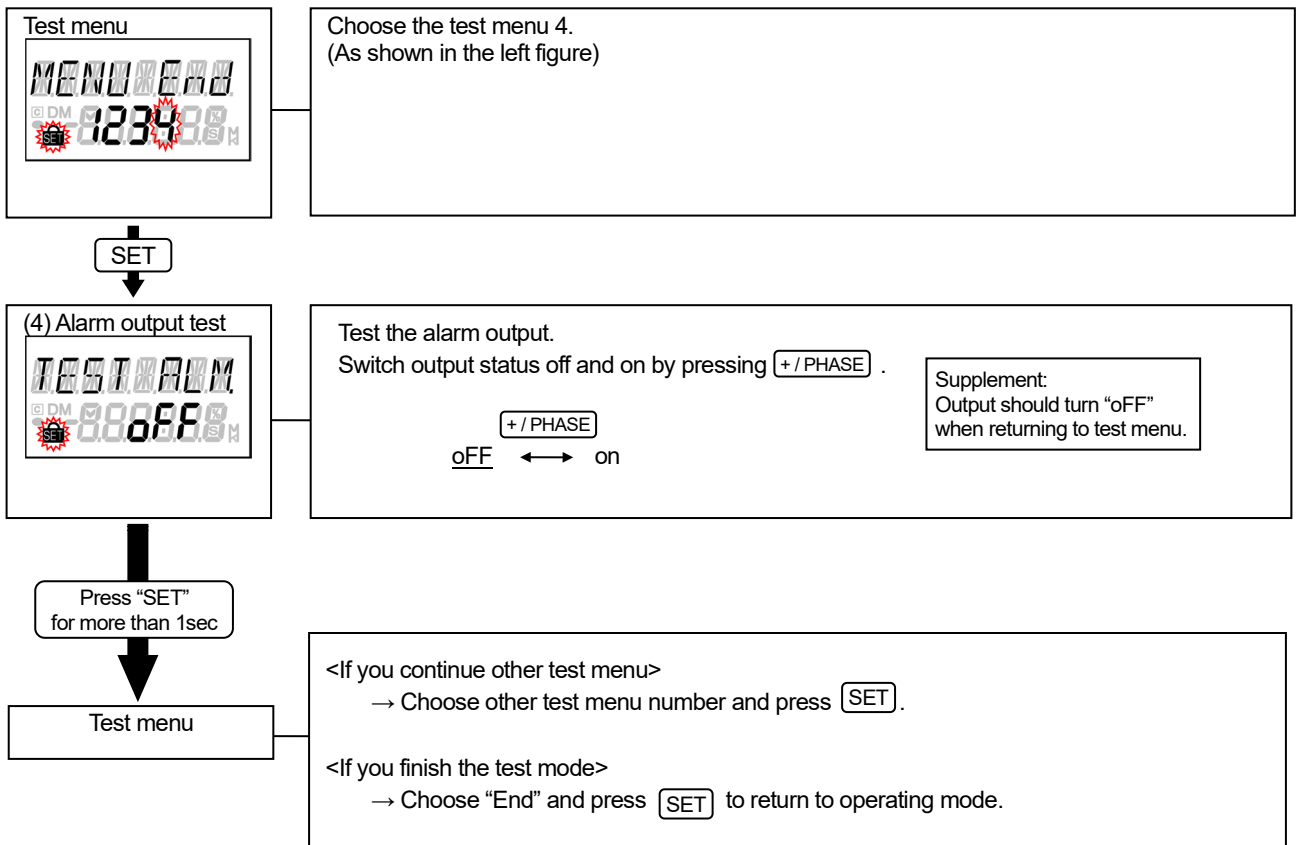
Test menu 3: Pulse output test

In test mode, the following operations can be possible.



Test menu 4: Alarm output test

In test mode, the following operations can be possible.



8. Operation

Operation procedure in operating mode

This unit indicates the measured value of each item in operating mode. (For the measured items which can be indicated, see page 53)

Operation procedure to change the measured item indicated is as follows:

Operation	Details			
Change the indicated item Press <input type="button" value="DISP"/>	Indicated item is changed by every operation in following order:			
	Measuring item	Display example	unit	Note
	Electric energy (Consumption)		kWh MWh	• Unit varies depending on the setting value (see P.46).
	Current	Current (phase 1) 	A	• For changing phase to be displayed (see P.40).
	Current demand	Current demand (phase 1) 	A	• For changing phase to be displayed (see P.40).
	Voltage	Voltage (1-2) 	V	• For changing phase to be displayed (see P.40).
	Electric power		kW MW	• Unit varies depending on the setting value (see P.46). • Sign explanation Unsigned: Consumption —: Regeneration
	Electric power demand		kW MW	• Unit varies depending on the setting value (see P.46).
	Reactive power		kVAR MVAR	• Unit varies depending on the setting value (see P.46). • Sign explanation Unsigned: Lag —: Lead
	Apparent power		kVA MVA	[EMU4-HD1-MB only] • Unit varies depending on the setting value (see P.46). • Indicated in three-phase 4-wire (3P4W) only.
	Power factor		%	• Sign explanation Unsigned: Lag, —: Lead
	Frequency		Hz	
	RMS value of harmonic current	RMS value of total harmonic current (phase 1) 	A	[EMU4-HD1-MB only] • Indicated in only when harmonic current indicator (see P.26) is set to "on" (skipped this display when set to "oFF"). • For changing phase of harmonic current (see P.40)
Distortion rate of harmonic current	Distortion rate of total harmonic current (phase 1) 	%	• For indication and change degree (see P.41).	
RMS value of harmonic voltage	RMS value of total harmonic voltage (phase 1) 	V	[EMU4-HD1-MB only] • Indicated in only when harmonic voltage indicator (see P.27) is set to "on" (skipped this display when set to "oFF"). • For changing phase of harmonic voltage (see P.40)	
Distortion rate of harmonic voltage	Distortion rate of total harmonic voltage (phase 1) 	%	• For indication and change degree (see P.41).	

Measuring item	Display example	unit	Note
Reactive energy (consumption lag)		kvarh Mvarh	• Unit varies depending on the setting value ● P. 46.
Electric energy (regeneration)		kWh MWh	• Unit varies depending on the setting value ● P. 46.
Periodic electric energy		kWh MWh	【EMU4-HD1-MB only】 Periodic electric energy is the electric energy while external contact input is ON. • Unit varies depending on the setting value ● P. 46. • Integrated electric energy (consumption) while contact input is "ON". • Indicated in only when contact / pulse input (● P.25) is set to "CO.P." (skipped this display when set to "PLS.").
CO2 conversion setting		kg t	【EMU4-HD1-MB only】 • Unit varies depending on the setting value ● P. 41 • Indicated in only when Equivalent CO2 indication (● P.26) is set to "on." (skipped this display when set to "oFF").
Pulse count value		-	【EMU4-HD1-MB only】 • Indicated in only when contact / pulse input (● P.25) is set to "PLS." (skipped this display when set to "CO.P.").
Condition of contact input		-	【EMU4-HD1-MB only】 • Indicated in only when contact / pulse input (● P.25) is set to "CO.P." (skipped this display when set to "PLS.").
Operating time		h	• Indicated in only when operating time indication (● P.27) is set to "on." (skipped this display when set to "oFF").
Date		-	• Indicated in only when the logging unit is connected.

Note: The display example above-mentioned is the example when measuring electric energy (consumption).

Change phase	Press + / PHASE	Phase is changed by every operation in following order:														
		<table border="1"> <thead> <tr> <th>Indicated item</th> <th>Order of change</th> </tr> </thead> <tbody> <tr> <td>Present current value</td> <td>1-phase → 2-phase → 3-phase → N-phase* → Average → 1-phase → ...</td> </tr> <tr> <td>Present current demand value</td> <td>1-phase → 2-phase → 3-phase → N-phase* → 1-phase → ...</td> </tr> <tr> <td>Present voltage value</td> <td>phase 12 → phase 23 → phase 31 → phase 1N* → phase 2N* → phase 3N* → Average → phase 12 → ...</td> </tr> <tr> <td>Harmonic current</td> <td>phase 1 → phase 2 → phase 3 → phase N* → phase 1 → ...</td> </tr> <tr> <td>Harmonic voltage (except for 3P4W)</td> <td>phase 12 → phase 23 → phase 12 → ...</td> </tr> <tr> <td>Harmonic voltage (3P4W)</td> <td>phase 1N* → phase 2N* → phase 3N* → phase 1N* → ...</td> </tr> </tbody> </table>	Indicated item	Order of change	Present current value	1-phase → 2-phase → 3-phase → N-phase* → Average → 1-phase → ...	Present current demand value	1-phase → 2-phase → 3-phase → N-phase* → 1-phase → ...	Present voltage value	phase 12 → phase 23 → phase 31 → phase 1N* → phase 2N* → phase 3N* → Average → phase 12 → ...	Harmonic current	phase 1 → phase 2 → phase 3 → phase N* → phase 1 → ...	Harmonic voltage (except for 3P4W)	phase 12 → phase 23 → phase 12 → ...	Harmonic voltage (3P4W)	phase 1N* → phase 2N* → phase 3N* → phase 1N* → ...
		Indicated item	Order of change													
		Present current value	1-phase → 2-phase → 3-phase → N-phase* → Average → 1-phase → ...													
		Present current demand value	1-phase → 2-phase → 3-phase → N-phase* → 1-phase → ...													
		Present voltage value	phase 12 → phase 23 → phase 31 → phase 1N* → phase 2N* → phase 3N* → Average → phase 12 → ...													
		Harmonic current	phase 1 → phase 2 → phase 3 → phase N* → phase 1 → ...													
		Harmonic voltage (except for 3P4W)	phase 12 → phase 23 → phase 12 → ...													
Harmonic voltage (3P4W)	phase 1N* → phase 2N* → phase 3N* → phase 1N* → ...															
<p>*: Indicated in three-phase 4-wire (3P4W) only. Supplement: Phase is not changed in the items except above regardless of phase wire system. For average current and average voltage, ● page 48.</p>																

• Indication of harmonic

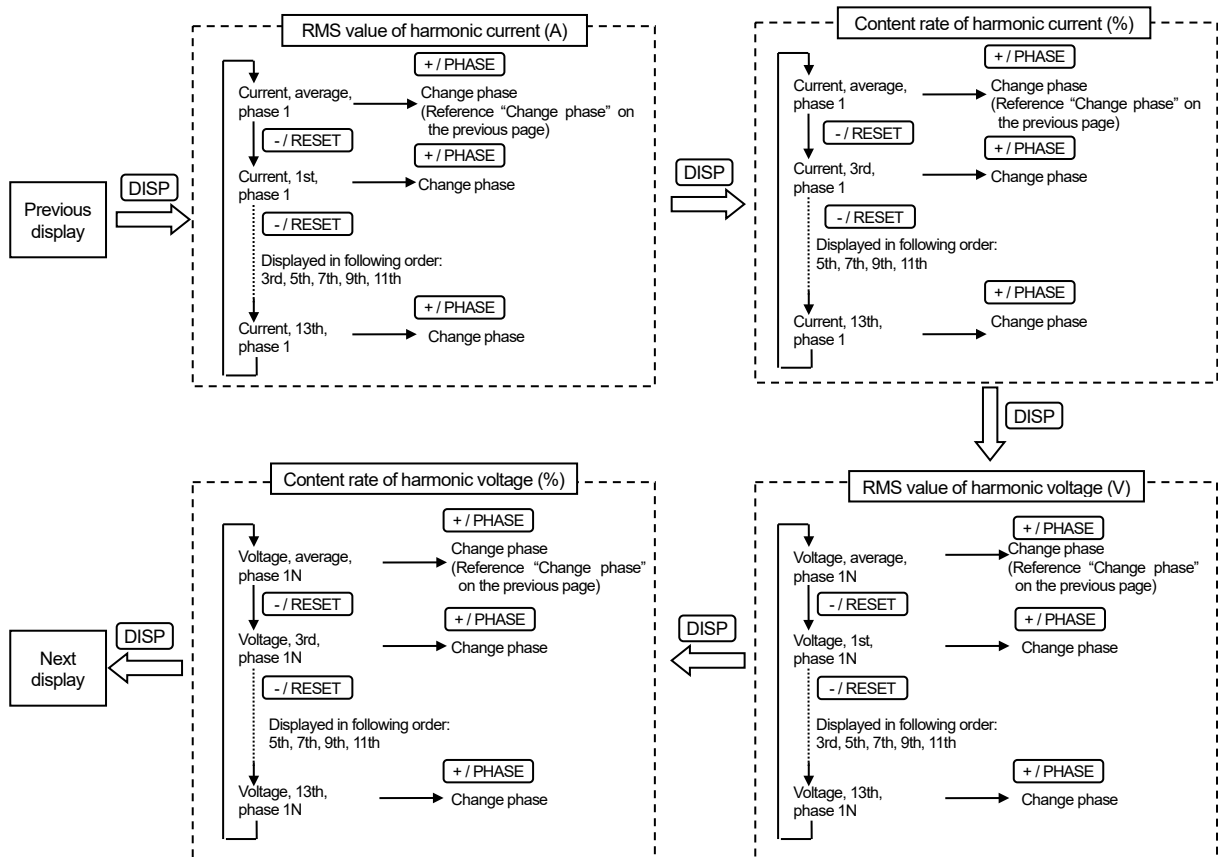
This unit can indicate the RMS value of harmonic, distortion rate and content rate. To indicate them, the indication setting of harmonic is needed in advance.

(For indication setting of harmonic, refer to p. 26 - 27.)

- Measured element

Order	Harmonic current		Harmonic voltage	
	RMS value	Distortion rate (Content rate)	RMS value	Distortion rate (Content rate)
Total of harmonic	○	○	○	○
1st	○	-	○	-
3rd	○	○	○	○
5th	○	○	○	○
7th	○	○	○	○
9th	○	○	○	○
11th	○	○	○	○
13th	○	○	○	○

- Transition diagram for indication of harmonic (change degree)



Supplement: Harmonic total is shown by "ALL".

• **Indication of electric energy, reactive energy and periodic energy**

- Indication format

The indication format of electric energy, reactive energy and periodic energy is as follows depending on the full load power:

$$\text{Full load power [kW]} = \frac{\alpha \times (\text{VT primary voltage}) \times (\text{CT primary current})}{1000}$$

}	α: 1	Single-phase, 2-wire
	2	Single-phase, 3-wire
	√3	Three-phase, 3-wire
	3	Three-phase, 4-wire

*1: VT primary voltage in single-phase 3-wire system is regarded as 110V.

*2: Using direct connection, replace VT primary voltage with direct voltage in calculation above.

*3: In three-phase 4-wire system, replace VT primary voltage or direct voltage with phase voltage in calculation above.

Full load power [kW]	Indication format	
	Digital indication	Unit
less than 12	8888.88	kWh kvarh
12 or more and less than 120	88888.8	
120 or more and less than 1200	888888	
1200 or more and less than 12000	8888.88	MWh Mvarh
12000 or more	88888.8	

• **Indication of electric power, power demand, reactive power and apparent power**

- Indication format

The indication format of electric power, power demand, reactive power and apparent power is as follows depending on the full load power:

(For the full load power, refer to above.)

Full load power [kW]	Indication format	
	Digital indication	Unit
less than 12	888.888	kW kvar kVA
12 or more and less than 120	8888.88	
120 or more and less than 1200	88888.8	
1200 or more and less than 12000	888888	
12000 or more	8888.88	MW Mvar MVA

• **Indication of current and current demand**

- Indication format

The indication style of current and current demand is as follows depending on the primary current:

Primary current [A]	Indication format	
	Digital indication	Unit
less than 40	888.888	A
40 or more and less than 400	8888.88	
400 or more and less than 4000	88888.8	
4000 or more	888888	

• **Indication of voltage**

- Indication style

The indication format of voltage is as follows depending on the primary voltage:

Primary voltage [V]	Indication format	
	Digital indication	Unit
less than 300	88888.8	V
300 or more	888888	

Caution: In three-phase 4-wire system, the indication of VT primary voltage and direct voltage depends on the phase voltage.

• **Indication of harmonic current and harmonic voltage**

- Indication format

To indicate harmonic current and harmonic voltage, the indication setting of them is needed in advance. The indication format of them is as follows depending on the full load power:

Measured element	Indication format	
	Digital indication	Unit
RMS value of harmonic current	same as current	same as current
Distortion rate of harmonic current (Content rate)	888.8	%
RMS value of harmonic voltage	same as voltage	same as voltage
Distortion rate of harmonic voltage (Content rate)	888.8	%

• **Indication of equivalent CO₂**

- Indication format

To indicate equivalent CO₂, the indication setting of it is needed in advance. The indication format of it is as follows depending on the full load power:

Full load power [kW]	Indication format	
	Digital indication	Unit
less than 12	8888.88	kg
12 or more and less than 120	88888.8	
120 or more and less than 1200	888888	
1200 or more and less than 12000	8888.88	t
12000 or more	88888.8	




How to use upper/lower limit alarm function

This device can set the upper/lower limit alarm value for each measured value individually.



<Monitoring items>

Upper limit alarm items	Current demand, phase N current demand, Voltage, Electric power demand, Power factor, Pulse count
Lower limit alarm items	Current demand, Voltage, Electric power demand, Power factor,

<Alarm setting>

- Upper limit value Set the upper limit of measured value. For setting value and setting range,  p. 28 - 29.
- Lower limit value Set the lower limit of measured value. For setting value and setting range,  p. 28 - 29.
- Alarm delay time Set the value in case you want to remove the inrush current of the load, etc. from the objects of monitoring. Alarm does not occur when the measured value goes below the upper limit or goes over the lower limit within the configured time. For setting value and setting range,  page 29.
- Alarm reset method Alarm recovery operation is different according to the alarm reset method.

Reset method	Alarm recovery operation
Auto-reset (Auto)	Reset the alarm automatically if the measured value goes below the upper limit or goes over the lower limit.
Self-retention (HoLd)	The alarm is held after the measured value goes below the upper limit or goes over the lower limit. Alarm is cleared by alarm reset.

For setting,  page 29. For alarm reset operation,  page 49.

<Alarm occurrence / recovery condition>

Alarm item	Alarm reset method	Alarm status	Alarm occurrence / recovery condition	
Current demand Phase N current demand Voltage Electric power demand Power factor	Auto-reset (Auto)	Upper limit monitoring	Occurrence	Measured value > configured upper limit (Alarm delay time is available)
			Recovery	Measured value ≤ configured upper limit
		Lower limit monitoring	Occurrence	Measured value < configured lower limit (Alarm delay time is available)
			Recovery	Measured value ≥ configured lower limit
	Self-retention (HoLd)	Upper limit monitoring	Occurrence	Measured value > configured upper limit (Alarm delay time is available)
			Retention	Measured value ≤ configured upper limit
		Lower limit monitoring	Recovery	Measured value ≤ configured upper limit AND Alarm reset
			Occurrence	Measured value < configured lower limit (Alarm delay time is available)
	Auto-reset (Auto)	Upper limit monitoring	Retention	Measured value ≥ configured lower limit
			Recovery	Measured value ≥ configured lower limit AND Alarm reset
	Self-retention (HoLd)	Upper limit monitoring	Recovery	Measured value ≥ configured lower limit AND Alarm reset
Pulse count	Auto-reset (Auto)	Upper limit monitoring	Occurrence	Measured value ≥ configured upper limit
			Recovery	Measured value < configured upper limit
	Self-retention (HoLd)	Upper limit monitoring	Occurrence	Measured value ≥ configured upper limit
			Retention	Measured value < configured upper limit
			Recovery	Measured value < configured upper limit

Caution: Since the measured value of pulse count value is an integrated value, it does not decrease.
When an alarm occurs, it is necessary to satisfy the recovery condition by one of the following methods.

- Reset Pulse count
- Preset Pulse count less than setting value of upper limit alarm
- Setup upper limit alarm more than pulse count.

<Alarm indication at alarm status>

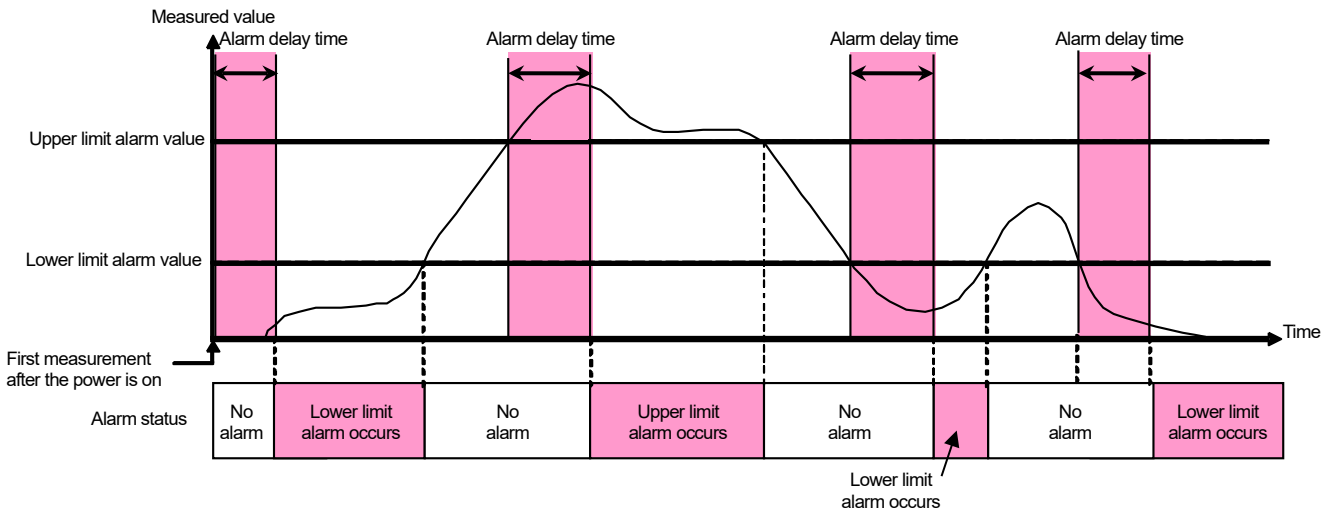
	No alarm	Alarm occurrence		Alarm retention	
		When indicating the alarm-occurrence phase	When indicating the other phase	When Indicating the alarm-occurrence phase	When indicating the other phase
Digital indication	Turn ON	Flash (*1)	Turn ON	Flash (*2)	Turn ON
Measured element, Unit, Phase	Turn ON	Flash (*1)	Flash (*1)	Flash (*2)	Flash (*2)

*1: Flash (250ms ON / 250ms OFF)

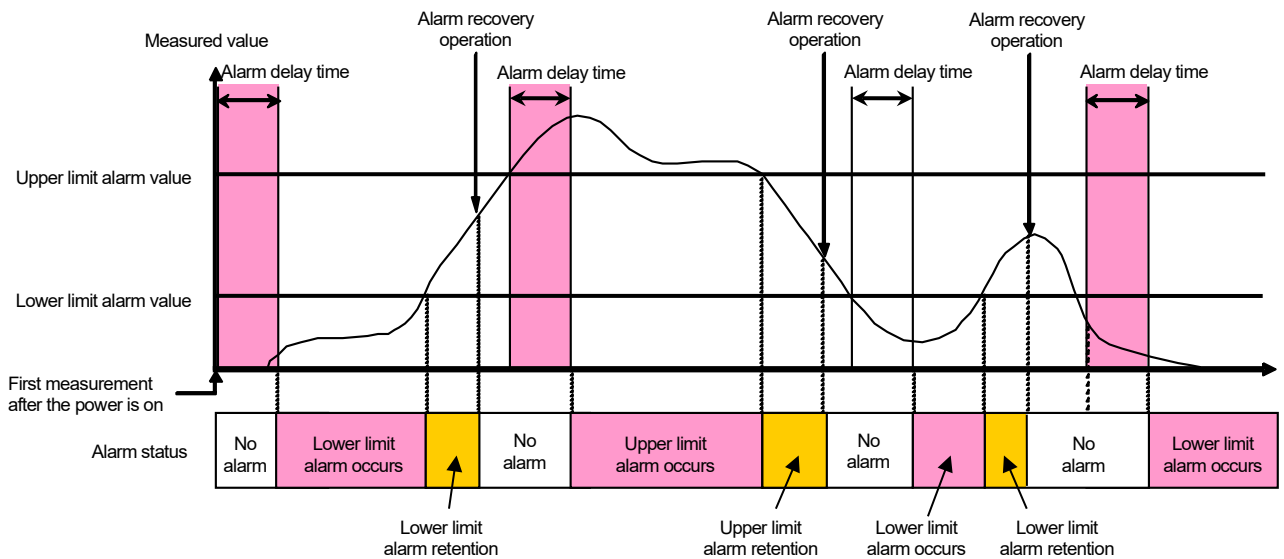
*2: Flash (500ms ON / 500ms OFF)

< Examples of alarm occurring (except for the upper limit of pulse count) >

(1) When the alarm reset method is "Auto-reset (Auto)".



(2) When the alarm reset method is "Self-retention (HoLd)".



Operations of alarm reset

Operations of alarm reset

Alarm recovery operation is different according to the alarm reset method.

Alarm reset method	Alarm recovery operation
Auto-reset (Auto)	Reset the alarm automatically if the measured value goes below the upper limit or goes over the lower limit.
Self-retention (HoLd)	The alarm is held after the measured value goes below the upper limit or goes over the lower limit. Clear the alarm as below after the value goes below the upper limit or goes over the lower limit. • In the present value display of operating mode, press <input type="button" value="- / RESET"/> button for two seconds to clear the alarm. (Alarm clear is effective even in other than the alarm-occurrence phase.)

Preset and all data reset

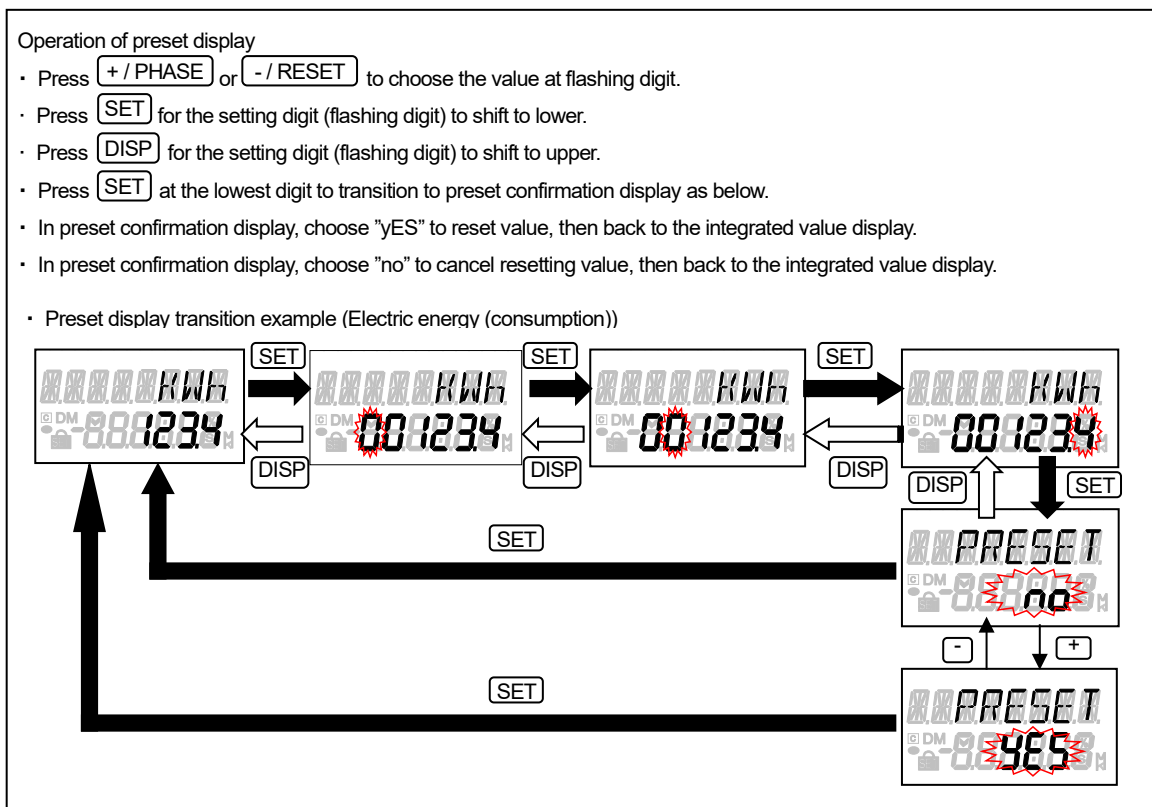
You can reset all the integrated measured values or some of them to zero. (such as electric energy, operating time, etc.)

- The integrated measured values you can reset to zero are as follows:

Electric energy (consumption), Reactive energy, Electric energy (regeneration), Periodic energy, Pulse count, Equivalent CO₂, Operation time

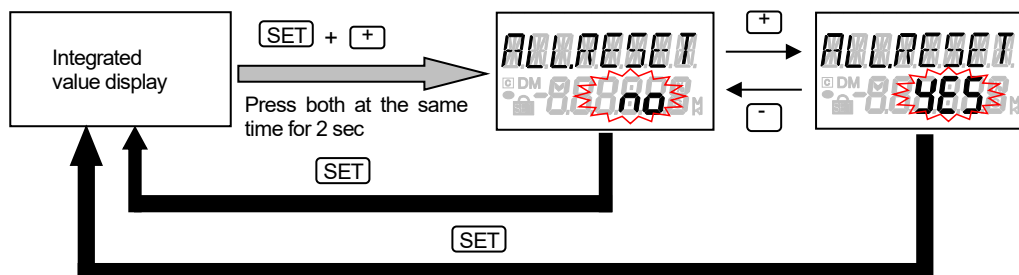
- Preset (Data reset of selected value)

- In each integrated value display of operating mode, press both **+ / PHASE** and **- / RESET** at the same time for more than two seconds to transition to preset mode.
- Preset procedure is as follows:



- All data reset

- In each integrated value display of operating mode, press both **SET** and **+ / PHASE** at the same time for more than two seconds to transition to all-data-reset display as below.
- In all-data-reset display, choose "yES" to reset all the integrated values to zero, then back to the integrated value display.
- In all-data-reset display, choose "no" to cancel resetting, then back to the integrated value display.
- All data reset display transition



9. Device operation

Measured items

The table below shows whether indication and output are performed or not for each measured item.

*: The measurable elements are different from the loggable elements.

● : Can be acquired with display, communication and logging by logging unit.

◎ : Can be acquired with display and communication.

○ : Can be acquired with display.

△ : Can be acquired with communication.

— : Can not be acquired

Measured item				EMU4-BD1-MB			EMU4-HD1-MB			
				1P2W	1P3W	3P3W	1P2W	1P3W	3P3W	3P4W
Current	phase 1			●	●	●	●	●	●	
	phase 2			-	●	●	-	●	●	
	phase 3			-	●	●	-	●	●	
	phase N			-	-	-	-	-	●	
	Average			●	●	●	●	●	●	
Current demand *moving average for the set period of current demand is indicated	phase 1			●	●	●	●	●	●	
	phase 2			-	●	●	-	●	●	
	phase 3			-	●	●	-	●	●	
	phase N			-	-	-	-	-	●	
Voltage	phase 12			●	●	●	●	●	●	
	phase 23			-	●	●	-	●	●	
	phase 31			-	●	●	-	●	●	
	phase 1N			-	-	-	-	-	●	
	phase 2N			-	-	-	-	-	●	
	phase 3N			-	-	-	-	-	●	
	Average line voltage			●	●	●	●	●	●	
Electric power				●	●	●	●	●	●	
Electric power demand *moving average for the set period of current demand is indicated				●	●	●	●	●	●	
Reactive power				●	●	●	●	●	●	
Apparent power				-	-	-	-	-	●	
Power factor				●	●	●	●	●	●	
Frequency				●	●	●	●	●	●	
Harmonic current	RMS	Total 1st 3rd - 13th	phase 1	-	-	-	●	●	●	●
			phase 2	-	-	-	-	-	-	●
			phase 3	-	-	-	-	●	●	●
			phase N	-	-	-	-	-	-	●
	Distortion ratio	Total 3rd - 13th	phase 1	-	-	-	●	●	●	●
			phase 2	-	-	-	-	-	-	●
			phase 3	-	-	-	-	●	●	●
			phase N	-	-	-	-	-	-	●
Harmonic voltage	RMS	Total 1st 3rd - 13th	phase 1N	-	-	-	-	-	-	●
			phase 2N	-	-	-	-	-	-	●
			phase 3N	-	-	-	-	-	-	●
			phase 12	-	-	-	●	●	●	-
			phase 23	-	-	-	-	●	●	-
	Distortion ratio	Total 3rd - 13th	phase 1N	-	-	-	-	-	-	●
			phase 2N	-	-	-	-	-	-	●
			phase 3N	-	-	-	-	-	-	●
Electric energy	Consumption			●	●	●	●	●	●	
	Regeneration			●	●	●	●	●	●	
	Consumption (extended) (*1)			△	△	△	△	△	△	
	Regeneration (extended) (*1)			△	△	△	△	△	△	
	Reactive energy				●	●	●	●	●	●
External input	Pulse input	Pulse count	-	-	-	●	●	●	●	
	Contact input	Periodic electric energy	-	-	-	●	●	●	●	
Operating time				◎	◎	◎	◎	◎	◎	
Equivalent CO2				-	-	-	○	○	○	○

*1: Output is supported, but indication is not supported.

Extended electric energy is the data of lower three digits more than electric energy data. The number of digits of response data is the same as the amount of electric energy data.

• The image of the Extended electric energy

In the case measuring device has "12345.6789" as internal data.

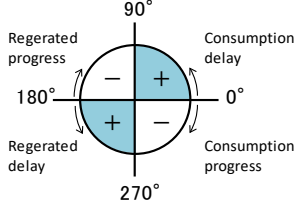
* Please multiply multiplying factor in electric energy for calculate measured value.

Electric energy data: "123456"

12345.6789

Extended electric energy data: "456789"

The details of measurement items showed below table.

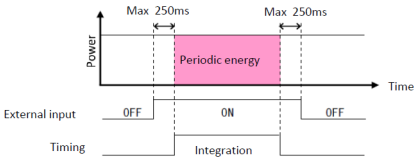
Item	Details								
Electric power Reactive power Power factor	Details of the sign is showed below figure. 								
RMS current value (Average)	Calculated depending on the phase-wire system. <table border="1" data-bbox="644 450 1497 607"> <thead> <tr> <th>Phase-wire system</th> <th>Calculating formula</th> </tr> </thead> <tbody> <tr> <td>Single-phase 2-wire</td> <td>phase 1 current</td> </tr> <tr> <td>Single-phase 3-wire Three-phase 3-wire</td> <td>(phase 1 current + phase 3 current) / 2</td> </tr> <tr> <td>Three-phase 4-wire</td> <td>(phase 1 current + phase 2 current + phase 3 current) / 3</td> </tr> </tbody> </table>	Phase-wire system	Calculating formula	Single-phase 2-wire	phase 1 current	Single-phase 3-wire Three-phase 3-wire	(phase 1 current + phase 3 current) / 2	Three-phase 4-wire	(phase 1 current + phase 2 current + phase 3 current) / 3
Phase-wire system	Calculating formula								
Single-phase 2-wire	phase 1 current								
Single-phase 3-wire Three-phase 3-wire	(phase 1 current + phase 3 current) / 2								
Three-phase 4-wire	(phase 1 current + phase 2 current + phase 3 current) / 3								
RMS voltage value (Average)	Calculated depending on the phase-wire system. <table border="1" data-bbox="644 645 1481 801"> <thead> <tr> <th>Phase-wire system</th> <th>Calculating formula</th> </tr> </thead> <tbody> <tr> <td>Single-phase 2-wire</td> <td>1-2 line voltage</td> </tr> <tr> <td>Single-phase 3-wire Three-phase 3-wire</td> <td>(1-2 line voltage + 2-3 line voltage) / 2</td> </tr> <tr> <td>Three-phase 4-wire</td> <td>(1-2 line voltage + 2-3 line voltage + 3-1 line voltage) / 3</td> </tr> </tbody> </table>	Phase-wire system	Calculating formula	Single-phase 2-wire	1-2 line voltage	Single-phase 3-wire Three-phase 3-wire	(1-2 line voltage + 2-3 line voltage) / 2	Three-phase 4-wire	(1-2 line voltage + 2-3 line voltage + 3-1 line voltage) / 3
Phase-wire system	Calculating formula								
Single-phase 2-wire	1-2 line voltage								
Single-phase 3-wire Three-phase 3-wire	(1-2 line voltage + 2-3 line voltage) / 2								
Three-phase 4-wire	(1-2 line voltage + 2-3 line voltage + 3-1 line voltage) / 3								
Pulse count	Measure the input pulse. Measure the output pulse of equipment by connecting it. <table border="1" data-bbox="651 837 986 909"> <thead> <tr> <th>Measurement range</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>0~999999</td> <td>Pulse</td> </tr> </tbody> </table>	Measurement range	Unit	0~999999	Pulse				
Measurement range	Unit								
0~999999	Pulse								
Contact state	Measuring the contact input state. By connecting other equipment, you can capture the contact output as an alarm. <table border="1" data-bbox="651 969 874 1037"> <thead> <tr> <th>Contact information</th> </tr> </thead> <tbody> <tr> <td>ON,OFF</td> </tr> </tbody> </table>	Contact information	ON,OFF						
Contact information									
ON,OFF									
Operating time	Measuring the time during contact input is ON or measuring current. <table border="1" data-bbox="651 1070 1050 1142"> <thead> <tr> <th>Measurement range</th> <th>Unit</th> </tr> </thead> <tbody> <tr> <td>0~999999</td> <td>Time [hour]</td> </tr> </tbody> </table>	Measurement range	Unit	0~999999	Time [hour]				
Measurement range	Unit								
0~999999	Time [hour]								
Periodic electric energy	Measuring the electric energy (consumption) during contact input is ON.								
Equivalent CO2	Calculated below equation. Electric energy (consumption)×CO ₂ converted value ※CO ₂ converted value : 0.000~0.999 (Initial value : 0.555)								

Restrictions of measured data

F/W version is displayed in five seconds after the power loading to this device.

Measurement and communication do not performed in a few seconds after the configuration or the change of the rating to it. Behaviors during operation are as follows:

Measured item	Behaviors of this device	
	Display part indication	Communication data
Current	Indicate "0A" if RMS value is under 0.4% range of rating. Indicate upper indication limit value if RMS value is over it.	Same as on the left
Current demand	Indicate upper indication limit value if RMS value is over it.	Same as on the left
Voltage (*1)	Indicate "0V" if RMS value is under 11V. Indicate upper indication limit value if RMS value is over it.	Same as on the left
Power Power demand Reactive power Apparent power	Indicate "0W", "0var" or "0VA" if indicated voltage values of all phases are 0V or indicated current values of them are 0A. Indicate upper indication limit value if the measured value is over it.	Same as on the left
Power factor	Indicate "100.0%" if indicated voltage values of all phases are 0V or indicated current values of them are 0A	Same as on the left
Frequency	Voltage condition: Indicate "----" if voltage V12 (voltage V1N for 3P4W) is 0V.	0
	Frequency condition: Indicate "----" if frequency is under 44.5Hz.	44.5
RMS value of harmonic current	Voltage condition: Indicate "----" at all phase if voltage V12 (voltage V1N for 3P4W) is under 11V. Indicate "0V" at all phase if voltage V12 (voltage V1N for 3P4W) is under 40V.	0 0
	Frequency condition: Indicate "----" at all phases if frequency is under 44.5Hz.	0
Content rate of harmonic current (modulation distortion)	Voltage condition: Indicate "----" at all phase if voltage V12 (voltage V1N for 3P4W) is under 11V. Indicate "0.0%" at all phase if voltage V12 (voltage V1N for 3P4W) is under 40V.	0 0
	Frequency condition: Indicate "----" at all phases if frequency is under 44.5Hz.	Outside-channel error
RMS value of harmonic voltage	Voltage condition: Indicate "----" at all phase if voltage V12 (voltage V1N for 3P4W) is under 11V. Indicate "0V" at all phase if voltage V12 (voltage V1N for 3P4W) is under 40V.	0
	Frequency condition: Indicate "----" at all phases if frequency is under 44.5Hz.	0
Content rate of harmonic voltage (modulation distortion)	Voltage condition: Indicate "----" at all phase if voltage V12 (voltage V1N for 3P4W) is under 11V. Indicate "0.0%" at all phase if voltage V12 (voltage V1N for 3P4W) is under 40V.	0
	Frequency condition: Indicate "----" at all phases if frequency is under 44.5Hz.	0
Electric energy	The electric energy is measured with a load that is about 0.4% or more of all load power. Even if the indicated value is "0," measurement value will increase.	Same as on the left
Pulse count	When use of upper / lower limit alarm = off or upper / lower limit alarm element ≠ pulse count (upper limit), counting restarts from 0 when 999999 have been exceeded. When use of upper / lower limit alarm = on and upper / lower limit alarm element = pulse count (upper limit), it is fixed to 999999 when 999999 have been exceeded.	Same as on the left

Operating time (*2)	Indicate "999999h" if operating time is over 999999h.	Same as on the left
Periodic electric energy	<p>For contact input ON/OFF, integrated value may deviate up to 250 ms less in time at the start or stop of integration.</p> 	Same as on the left

*1: In single-phase, three-wire system, indicate "0V" if RMS value is under 22V.

*2: Operation time is reference value.

10. Reference

This chapter explains the ways of dealing when you think the unit is in failure, Q&A, etc.

In case you think the unit is in failure

If an abnormal sound, bad-smelling smoke, fever break out from this unit, switch it off promptly and don't use it. If you think the unit is in failure, check the following before sending for repair.

Obtained value is incompatible with other values.

- **Integrated electric energy value is not measured though current value is indicated.**
- **Obtained values are different from other measuring instruments.**

Check the connection to the terminals of "Power supply side (K)" and "Load side (L)".

Check the settings of phase wire system, primary voltage and primary current.
Wrong settings may cause the incorrect measurement.

Check whether the short circuit or disconnection is present.

Obtained values are different from other measuring instruments. (over tolerance)

Check that the measuring instrument used for comparison indicates a correct RMS value. This unit indicates an RMS value.

If the measuring instrument used for comparison measures an average value instead of RMS value, distortion caused by harmonic etc. in the current of the circuit to be measured causes a significant difference of values.

About error number

In case the display part indicates the error number as below, adopt measures indicated in the table below.
If the unit does not resume after measures, it may be in failure. Contact our sales representative near you.

(Example) Error No.005



Error No.	Kind of Error	Measures
002	FRAM error	Press the reset button until the display (LED) turns off. Or restore auxiliary power supply.
003	Memory error	
004	Timeout error	
005	Outside-set-value error	Press SET button
009	Communication module error	Make sure that the communication module is connected properly, then turn on the power again auxiliary.
261	Communication error	Communication instrument is short circuit or not connected right. Confirm the signal mark and check the communication connector, tighting screw and terminal screw is loose.
262	Communication error	Communication is crowded. Return from abnormal automatically after a while. Please contact to sales outlet when many times.
263	Unit error	There is malfunction in energy measure unit. Please contact MITSUBISHI electric service or sales outlet.(Tell the error number when contact)

264, 265	Communication error	<p><B/NET transmission> Confirm below 3 points. ① Power supply of B/NET transmission is turned OFF? ② B/NET transmission line is disconnection? ③ Transmission line is connected right? (Confirm signal mark D, N, S and B/NET transmission connector and ascrew is loose.)</p> <p><CC-Link communication> Confirm below 2 points ① CC-Link communication line is disconnection ② Transmission line is connected right? (Confirm signal mark DA, DB, DG, SLD and CC-Link Communication connector and tightening screw and terminal screw are loose.)</p>
266, 912	Option unit error	Communication between Energy measuring unit and Option unit is failed. Please reset Energy measuring unit.
281	Communication error	Address duplicate with other devices. Confirm all address of energy measure unit and connected device.
901	SD memory card error	Light protect switch of SD memory card in logging unit is ON. Turn the light protect switch to OFF.
902	Logging error	Logging element that energy measure unit can't measure is set. Setup logging conditions again.
903	Unit error	Turn on the auxiliary power again.
905	Time error	Setup the present time again.
907	Logging setting error	There is a possibilities that setup data file for logging is wrong or out of range of the data. Confirm the contents of setup data file again.

After-sales service

If you have any questions or the product is broken down, contact our sales representative near you. (For details, refer to the end of this manual.)

- Gratis warranty is effective until the earlier of 1 year after the date of your purchase or 18 months after manufacturing.
- The gratis warranty shall apply if the product fails even though it is being used properly in the conditions, with the methods and under the environments in accordance with the terms and precautions described in the catalogs, the instruction manual, caution label on the product, etc.
- Repair shall be charged for the following cases even during the gratis warranty period.
 - Failures occurring due to your improper storage or handling, carelessness or fault.
 - Failures due to faulty workmanship
 - Failures due to faults in use and undue modification
 - Failures due to accidental force such as a fire, abnormal voltage, etc. and force majeure such as an earthquake, wind, flood, etc.
 - Failures due to matters unpredictable based on the level of science technology at the time of product.
- Our company shall not be liable to compensate for any loss arising from events not attributable to our company, opportunity loss and lost earning of the customer due to failure of the product, and loss, secondary loss, accident compensation, damage to other products besides our products and other operations caused by a special reason regardless of our company's predictability

Q&A

• General

Q	To what degree is the unit durable against overvoltage and over current?
A	Durability is as follows: Momentary*: Up to 10 times as high as rated current and 2 times as high as rated voltage. *Momentary means: Energizing 9 times for 0.5 seconds at 1-minute intervals, and then 1 time for 5 seconds. Continuous: Up to 1.1 times as high as rated voltage and rated current.
Q	Can the unit be used as an electric energy meter?
A	This unit cannot be used for deal and proof of electric energy measurement stipulated in the measurement law.
Q	Are errors in wiring verifiable easily?
A	They are verifiable by the indication for discrimination support function for improper connection.(Please refer to appendix)
Q	If a load such as welding equipment exists, a current flows only for a short period (e.g. 2 cycles). Is measurement possible?
A	The electrical amount such as current, voltage, electric power, power factor, frequency, harmonic voltage and harmonic current is measured in a cycle of 250 ms period. So it is impossible to measure the current accurately for a short period. The amount of electricity and reactive power amount are measured separately from the momentary data described above, using a sampling period of 4340 Hz continuously without intermittence. Therefore, it is possible to measure the load for a short period.
Q	Is it OK to open the secondary terminals of the current sensor?
A	The secondary side of the models EMU2-CT5, EMU2-CT5-4W, EMU-CT5-A, EMU-CT50, EMU-CT100, EMU-CT250, EMU-CT50-A, EMU-CT100-A, EMU-CT250-A, EMU-CT400-A and EMU-CT600-A is equipped with the protective circuit against opening of secondary terminals. Opening them during the wiring work causes no problems. However, for safety, please do not continuously energize the module with the terminals open. The secondary side of the models EMU-CT400 and EMU-CT600 is equipped with the protective circuit against opening of secondary terminals. However, during the wiring work, be sure to turn the secondary side short-circuit switch to short. After completion of work, be sure to turn the secondary short-circuit switch to open. Note that failing to turn the switch open results in an inaccurate measurement.
Q	Obtained values may be different from other measuring instruments. Why is it so?
A	There are various possible causes. Check the following first, please: (1) Check for wiring errors. (2) Check for the settings. (phase wires, primary voltage ,primary current and sensor type) (3) On the split-type current sensor, check for the poor engagement or separation of fitting surfaces. (4) On the split-type current sensor, check for pinching of foreign object between fitting surfaces. (5) Check for the short circuit on the secondary side of the current transformer (CT). (6) Current sensor connectable to the unit is the dedicated current sensor only. Check that the proper current sensor is connected or not. (7) Check that the measuring instrument used for comparison indicates a correct RMS value. This unit indicates an RMS value. If the measuring instrument used for comparison measures an average value instead of RMS value, distortion caused by harmonic etc. in the current of the circuit to be measured causes a significant difference of values.

• **Q&A about specifications**

Q	What does “Allowable tolerance” mean?
A	In terms of the amount of electricity, it means a range of tolerances in reading values. For example, when the reading value is “10 kWh,” a tolerance is ± 0.2 kWh. In terms of measured elements other than the amount of electricity, it means tolerance for the rated input. For a current, when a rated current is set to 5 A, $\pm 1\%$ of 5 A is a tolerance.
Q	Is accuracy of a current sensor included?
A	Accuracy of a current sensor is not included in accuracy of the unit. A maximum value of tolerance is obtained by summing tolerance of the unit and that of a current sensor.
Q	To what degree an area of micro current is measured?
A	A current value is measured from the area exceeding 0.4% of the rated current. In an area below 0.4%, measurement result is indicated as “0” (zero). However, in that case, still, the amount of electricity is being measured. Even if the indicated value is “0,” measurement value will increase in continuing measurement for a long time. The amount of electricity is measured with a load that is about 0.4% or more of all load power.
Q	Is measurement of inverter circuit possible?
A	Measuring the secondary side of the inverter is impossible due to the large fluctuation of frequency. Make measurement on the primary side of the inverter. However, since a current waveform on the primary side of the inverter has a distortion containing the harmonic components, a slight error occurs.

• **Q&A about installation**

Q	What is wire diameter that allows installing a current sensor?
A	The following lists the nominal cross-sectional areas of the conductor of 600-V vinyl coated wires that can penetrate. (values for reference) · IV wire (600-V vinyl insulated wire) 38mm ² (EMU-CT50-A) 、 60mm ² (EMU-CT50/CT100, EMU-CT100-A) 、 150mm ² (EMU-CT250) 200mm ² (EMU-CT250-A) 、 500mm ² (EMU-CT400-A, EMU-CT600-A) 、 500 mm ² × 1wire, 325 mm ² × 2wire (EMU-CT400/CT600) · CV wire (600-V vinyl insulated wire) 22mm ² (EMU-CT50-A) , 38mm ² (EMU-CT50/CT100), 60mm ² (EMU-CT100-A) , 150mm ² (EMU-CT250 (100mm ² is recommended), EMU-CT250A) 400mm ² (EMU-CT400-A, EMU-CT600-A) , 500 mm ² × 1 wire, 325 mm ² × 2 wires (EMU-CT400/CT600) The above shows the standard nominal cross-sectional areas. Due to the outer difference of finished vinyl insulation and deformation (bending) depending on manufacturers, a wire may not penetrate. Make verification on site.
Q	What are the points when installing a current sensor?
A	Models EMU2-CT5, EMU2-CT5-4W, EMU-CT5-A, EMU-CT***, EMU-CT***-A are split-type. If split surfaces are not engaged sufficiently or a foreign object exists between the split surfaces, adequate performances are not obtained. Pay attention in installation.

• **Q&A about connection**

Q	Does polarity exist in connection between a current sensor and the unit?
A	Yes. Make connections so that secondary terminals of current sensor (k, l) and terminal symbols of unit agree with each other. If polarity is incorrect, the current value is measurable, but the electric power and the electrical energy cannot be measured correctly.
Q	Are there any key points in avoiding errors in wiring?
A	Check polarity of current sensor on the primary current side. Power supply side of the circuit is indicated as “K,” and the load is indicated as “L.” An arrow indicates the direction from K to L. Check the current sensor and the module are connected correctly for the 1-side circuit, 2-side circuit, and 3-side circuit. Besides, check that voltage inputs for voltage transform unit are connected correctly among P1, P2, P3, and P0.
Q	How do wires extend between a current sensor and the module?
A	Model EMU-CT***, EMU-CT***-A are extendable up to 50m. Model EMU2-CT5 and EMU2-CT5-4W are extendable up to 11 m, using together with a extension cable. To extend the wire further, use the current transformer CW-5S(L) for split-type instrument in combination, extending the secondary wiring on CW-5S(L) side.

• **Q&A about setting**

Q	Is the setting required?
A	At least, settings of phase wires, primary current and primary voltage are required. Specify settings in accordance with a circuit to be connected.
Q	If a primary current setting value is different from that of rated current on a connected current sensor, does it cause a breakdown?
A	It does not cause breakdown or burning. However, measurement values will be totally incorrect.

11. Requirement for the compliance with EMC Directives

EMC Directives prescribe both "Emission (electromagnetic interference): Do not radiate strong electromagnetic waves outside" and "Immunity (electromagnetic susceptibility): Do not be influenced by electromagnetic waves from outside".

This section compiles the precautions for the compliance of the system incorporating the energy measuring unit (target model: EMU4-BD1-MB and EMU4-HD1-MB) with the EMC Directives. The following description is based on the requirement of the regulations and the standards we understand, but we do not guarantee to comply with the directives above for the whole system built in accordance with this description. The manufacturer of the system finally needs to evaluate the way of the compliance with EMC Directives and whether the system complies with them or not.

- (1) Harmonized standard for EMC Directives: EN61326-1:2013
 - (a) Compatibility condition for harmonized standard

The energy measuring unit is the open type device (i.e. the device incorporated in other device), and needs to be installed in the conductive control panel. The unit is tested with installed in the control panel for the emission and the immunity out of the test items for the standard.
- (2) Condition for installation in the control panel
 - (a) Control panel
 - Control panel needs to have conducting property.
 - When bolting the top panel, bottom panel etc. of the control panel, mask the grounding part of the panel so as not to be painted.
 - In inner panel, keep the conductivity in as large area as possible by masking the bolting part to the main panel to keep the electric contact to main panel.
 - Ground the main panel by the thick wire so as to keep high impedance even for high-frequency wave.
 - (b) Installation of power line and ground line
 - Set up the ground point to the control panel near the energy measuring unit, and ground the frame GND terminal of the unit to the ground terminal of the control panel (PE) by as thick and short wires as possible. (wire length is 30cm or shorter)
 - (c) Cable
 - power line

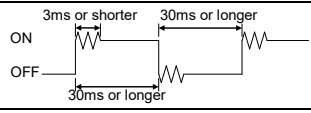
Attach ferrite cores to power line. Ferrite cores used in our testing is below.
KITAGAWA INDUSTRIES CO.,LTD., RFC-10
 - External input signal line, External output signal line

Wiring of each connection wire should satisfy the following conditions.

 - For wiring inside buildings, the wiring length should not exceed 30 m.
 - Do not route wiring from the inside of the building to the outside of the building.

12. Specifications

Common specifications

Item		Specifications	
Model		EMU4-BD1-MB	EMU4-HD1-MB
Phase-wire system		Single-phase 2-wire / Single-phase 3-wire / Three-phase 3-wire (Change of setting)	Single-phase 2-wire / Single-phase 3-wire / Three-phase 3-wire / Three-phase 4-wire(Change of setting)
Rating	Voltage circuit	Single-phase 2-wire / Three-phase 3-wire	110V, 220V AC(*1)
		Single-phase 3-wire	AC110V (b/w 1- and 2-phase, 2- and 3-phase), AC220V (b/w 1- and 3-phase)
		Three-phase 4-wire	-
	Current circuit (*1)	50A, 100A, 250A, 400A, 600AAC (The dedicated split type current sensor is used. Each value refers to the current at the primary side of the current sensor.) 5AAC (The dedicated split type current sensor is used. 5A current sensor is used together with the current transformer (CT), and the primary-side current is configurable up to 6000A.) (*4) Secondary-side current is up to 66.66mAAC.	110V, 220V, 440V AC(*2)
Frequency	50Hz / 60Hz (Auto-detect)	Min: 63.5V/110V AC, Max: 277V/480V AC(*3)	
Auxiliary power supply rating		100 - 240V AC (+10%, -15%) 50Hz-60Hz, 10VA, Transient overvoltage 4,000V	
Transient overvoltage		Measuring circuit: CAT III, Auxiliary power supply: CAT III.	
Measurable circuit count		1 circuit	
Consumption VA	Voltage circuit	Each phase 0.1VA (at 110V AC), 0.2VA (at 220V AC), 0.4VA (at 440V AC)	
	Current circuit	Each phase 0.1VA (current sensor primary side)	
	Auxiliary power supply circuit(*5)	At 110V AC: 9VA At 220V AC: 10VA	
Allowable tolerance (*6)		Current, voltage, electric power, reactive power, apparent power, frequency : ±1.0% (100% of the rating) Power factor : ±3.0% Electric energy : ±2.0% (5 - 100% range of the rating, power factor=1) Reactive energy : ±2.5% (10 - 100% range of the rating, power factor=0) Harmonic current, harmonic voltage (*2) : ±2.5%	
Data update interval		250msec *Integrated values of electric energy and reactive energy are always accumulated (following up the short-cycled load fluctuation)	
Range of demand time setting		0, 10s, 20s, 30s, 40s, 50s, 1 - 15min (1min intervals), 20min, 25min, 30min	
External input	Input signal	-	Non-voltage Form A contact or Open collector 1 input (choose the function from below)
	Function	-	Setting to "pulse input" : Pulse count (0 - 999,999 counts)
		-	Setting to "contact input" : Contact monitoring only : Contact monitoring and energy measuring at work (when contact is on)
	Isolation	-	By photo coupler
	Rated input voltage and current	-	Voltage of the contact is 5V DC, and current is 7mA, so use something appropriate for the switching condition.
	Input condition	Pulse	-
Contact		-	Contact ON time: 30ms or longer Contact OFF time: 30ms or longer Chattering time: 3ms or shorter 
External output	Output signal	-	Non-voltage Form A contact, 1 output (choose the function from below)
	Function	-	Alarm output / Pulse output
		-	Upper limit monitoring of current demand, Lower limit monitoring of current demand, Upper/Lower limit monitoring of voltage, Upper limit monitoring of power demand, Lower limit monitoring of power demand, Upper limit monitoring of power factor, Lower limit monitoring of power factor, Upper limit monitoring of pulse count
	Isolation	-	By semiconductor relay
Rated switching voltage and current	-	35V DC, 75mA 24V AC, 75mA (power factor = 1)	

Item		Specifications	
Model		EMU4-BD1-MB	EMU4-HD1-MB
Pulse output	Output element	-	Electric energy(Consumption)
	Output signal	-	Non-voltage Form A contact, 1 output ·Unit of pulse (kWh / pulse): 0.001 / 0.01 / 0.1 / 1 / 10 / 100 / 1000 / 10000
	Isolation	-	By semiconductor relay
	Rated switching voltage and current	-	35V DC, 75mA 24V AC, 75mA (power factor = 1)
	Output pulse width	-	0.1 - 0.15s
Compensation for power failure	Stored items	Setting values, Electric energy (consumption, regeneration), reactive energy, periodic electric energy, pulse count value, Operating time (stored in the nonvolatile memory)	
Standard(*7)		EMC: EN-61326-1: 2013 UL: UL61010-1 LVD: EN-61010-1: 2010	
Usage environment	Operating temperature	-5 - +55°C (Daily average temperature is 35°C or lower)	
	Operating humidity	30 - 85%RH (No condensation)	
	Storage temperature	-10 - +60°C	
	Operating altitude	2000m or below	
Commercial frequency withstand voltage		b/w all terminals (except for communication circuit and frame GND terminal) and casing: 2000V AC, 1min	
		b/w all terminals of current input, voltage input / auxiliary power : 2000V AC, 1min	
		b/w all terminals of current input, voltage input, auxiliary power and all terminals of digital / pulse input, pulse / alarm output, communication: 2000V AC, 1min	
Insulation resistance		10MΩ or more at the same part above (500V DC)	
Appropriate wire	Terminals of auxiliary power circuit and voltage input	stranded wire: AWG24-16 (0.2~1.25mm ²) single wire : AWG24-16 (φ 0.5~1.2mm)	stranded wire: AWG24-16 (0.12~2mm ²) single wire : AWG24-16 (φ 0.5~1.6mm)
	Terminals of current input and input/output	stranded wire: AWG22-16(0.3~1.25mm ²) single wire : AWG22-16(φ 0.5~1.2mm)	
Tightening torque	Screws for terminals of auxiliary power circuit and voltage input	0.8 N·m	0.8 - 1.0N·m
	Screws for terminals of current input and input/output	0.5 - 0.6N·m	
	Screws for installation to the panel	0.63N·m	
Mass		0.2kg	0.3kg
External dimensions (unit: mm)		75 (W) x 90 (H) x 75 (D) (expect for the protruding portions) (Maximum dimension including the protruding portions: 79 (W) x 90 (H) x 75 (D))	

- *1: 110V, 220V AC can connected to this unit directly. For the circuit over this voltage, transformer (VT) is necessary (Primary voltage of VT can be set up to 6600V, and secondary voltage of VT can be set up to 220V as optional setting). Star- delta connection and delta-star connection transformer instead of VT cannot measure definitely to be out of phase. Please use a transformer of the same connection.
- *2: 110V, 220V, 440V AC can connected to this unit directly. For the circuit over this voltage, transformer (VT) is necessary (Primary voltage of VT can be set up to 6600V, and secondary voltage of VT can be set up to 220V as optional setting). Star- delta connection and delta-star connection transformer instead of VT cannot measure definitely to be out of phase. Please use a transformer of the same connection.
- *3: 63.5/110V – 277/480V AC can connected to this unit directly. For the circuit over this voltage, transformer (VT) is necessary (Primary voltage of VT can be set up to 6600V, and secondary voltage of VT can be set up to 220V as optional setting). Star- delta connection and delta-star connection transformer instead of VT cannot measure definitely to be out of phase. Please use a transformer of the same connection.
- *4: Configurable primary current when using 5A current sensor is as follows:
5A, 6A, 7.5A, 8A, 10A, 12A, 15A, 20A, 25A, 30A, 40A, 50A, 60A, 75A, 80A, 100A, 120A, 150A, 200A, 250A, 300A, 400A, 500A, 600A, 750A, 800A, 1000A, 1200A, 1500A, 1600A, 2000A, 2500A, 3000A, 4000A, 5000A, 6000A
(at "any setting" CT primary current is configurable up to 6000A, but CT secondary current is fixed to 5A.)
- *5: The maximum value of consumption VA is described.
- *6: For relative error of current sensor, refer to chapter 13 "Option devices" section (1).
- *7: When combine it with B/NET Communication Unit(Model : EMU4-CM-B), it becomes out of a conformity standard.
When combine this unit with a CT (Model : EMU2-CT5, EMU2-CT5-4W, EMU-CT50, EMU-CT100, EMU-CT250, EMU-CT400-A, EMU-CT600-A), it becomes UL standard.

Specifications of MODBUS communication

Item	Specifications
Communication method	RS-485 2wires half duplex
Protocol	MODBUS RTU mode
Synchronization method	Asynchronous
Transmission wiring type	Multi-point bus (either directly on the trunk cable, forming a daisy-chain)
Baud rate	2400, 4800, 9600, 19200, 38400bps (default: 19200bps)
Data bit	8bit
Stop bit	1, 2bit (default: 1bit)
Parity bit	ODD,EVEN,NONE (default: EVEN)
Slave address	1~255 (default: 1) (But 0 is impossible of authorization for a broadcast address. 248-255 is Reserve)
Response time	1s or shorter from completion of receiving query data to response transmission
Communications distance	Maximum 1200m
Connectable devices	Maximum 31 devices
Termination resistor	120Ω 1/2W
Recommended cable	SPEV(SB)-MPC-0.2 ×1P or more (Fujikura Dia Cable)

■MODBUS communication data Multiplying factor

"Data" and "Multiplying factor" is acquired by MODBUS communication.
Measured value is calculated below equation.

$$\text{Measured value} = \text{Data} \times 10^n \quad (n: \text{Multiplying factor})$$

Example: Acquired data is when Average current is measured 123.456A

Data: 123456

Multiplying factor: -3

$$\begin{aligned} \text{Measured value} &= 123456 \times 10^{-3} \\ &= 123.456 \text{ A} \end{aligned}$$

The multiplying factor of electric energy, reactive energy and periodic energy is as follows depending on the full load power

$$\text{Full load power [kW]} = \frac{\alpha \times (\text{VT primary voltage}) \times (\text{CT primary current})}{1000}$$

$\left. \begin{array}{l} \alpha: 1 \quad \text{Single-phase, 2-wire} \\ 2 \quad \text{Single-phase, 3-wire} \\ \sqrt{3} \quad \text{Three-phase, 3-wire} \\ 3 \quad \text{Three-phase, 4-wire} \end{array} \right\}$

*1: VT primary voltage in single-phase 3-wire system is regarded as 110V.

*2: Using direct connection, replace VT primary voltage with direct voltage in calculation above.

*3: In three-phase 4-wire system, replace VT primary voltage or direct voltage with phase voltage in calculation above.

Full load power [kW]	Multiplying factor
less than 12	×0.01
12 or more and less than 120	×0.1
120 or more and less than 1200	×1
1200 or more and less than 12000	×10
12000 or more	×100

The multiplying factor of electric power, power demand, reactive power and apparent power is as follows depending on the full load power

(For the full load power, refer to above.)

Full load power [kW]	Multiplying factor
less than 12	×0.001
12 or more and less than 120	×0.01
120 or more and less than 1200	×0.1
1200 or more and less than 12000	×1
12000 or more	×10

The multiplying factor of current and current demand is as follows depending on the primary current

Primary current [A]	Multiplying factor
less than 40	×0.001
40 or more and less than 400	×0.01
400 or more and less than 4000	×0.1
4000 or more	×1

The Multiplying factor of voltage and harmonic voltage is as follows depending on the primary voltage:

Caution: In three-phase 4-wire system, the Multiplying factor of VT primary voltage and direct voltage depends on the phase voltage

Primary voltage [V]	Multiplying factor
less than 300	×0.1
300 or more	×1

The multiplying factor of frequency and power factor is ×0.1 fixed.

13. Option devices

About option devices

Option devices of this unit are showed below. Please reference to manual of option devices.

Product name	Model	Note	
Option unit	CC-Link Communication Unit for Energy Measuring Unit	EMU4-CM-C	You can use CC-Link communication by connecting main unit.
	Logging Unit for Energy Measuring Unit	EMU4-LM	You can log the measured data by connecting main unit.
	CC-Link IE Filed Basic Communication Unit for Energy Measuring Unit	EMU4-CM-CIFB	You can use CC-Link IE Field Basic Communication by connecting main unit.
Peripheral equipment	Current sensor	EMU-CT50 EMU-CT50-A	50A split type
		EMU-CT100 EMU-CT100-A	100A split type
		EMU-CT250 EMU-CT250-A	250A split type
		EMU-CT400 EMU-CT400-A	400A split type
		EMU-CT600 EMU-CT600-A	600A split type
		EMU-CT5-A	5A split type
		EMU2-CT5	5A split type (1P2W, 1P3W, 3P3W)
	Split type 5A current sensor cable	EMU2-CT5-4W	5A split type (3P4W)
		EMU2-CB-Q5A	Connect to current input terminal for 1P2W, 1P3W, 3P3W.
		EMU2-CB-Q5A-4W	Connect to current input terminal for 3P4W.
		EMU2-CB-T1M	Extension cable (Standard type) 1m
		EMU2-CB-T5M	Extension cable (Standard type) 5m
		EMU2-CB-T10M	Extension cable (Standard type) 10m
		EMU2-CB-T20M	Extension cable (Standard type) 20m
		EMU2-CB-T1MS	Extension cable (Separate type) 1m
EMU2-CB-T5MS	Extension cable (Separate type) 5m		
EMU2-CB-T10MS	Extension cable (Separate type) 10m		

Specifications of option devices

- Split type current sensor

Item	Specifications				
Model	EMU-CT50	EMU-CT100	EMU-CT250	EMU-CT400	EMU-CT600
Rated primary current	50AAC	100AAC	250AAC	400AAC	600AAC
Rated secondary current	16.66mA	33.33mA	66.66mA	66.66mA	66.66mA
Rated load	0.1VA				
Maximum operating voltage	460V AC				
Relative error	±1% (5 - 100% range of rating, RL ≤ 10 Ω)				
Variability of phase difference	±30° (5 - 100% range of rating, RL ≤ 10 Ω)				
Over voltage category	III				
Pollution degree	2				
Operating temperature	-5 - +55°C (Daily average temperature is 35°C or lower)				
Operating humidity	5 - 95%RH (No condensation)				
Standard for CE marking	EN61010-2-32				
Maximum operating voltage for compliance with CE marking	460V AC				
Mass (per device)	0.1kg			0.7kg	

*Use an electric wire of the size of penetrating this current sensor for a primary side cable, do not use a non-insulation electric wire or a metal for a primary cable.

*EMU-CT400 and EMU-CT600 are stopped.

Item	Specifications				
Model	EMU-CT50-A	EMU-CT100-A	EMU-CT250-A	EMU-CT400-A	EMU-CT600-A
Rated primary current	50AAC	100AAC	250AAC	400AAC	600AAC
Rated secondary current	16.66mA	33.33mA	66.66mA	66.66mA	66.66mA
Rated load	0.1VA				
Maximum operating voltage	460V AC				
Relative error	±1% (5 - 100% range of rating, RL ≤ 10Ω)				
Variability of phase difference	±45° (10%-100% of rating, RL ≤ 10Ω) ±60° (5% of rating, RL ≤ 10Ω)		±40° (5%-100% of rating, RL ≤ 10Ω)		
Over voltage category	-			III	
Pollution degree	-			2	
Operating temperature	-5 - +55°C (Daily average temperature is 35°C or lower)				
Operating humidity	30 - 85%RH (No condensation)				
Standard for CE marking	-			EN61010-2-32	
Maximum operating voltage for compliance with CE marking	-			460V AC	
Mass (per device)	0.1kg	0.1kg	0.2kg	0.3kg	0.4kg

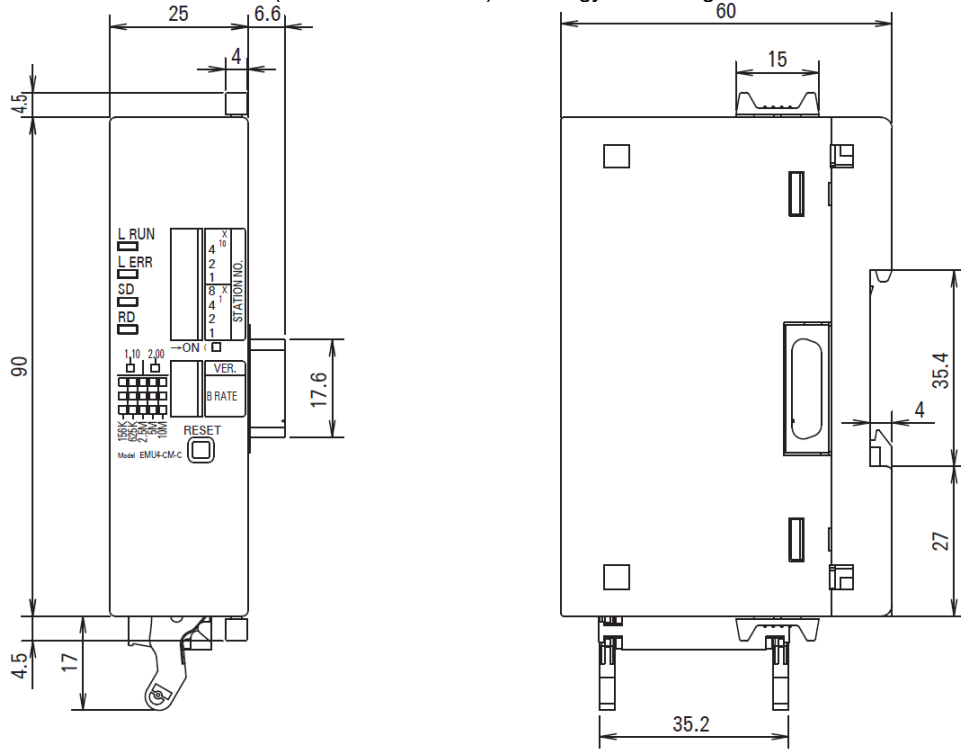
*Use an electric wire of the size of penetrating this current sensor for a primary side cable, do not use a non-insulation electric wire or a metal for a primary cable.

· 5A current sensor

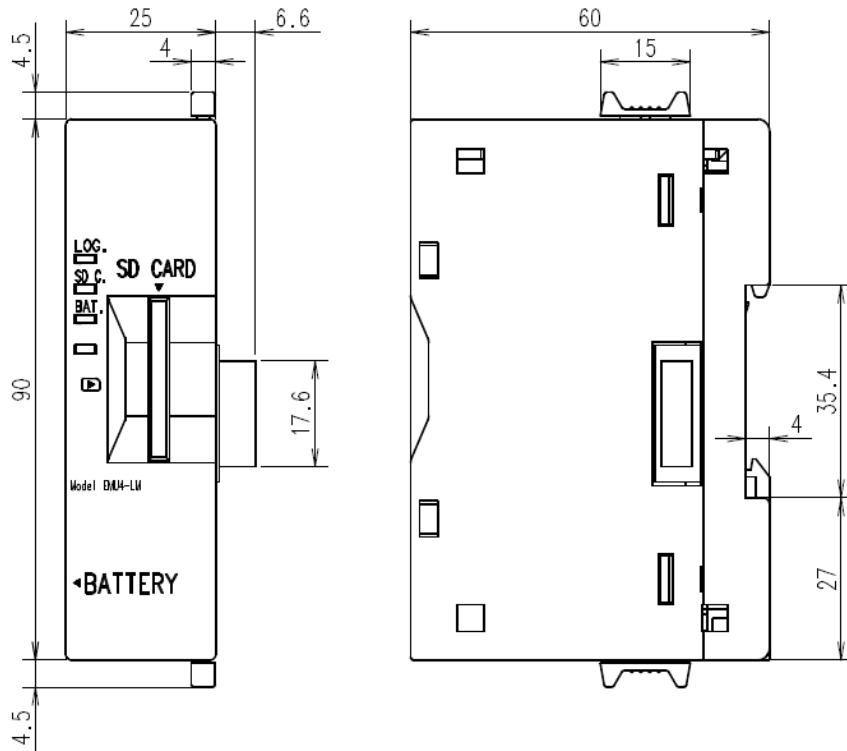
Item	Specifications	
Model	EMU2-CT5, EMU2-CT5-4W	EMU-CT5-A
Rated primary current	5A AC	
Rated secondary current	1.66mA	
Rated load	0.1VA	
Maximum operating voltage	260V AC	460V AC
Relative error	±1% (5 - 100% range of rating)	±1% (5 - 100% range of rating, RL ≤ 10Ω)
Variability of phase difference	±0.5°(5 - 100% range of rating, RL ≤ 10Ω)	±60°(maximum)
Variability of phase difference	±30° (5%-100% of rating, RL ≤ 10Ω)	±45° (10%-100% of rating, RL ≤ 200Ω) ±60° (5% of rating, RL ≤ 200Ω)
Over voltage category	III	-
Pollution degree	2	-
Operating temperature	-5 - +55°C (Daily average temperature is 35°C or lower)	-5 - +55°C (Daily average temperature is 35°C or lower)
Operating humidity	5 - 95%RH (No condensation)	30 - 85%RH (No condensation)
Standard for CE marking	EN61010-2-32	-
Maximum operating voltage for compliance with CE marking	260V AC	-
Mass (per device)	0.1kg	0.1kg

*Use an electric wire of the size of penetrating this current sensor for a primary side cable, do not use a non-insulation electric wire or a metal for a primary cable.

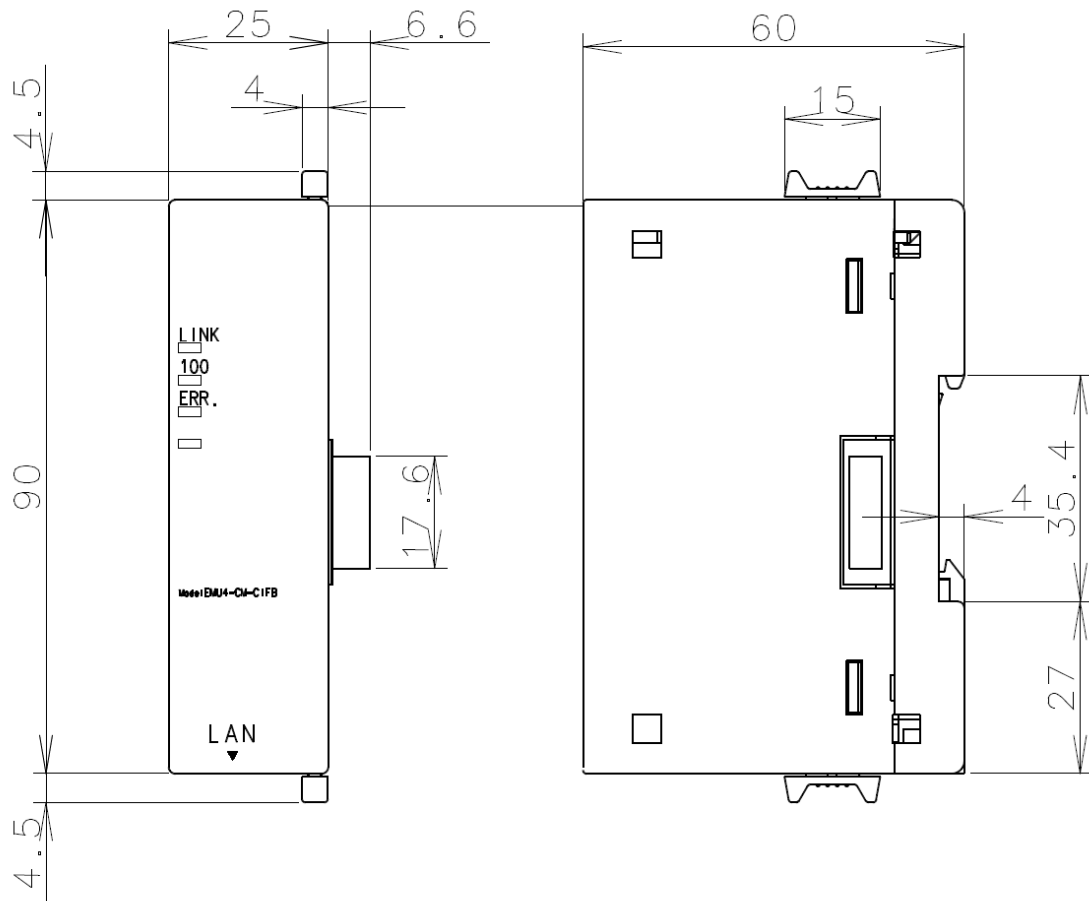
■ CC-Link Communication unit(Model: EMU4-CM-C) for Energy Measuring Unit



■ Logging Unit(Model: EMU4-LM) for Energy Measuring Unit



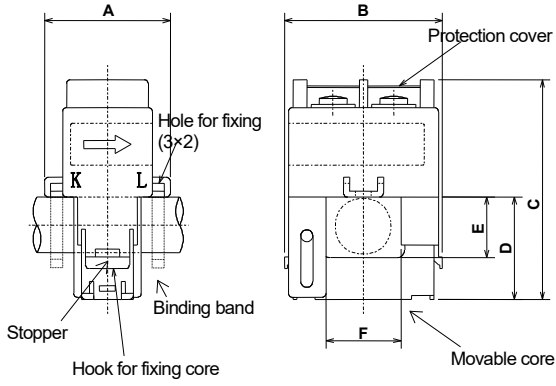
■ CC-Link IE Field Basic Communication unit(Model: EMU4-CM-CIFB) for Energy Measuring Unit



■ Current sensor

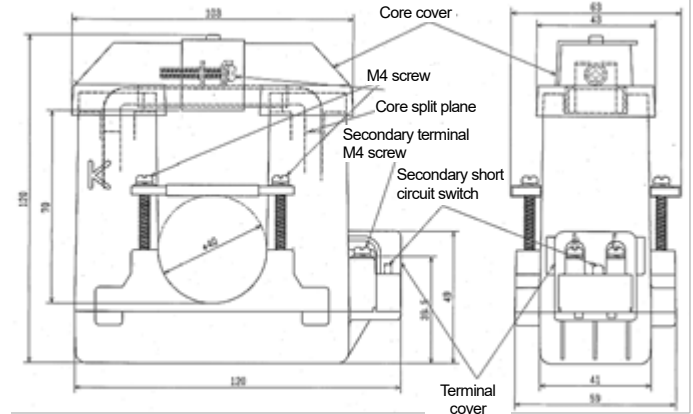
- Split type current sensor EMU-CT50, EMU-CT100, EMU-CT250

- Split type current sensor EMU-CT400, EMU-CT600



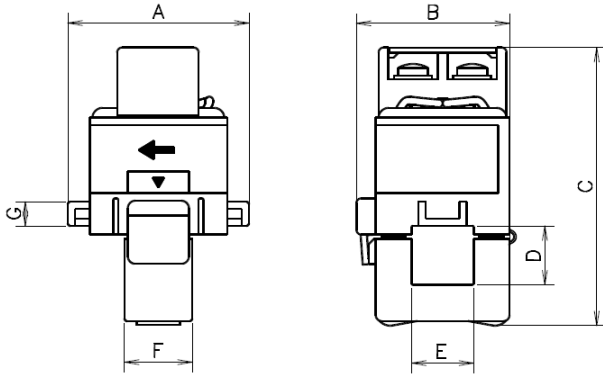
Model	A	B	C	D	E	F
EMU-CT50/CT100	31.5	39.6	55.2	25.7	15.2	18.8
EMU-CT250	36.5	44.8	66.0	32.5	22.0	24.0

Unit: mm



Unit: mm

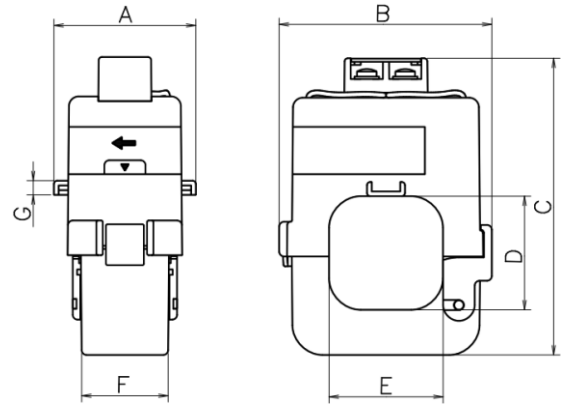
- Split type current sensor (EMU-CT5-A, EMU-CT50-A, EMU-CT100-A)



Model	A	B	C	D	E	F	G
EMU-CT5-A /CT50-A	37.4	31.6	57.5	12.2	12.8	14	5
EMU-CT100-A	43.6	33.6	65	16.2	16.2	19	5

Unit: mm

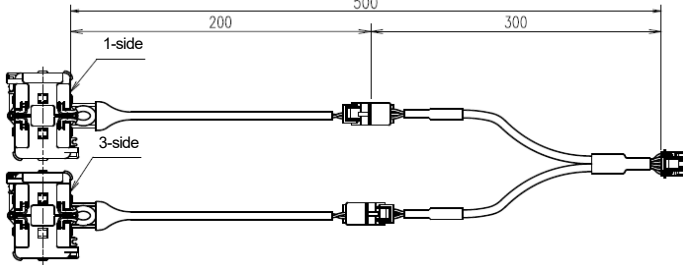
- Split type current sensor EMU-CT250-A, EMU-CT400-A, EMU-CT600-A



Model	A	B	C	D	E	F	G
EMU-CT250-A	42.6	49.4	74.5	24	24	25.2	4.5
EMU-CT400-A /CT600-A	44.9	67.2	94	36	36	27	4.5

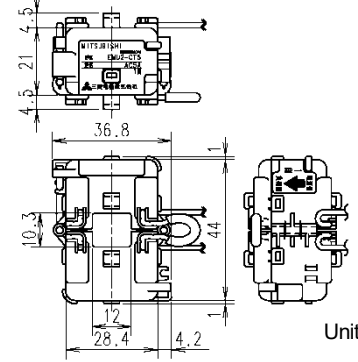
Unit: mm

- Split type 5A current sensor EMU2-CT5



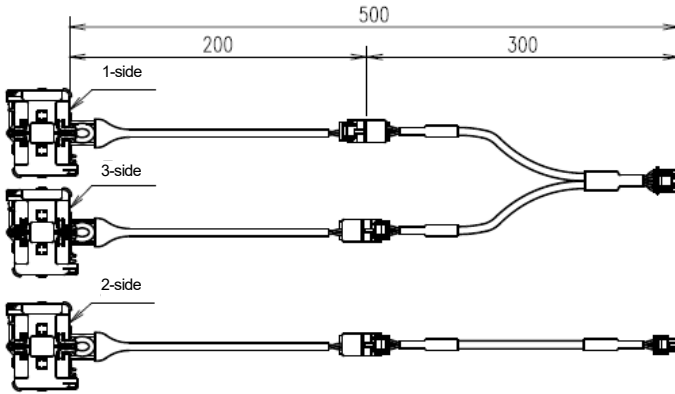
Unit: mm

Details for sensor part



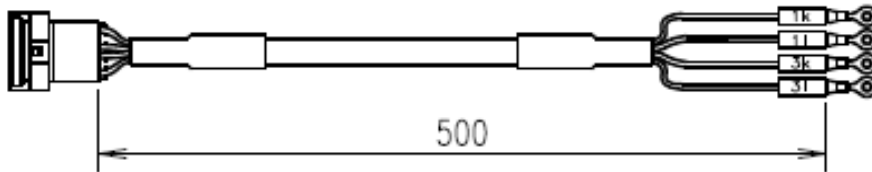
Unit: mm

- Split type 5A current sensor EMU2-CT5-4W



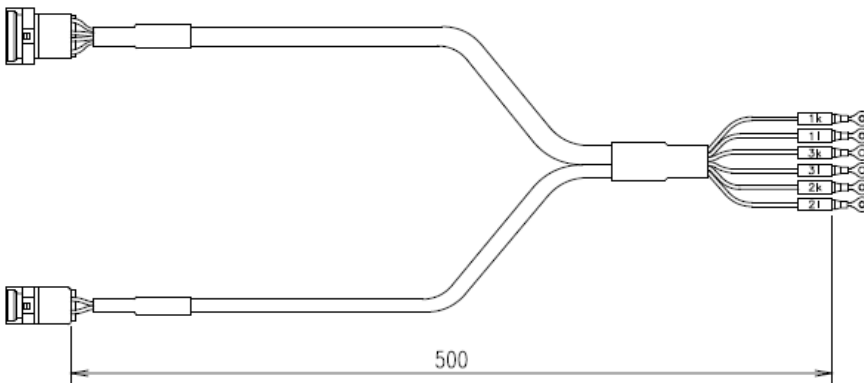
· Current sensor cable

- Split type 5A current sensor cable EMU2-CB-Q5B



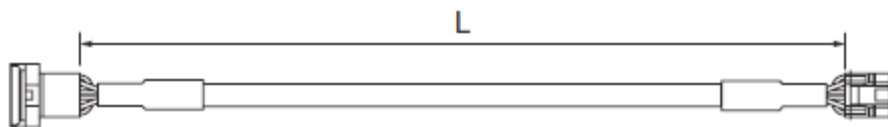
Unit: mm

- Split type 5A current sensor cable EMU2-CB-Q5B-4W



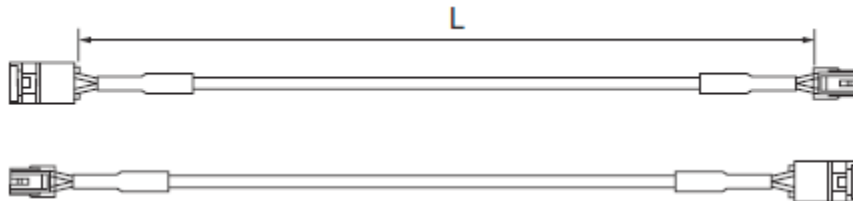
Unit: mm

- Split type 5A current sensor extension cable (standard type) EMU2-CB-T**M



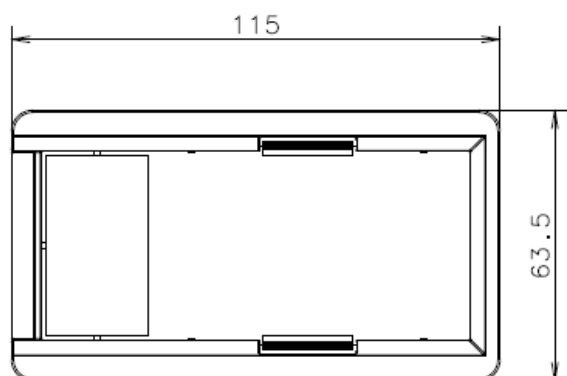
Model	EMU2-CB-T1M	EMU2-CB-T5M	EMU2-CB-T10M
L size	1m	5m	10m

- Split type 5A current sensor extension cable (separate type) EMU2-CB-T**MS



Model	EMU2-CB-T1MS	EMU2-CB-T5MS	EMU2-CB-T10MS
L size	1m	5m	10m

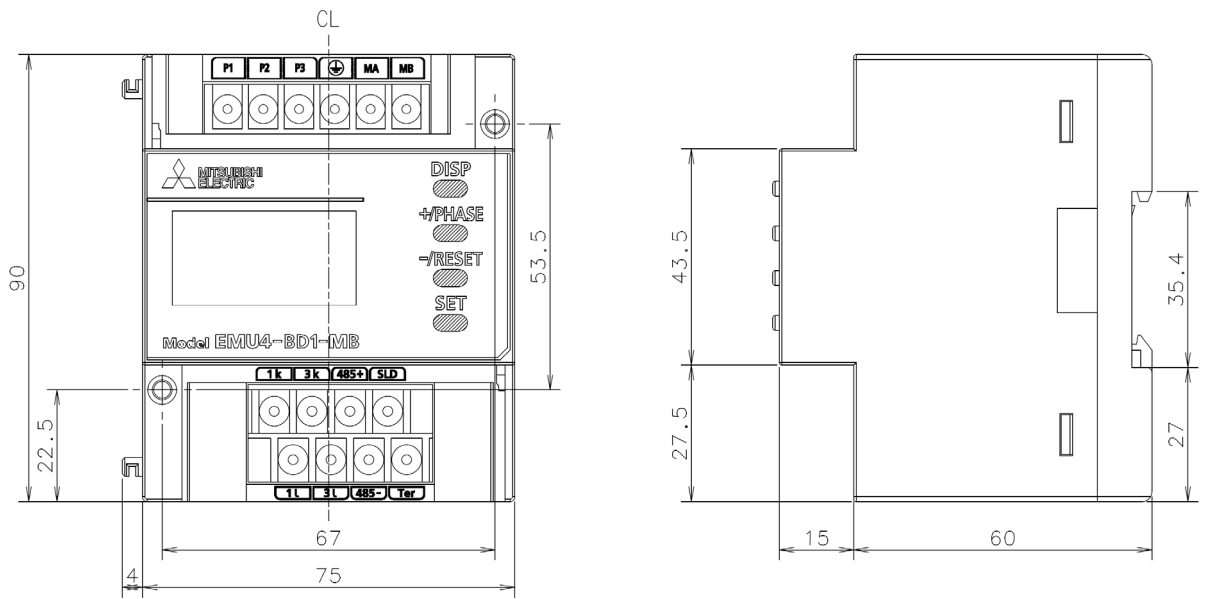
- Part for installation to panel
- Attachment for installation to panel EMU4-PAT



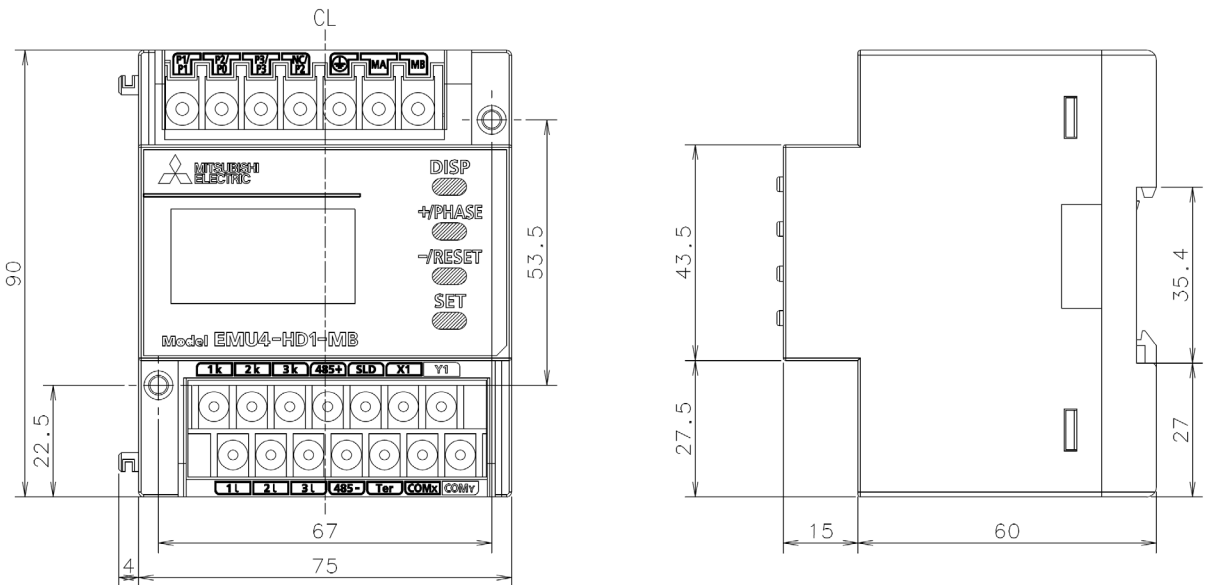
14. External dimensions

Unit: mm

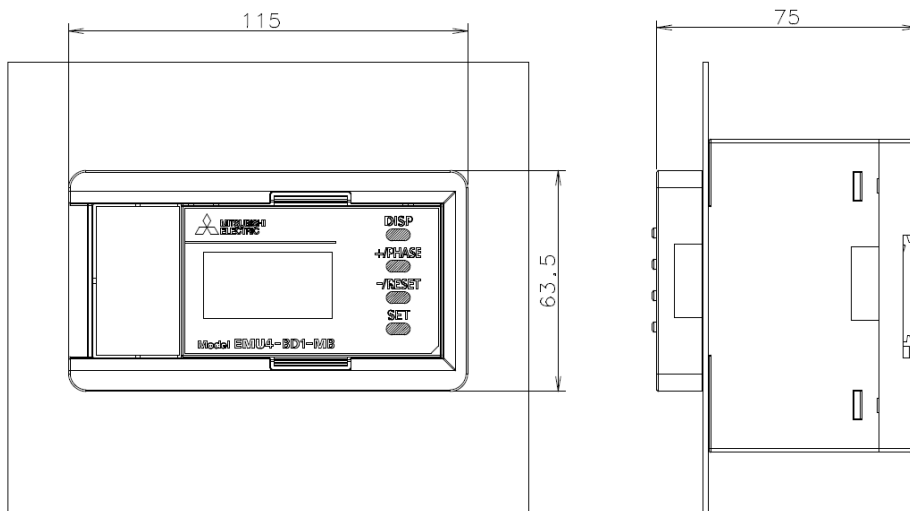
• EMU4-BD1-MB



• EMU4-HD1-MB



• When installing the attachment



15. Index

All data reset.....	56	Operating mode	17
Alarm output test.....	48	Operation procedure.....	49
Attaching and removing the unit.....	8	Option devices	67
Clock setting	32	Precautions for use	3
Communication test.....	47	Preset.....	56
Common specifications	64	Phase wire system.....	20
Customer service	71	Procedures for setting.....	19
Device operation.....	57	Procedure for wiring.....	10
Disclaimer.....	6	Pulse output test	48
Disposal Precautions.....	5	Q&A	61
Date format.....	33	Requirement for the compliance with EMC Directives.....	63
Discrimination support function for improper connection.....	33	Restrictions of measured data	59
Error number	60	Safety precautions	1
External dimensions	70	Setting menu.....	20
Features	1	Setting method.....	18
In case you think the unit is in failure	60	Specifications	64
Initialization	31	Specifications of MODBUS communication	66
Installation and wiring precautions.....	3	Storage precautions.....	5
Maintenance precautions	5	Test mode	34
Measured item indication.....	49	Upper / lower limit alarm.....	28, 54
Measured items.....	57		
MODBUS communication.....	24		
Name and function of each part	6		

16. Appendix

Appendix 1: Discrimination support function for improper connection

■ Display example of discrimination support function for improper connection

Display example (Connection example for three-phase 3-wire) ----- Indicates improper connection

No.	Power factor (Input)	At the average current ($V_{12}=V_{23}, I_1=I_3$)											Wiring	
		Phase angle display				Electric power display		Voltage display			Current display			
		$\angle V_{12}$	$\angle V_{23}$	$\angle I_1$	$\angle I_3$	W_1	W_3	V_{12}	V_{23}	V_{31}	I_1	I_2		I_3
Normal status	Forward 0.707	0	300	345	225	$W_1 > W_3$	$V_{12}=V_{23}=V_{31}$		$I_1=I_2=I_3$					
	Forward 0.866			0	240									
	1			30	270	$W_1 = W_3$								
	Delayed 0.866			60	300	$W_1 < W_3$								
	Delayed 0.707			75	315									
1	Forward 0.707	0	60	165	45	$W_1 = \text{Negative value}$	$V_{12}=V_{23}=V_{31}$		$I_1=I_2=I_3$					
	Forward 0.866			180	60						$W_3 = \text{Positive value}$			
	1			210	90									
	Delayed 0.866			240	120									
	Delayed 0.707			255	135									
2	Forward 0.707	0	120	165	45	$W_1 = \text{Negative value}$	$V_{12}=V_{23} < V_{31}$		$I_1=I_2=I_3$					
	Forward 0.866			180	60						$W_3 = \text{Positive value}$			
	1			210	90									
	Delayed 0.866			240	120									
	Delayed 0.707			255	135									
3	Forward 0.707	0	300	165	225	$W_1 = \text{Negative value}$	$V_{12}=V_{23}=V_{31}$		$I_1=I_3 < I_2$					
	Forward 0.866			180	240						$W_3 = \text{Positive value}$			
	1			210	270									
	Delayed 0.866			240	300									
	Delayed 0.707			255	315									
4	Forward 0.707	0	300	225	345	$W_1 = \text{Negative value}$	$V_{12}=V_{23}=V_{31}$		$I_1=I_2=I_3$					
	Forward 0.866			240	0						$W_3 = \text{Positive value}$			
	1			270	30	$W_1 = W_3 = 0$								
	Delayed 0.866			300	60	$W_3 = \text{Negative value}$								
	Delayed 0.707			315	75									
5	Forward 0.707	0	300	225	105	$W_1 = \text{Negative value}$	$V_{12}=V_{23}=V_{31}$		$I_1=I_2=I_3$					
	Forward 0.866			240	120						$W_3 = \text{Negative value}$			
	1			270	150	$W_1 = 0$								
	Delayed 0.866			300	180	$W_3 = \text{Negative value}$								
	Delayed 0.707			315	195									

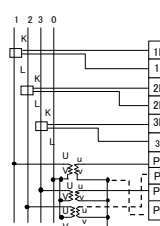
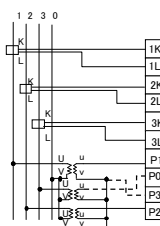
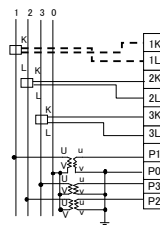
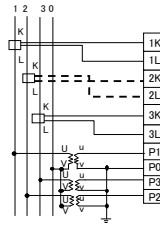
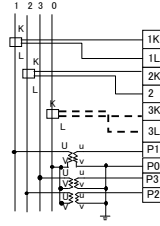
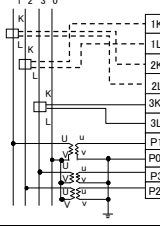
No.	Power factor (Input)	At the average current ($V_{12}=V_{23}, I_1=I_3$)											Connection							
		Phase angle display				Electric power display		Voltage display			Current display			Voltage			Current		Connecting diagram	
		$\angle V_{12}$	$\angle V_{23}$	$\angle I_1$	$\angle I_3$	W_1	W_3	V_{12}	V_{23}	V_{31}	I_1	I_2	I_3	1	2	3	CT(side "1")	CT(side "3")		
Normal status	Forward 0.707	0	180	315	135	$W_1=W_3$	$V_{12}=V_{23}<V_{31}$	$I_1=I_3$	$I_2=0$	P1	P2	P3	1K	1L	3K	3L	Forward	Forward		
	Forward 0.866			330	150															
	1			0	180															0
	Delayed 0.866			30	210															
	Delayed 0.707			45	225															
1	Forward 0.707	0	0	135	315	$W_1 =$ Negative value	$V_{12}=V_{23}<V_{31}$	$I_1=I_3$	$I_2=0$	P2	P1	P3	1K	1L	3K	3L	Forward	Forward		
	Forward 0.866			150	330															$W_3 =$ Positive value
	1			180	0															
	Delayed 0.866			210	30															
	Delayed 0.707			225	45															
2	Forward 0.707	0	0	135	315	$W_1 =$ Negative value	$V_{12}>V_{23}=V_{31}$	$I_1=I_3$	$I_2=0$	P2	P3	P1	1K	1L	3K	3L	Forward	Forward		
	Forward 0.866			150	330															
	1			180	0															
	Delayed 0.866			210	30															
	Delayed 0.707			225	45															
3	Forward 0.707	0	180	315	315	$W_1 =$ Positive value	$V_{12}=V_{23}<V_{31}$	$I_1=I_3<I_2$	P1	P2	P3	1K	1L	3K	3L	Reverse	Reverse			
	Forward 0.866			330	330															
	1			0	0															
	Delayed 0.866			30	30															
	Delayed 0.707			45	45															
4	Forward 0.707	0	180	135	315	$W_1 =$ Negative value	$V_{12}=V_{23}<V_{31}$	$I_1=I_3$	$I_2=0$	P1	P2	P3	3K	3L	1K	1L	Forward	Forward		
	Forward 0.866			150	330															
	1			180	0															
	Delayed 0.866			210	30															
	Delayed 0.707			225	45															
5	Forward 0.707	0	180	135	315	$W_1 =$ Negative value	$V_{12}=V_{23}<V_{31}$	$I_1=I_3$	$I_2=0$	P3	P2	P1	1K	1L	3K	3L	Forward	Forward		
	Forward 0.866			150	330															
	1			180	0															
	Delayed 0.866			210	30															
	Delayed 0.707			225	45															

■ Display example of discrimination support function for improper connection.

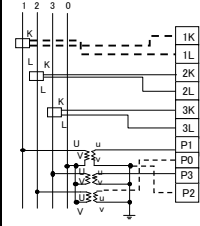
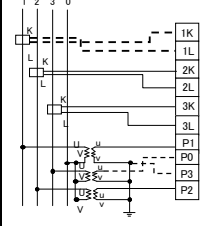
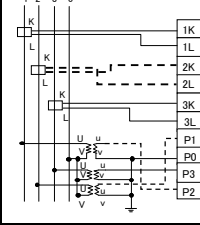
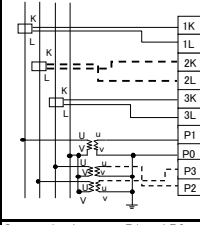
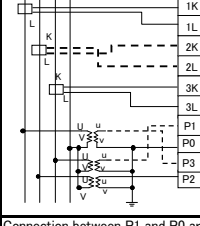
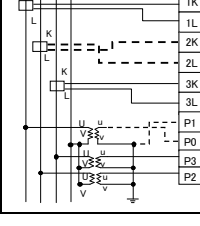
Display example (connection example for three-phase 4-wire)

----- Indicates improper connection

No.	Power factor (input)	Phase angle display						At the average current ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$)									Wiring		
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	Electric power display			Voltage display			Current display					
								W_1	W_2	W_3	V_{1N}	V_{2N}	V_{3N}	I_1	I_2	I_3			
Normal status	Forward 0.707	0	120	240	315	75	195	$W_1=W_2=W_3$			$V_{1N}=V_{2N}=V_{3N}$		$I_1=I_2=I_3$						
	Forward 0.866				330	90	210												
	1				0	120	240										0	120	240
	Delayed 0.866				30	150	270												
	Delayed 0.707				45	165	285												
1	Forward 0.707	0	120	240	315	75	195	$W_1=W_2=W_3$			$V_{1N}=V_{2N}=V_{3N}$		$I_1=I_2=I_3$						
	Forward 0.866				330	90	210												
	1				0	120	240										0	120	240
	Delayed 0.866				30	150	270												
	Delayed 0.707				45	165	285												
2	Forward 0.707	0	240	120	190	315	75	W_1 =Negative value W_2 =Positive value W_3 =Positive value			$V_{1N}=V_{2N}=V_{3N}$		$I_1=I_2=I_3$						
	Forward 0.866				210	330	90	W_1 =Negative value W_2 =0 W_3 =Positive value											
	1				0	240	120	240									0	120	W_1 =Negative value W_2 =Negative value W_3 =Positive value
	Delayed 0.866				270	30	150	W_1 =0 W_2 =Negative value W_3 =Positive value											
	Delayed 0.707				285	45	165	W_1 =Positive value W_2 =Negative value W_3 =Positive value											
3	Forward 0.707	0	240	120	315	75	195	W_1 =Positive value W_2 =Negative value W_3 =Positive value			$V_{1N}=V_{2N}=V_{3N}$		$I_1=I_2=I_3$						
	Forward 0.866				330	90	210	W_1 =Positive value W_2 =Negative value W_3 =0											
	1				0	240	120	0									120	240	W_1 =Positive value W_2 =Negative value W_3 =Negative value
	Delayed 0.866				30	150	270	W_1 =Positive value W_2 =0 W_3 =Negative value											
	Delayed 0.707				45	165	285	W_1 =Positive value W_2 =Positive value W_3 =Negative value											
4	Forward 0.707	0	240	120	75	195	315	W_1 =Positive value W_2 =Positive value W_3 =Negative value			$V_{1N}=V_{2N}=V_{3N}$		$I_1=I_2=I_3$						
	Forward 0.866				90	210	330	W_1 =0 W_2 =Positive value W_3 =Negative value											
	1				0	240	120	120									240	0	W_1 =Negative value W_2 =Positive value W_3 =Negative value
	Delayed 0.866				150	270	30	W_1 =Negative value W_2 =Positive value W_3 =0											
	Delayed 0.707				165	285	45	W_1 =Negative value W_2 =Positive value W_3 =Positive value											
5	Forward 0.707	0	330	30	135	255	15	W_1 =Negative value W_2 =Positive value W_3 =Positive value			$V_{1N}<V_{2N}=V_{3N}$		$I_1=I_2=I_3$						
	Forward 0.866				150	270	30												
	1				0	330	30										180	300	60
	Delayed 0.866				210	330	90												
	Delayed 0.707				225	345	105												

No.	Power factor (input)	Phase angle display						At the average current (V1N=V2N=V3N, I1=I2=I3)									Wiring
								Electric power display			Voltage display			Current display			
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W1	W2	W3	V1N	V2N	V3N	I1	I2	I3	
6	Forward 0.707	0	330	300	345	105	225	W1=Positive value W2=Negative value W3=Positive value	V1N=V3N>V2N	I1=I2=I3	<p>Connection between P2 and P0 are reserved.</p> 						
	Forward 0.866				0	120	240										
	1				30	150	270										
	Delayed 0.866				60	180	300										
	Delayed 0.707				75	195	315										
7	Forward 0.707	0	60	30	285	45	165	W1=Positive value W2=Positive value W3=Negative value	V1N=V2N>V3N	I1=I2=I3	<p>Connection between P3 and P0 are reserved.</p> 						
	Forward 0.866				300	60	180										
	1				330	90	210										
	Delayed 0.866				0	120	240										
	Delayed 0.707				15	135	255										
8	Forward 0.707	0	120	240	135	75	195	W1=Negative value W2=Positive value W3=Positive value	V1N=V2N=V3N	I1=I2=I3	<p>Connection of CT on side "1" is reserved.</p> 						
	Forward 0.866				150	90	210										
	1				180	120	240										
	Delayed 0.866				210	150	270										
	Delayed 0.707				225	165	285										
9	Forward 0.707	0	120	240	315	255	195	W1=Positive value W2=Negative value W3=Positive value	V1N=V2N=V3N	I1=I2=I3	<p>Connection of CT on side "2" is reserved.</p> 						
	Forward 0.866				330	270	210										
	1				0	300	240										
	Delayed 0.866				30	330	270										
	Delayed 0.707				45	345	285										
10	Forward 0.707	0	120	240	315	75	15	W1=Positive value W2=Positive value W3=Negative value	V1N=V2N=V3N	I1=I2=I3	<p>Connection of CT on side "3" is reserved.</p> 						
	Forward 0.866				330	90	30										
	1				0	120	60										
	Delayed 0.866				30	150	90										
	Delayed 0.707				45	165	105										
11	Forward 0.707	0	120	240	75	315	195	W1=Positive value W2=Negative value W3=Positive value	V1N=V2N=V3N	I1=I2=I3	<p>CT side "1" and "2" are swapped.</p> 						
	Forward 0.866				90	330	210					W1=0 W2=Negative value W3=Positive value					
	1				120	0	240					W1=Negative value W2=Negative value W3=Positive value					
	Delayed 0.866				150	30	270					W1=Negative value W2=0 W3=Positive value					
	Delayed 0.707				165	45	285					W1=Negative value W2=Positive value W3=Positive value					

No.	Power factor (input)	Phase angle display						At the average current ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$)									Wiring
		Electric power display			Voltage display			Current display									
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W_1	W_2	W_3	V_{1N}	V_{2N}	V_{3N}	I_1	I_2	I_3	
12	Forward 0.707	0	120	240	315	195	75	W_1 =Positive value W_2 =Positive value W_3 =Negative value	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	CT side "2" and "3" are swapped.						
	Forward 0.866				330	210	90	W_1 =Positive value W_2 =0 W_3 =Negative value									
	1				0	240	120	W_1 =Positive value W_2 =Negative value W_3 =Negative value									
	Delayed 0.866				30	270	150	W_1 =Positive value W_2 =Negative value W_3 =0									
	Delayed 0.707				45	285	165	W_1 =Positive value W_2 =Negative value W_3 =Positive value									
13	Forward 0.707	0	120	240	195	75	315	W_1 =Negative value W_2 =Positive value W_3 =Positive value	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	CT side "1" and "3" are swapped.						
	Forward 0.866				210	90	330	W_1 =Negative value W_2 =Positive value W_3 =0									
	1				240	120	0	W_1 =Negative value W_2 =Positive value W_3 =Negative value									
	Delayed 0.866				270	150	30	W_1 =0 W_2 =Positive value W_3 =Negative value									
	Delayed 0.707				285	165	45	W_1 =Positive value W_2 =Positive value W_3 =Negative value									
14	Forward 0.707	0	240	120	15	315	75	W_1 =Positive value W_2 =Positive value W_3 =Positive value	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	Connection between P1 and P2 are reserved. And connection of CT on side "1" is reserved.						
	Forward 0.866				30	330	90	W_1 =Positive value W_2 =0 W_3 =Positive value									
	1				60	0	120	W_1 =Positive value W_2 =Negative value W_3 =Positive value									
	Delayed 0.866				90	30	150	W_1 =0 W_2 =Negative value W_3 =Positive value									
	Delayed 0.707				105	45	165	W_1 =Negative value W_2 =Negative value W_3 =Positive value									
15	Forward 0.707	0	240	120	135	75	195	W_1 =Negative value W_2 =Negative value W_3 =Positive value	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	Connection between P2 and P3 are reserved. And connection of CT on side "1" is reserved.						
	Forward 0.866				150	90	210	W_1 =Negative value W_2 =Negative value W_3 =0									
	1				180	120	240	W_1 =Negative value W_2 =Negative value W_3 =Negative value									
	Delayed 0.866				210	150	270	W_1 =Negative value W_2 =0 W_3 =Negative value									
	Delayed 0.707				225	165	285	W_1 =Negative value W_2 =Positive value W_3 =Negative value									
16	Forward 0.707	0	240	120	255	195	315	W_1 =Negative value W_2 =Positive value W_3 =Negative value	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	Connection between P1 and P3 are reserved. And connection of CT on side "1" is reserved.						
	Forward 0.866				270	210	330	W_1 =0 W_2 =Positive value W_3 =Negative value									
	1				300	240	0	W_1 =Positive value W_2 =Positive value W_3 =Negative value									
	Delayed 0.866				330	270	30	W_1 =Positive value W_2 =Positive value W_3 =0									
	Delayed 0.707				345	285	45	W_1 =Positive value W_2 =Positive value W_3 =Positive value									
17	Forward 0.707	0	330	30	315	255	15	W_1 =Positive value W_2 =Positive value W_3 =Positive value	$V_{1N} < V_{2N}=V_{3N}$	$I_1=I_2=I_3$	Connection between P1 and P0 are reserved. And connection of CT on side "1" is reserved.						
	Forward 0.866				330	270	30										
	1				0	300	60										
	Delayed 0.866				30	330	90										
	Delayed 0.707				45	345	105										

No.	Power factor (input)	Phase angle display						At the average current (V1N=V2N=V3N, I1=I2=I3)									Wiring
					Electric power display			Voltage display			Current display						
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W ₁	W ₂	W ₃	V _{1N}	V _{2N}	V _{3N}	I ₁	I ₂	I ₃	
18	Forward 0.707	0	330	300	165	105	225	W ₁ =Negative value W ₂ =Negative value W ₃ =Positive value	V _{1N} =V _{3N} >V _{2N}	I ₁ =I ₂ =I ₃	<p>Connection between P2 and P0 are reserved. And connection of CT on side "1" is reserved.</p> 						
	Forward 0.866				180	120	240										
	1				210	150	270										
	Delayed 0.866				240	180	300										
	Delayed 0.707				255	195	315										
19	Forward 0.707	0	60	30	105	45	165	W ₁ =Negative value W ₂ =Positive value W ₃ =Negative value	V _{1N} =V _{2N} >V _{3N}	I ₁ =I ₂ =I ₃	<p>Connection between P3 and P0 are reserved. And connection of CT on side "1" is reserved.</p> 						
	Forward 0.866				120	60	180										
	1				150	90	210										
	Delayed 0.866				180	120	240										
	Delayed 0.707				195	135	255										
20	Forward 0.707	0	240	120	195	135	75	W ₁ =Negative value W ₂ =Negative value W ₃ =Positive value	V _{1N} =V _{2N} =V _{3N}	I ₁ =I ₂ =I ₃	<p>Connection between P1 and P2 are reserved. And connection of CT on side "2" is reserved.</p> 						
	Forward 0.866				210	150	90										
	1				240	180	120										
	Delayed 0.866				270	210	150										
	Delayed 0.707				285	225	165										
21	Forward 0.707	0	240	120	315	255	195	W ₁ =Positive value W ₂ =Positive value W ₃ =Positive value	V _{1N} =V _{2N} =V _{3N}	I ₁ =I ₂ =I ₃	<p>Connection between P2 and P3 are reserved. And connection of CT on side "2" is reserved.</p> 						
	Forward 0.866				330	270	210										
	1				0	300	240										
	Delayed 0.866				30	330	270										
	Delayed 0.707				45	345	285										
22	Forward 0.707	0	240	120	75	15	315	W ₁ =Positive value W ₂ =Negative value W ₃ =Negative value	V _{1N} =V _{2N} =V _{3N}	I ₁ =I ₂ =I ₃	<p>Connection between P1 and P3 are reserved. And connection of CT on side "2" is reserved.</p> 						
	Forward 0.866				90	30	330										
	1				120	60	0										
	Delayed 0.866				150	90	30										
	Delayed 0.707				165	105	45										
23	Forward 0.707	0	330	30	135	75	15	W ₁ =Negative value W ₂ =Negative value W ₃ =Positive value	V _{1N} <V _{2N} =V _{3N}	I ₁ =I ₂ =I ₃	<p>Connection between P1 and P0 are reserved. And connection of CT on side "2" is reserved.</p> 						
	Forward 0.866				150	90	30										
	1				180	120	60										
	Delayed 0.866				210	150	90										
	Delayed 0.707				225	165	105										

No.	Power factor (input)	Phase angle display						At the average current (V1N=V2N=V3N, I1=I2=I3)									Wiring
								Electric power display			Voltage display			Current display			
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W1	W2	W3	V1N	V2N	V3N	I1	I2	I3	
24	Forward 0.707	0	330	300	345	285	225	W1=Positive value W2=Positive value W3=Positive value	V1N=V3N > V2N	I1=I2=I3	<p>Connection between P2 and P0 are reserved. And connection of CT on side "2" is reserved.</p>						
	Forward 0.866				0	300	240										
	1				30	330	270										
	Delayed 0.866				60	0	300										
	Delayed 0.707				75	15	315										
25	Forward 0.707	0	60	30	285	225	165	W1=Positive value W2=Negative value W3=Negative value	V1N=V2N > V3N	I1=I2=I3	<p>Connection between P3 and P0 are reserved. And connection of CT on side "2" is reserved.</p>						
	Forward 0.866				300	240	180										
	1				330	270	210										
	Delayed 0.866				0	300	240										
	Delayed 0.707				15	315	255										
26	Forward 0.707	0	240	120	195	315	255	W1=Negative value W2=Positive value W3=Negative value	V1N=V2N=V3N	I1=I2=I3	<p>Connection between P1 and P2 are reserved. And connection of CT on side "3" is reserved.</p>						
	Forward 0.866				210	330	270										
	1				240	0	300										
	Delayed 0.866				270	30	330										
	Delayed 0.707				285	45	345										
27	Forward 0.707	0	240	120	315	75	15	W1=Positive value W2=Negative value W3=Negative value	V1N=V2N=V3N	I1=I2=I3	<p>Connection between P2 and P3 are reserved. And connection of CT on side "3" is reserved.</p>						
	Forward 0.866				330	90	30										
	1				0	120	60										
	Delayed 0.866				30	150	90										
	Delayed 0.707				45	165	105										
28	Forward 0.707	0	240	120	75	195	135	W1=Positive value W2=Positive value W3=Positive value	V1N=V2N=V3N	I1=I2=I3	<p>Connection between P1 and P3 are reserved. And connection of CT on side "3" is reserved.</p>						
	Forward 0.866				90	210	150										
	1				120	240	180										
	Delayed 0.866				150	270	210										
	Delayed 0.707				165	285	225										
29	Forward 0.707	0	330	30	135	255	195	W1=Negative value W2=Positive value W3=Negative value	V1N < V2N=V3N	I1=I2=I3	<p>Connection between P1 and P0 are reserved. And connection of CT on side "3" is reserved.</p>						
	Forward 0.866				150	270	210										
	1				180	300	240										
	Delayed 0.866				210	330	270										
	Delayed 0.707				225	345	285										

No.	Power factor (input)	Phase angle display						At the average current ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$)									Wiring
		Electric power display			Voltage display			Current display									
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W_1	W_2	W_3	V_{1N}	V_{2N}	V_{3N}	I_1	I_2	I_3	
30	Forward 0.707	0	330	300	345	105	45	W_1 =Positive value W_2 =Negative value W_3 =Negative value	$V_{1N}=V_{2N}>V_{2N}$	$I_1=I_2=I_3$	<p>Connection between P2 and P0 are reserved. And connection of CT on side "3" is reserved.</p>						
	Forward 0.866				0	120	60										
	1				30	150	90										
	Delayed 0.866				60	180	120										
	Delayed 0.707				75	195	135										
31	Forward 0.707	0	60	30	285	45	345	W_1 =Positive value W_2 =Positive value W_3 =Positive value	$V_{1N}=V_{2N}>V_{3N}$	$I_1=I_2=I_3$	<p>Connection between P3 and P0 are reserved. And connection of CT on side "3" is reserved.</p>						
	Forward 0.866				300	60	0										
	1				330	90	30										
	Delayed 0.866				0	120	60										
	Delayed 0.707				15	135	75										
32	Forward 0.707	0	240	120	315	195	75	$W_1=W_2=W_3$	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	<p>Connection between P1 and P2 are reserved. And CT side "1" and "2" are swapped.</p>						
	Forward 0.866				330	210	90										
	1				0	240	120										
	Delayed 0.866				30	270	150										
	Delayed 0.707				45	285	165										
33	Forward 0.707	0	240	120	75	315	195	$W_1=W_2=W_3$	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	<p>Connection between P2 and P3 are reserved. And CT side "1" and "2" are swapped.</p>						
	Forward 0.866				90	330	210										
	1				120	0	240										
	Delayed 0.866				150	30	270										
	Delayed 0.707				165	45	285										
34	Forward 0.707	0	240	120	195	75	315	$W_1=W_2=W_3$	$V_{1N}=V_{2N}=V_{3N}$	$I_1=I_2=I_3$	<p>Connection between P1 and P3 are reserved. And CT side "1" and "2" are swapped.</p>						
	Forward 0.866				210	90	330										
	1				240	120	0										
	Delayed 0.866				270	150	30										
	Delayed 0.707				285	165	45										
35	Forward 0.707	0	330	30	255	135	15	W_1 =Negative value W_2 =Negative value W_3 =Positive value	$V_{1N}<V_{2N}=V_{3N}$	$I_1=I_2=I_3$	<p>Connection between P1 and P0 are reserved. And CT side "1" and "2" are swapped.</p>						
	Forward 0.866				270	150	30										
	1				300	180	60										
	Delayed 0.866				330	210	90										
	Delayed 0.707				345	225	105										

No.	Power factor (input)	Phase angle display						At the average current (V1N=V2N=V3N, I1=I2=I3)									Wiring
								Electric power display			Voltage display			Current display			
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W1	W2	W3	V1N	V2N	V3N	I1	I2	I3	
36	Forward 0.707	0	330	300	105	345	225	W1=Negative value W2=Positive value W3=Positive value	V1N=V3N > V2N	I1=I2=I3	<p>Connection between P2 and P0 are reserved. And CT side "1" and "2" are swapped.</p>						
	Forward 0.866				120	0	240										
	1				150	30	270										
	Delayed 0.866				180	60	300										
	Delayed 0.707				195	75	315										
37	Forward 0.707	0	60	30	45	285	165	W1=Positive value W2=Negative value W3=Negative value	V1N=V2N > V3N	I1=I2=I3	<p>Connection between P3 and P0 are reserved. And CT side "1" and "2" are swapped.</p>						
	Forward 0.866				60	300	180										
	1				90	330	210										
	Delayed 0.866				120	0	240										
	Delayed 0.707				135	15	255										
38	Forward 0.707	0	330	30	135	15	255	W1=Negative value W2=Positive value W3=Negative value	V1N < V2N = V3N	I1=I2=I3	<p>Connection between P1 and P0 are reserved. And CT side "2" and "3" are swapped.</p>						
	Forward 0.866				150	30	270										
	1				180	60	300										
	Delayed 0.866				210	90	330										
	Delayed 0.707				225	105	345										
39	Forward 0.707	0	330	300	345	225	105	W1=Positive value W2=Negative value W3=Negative value	V1N=V3N > V2N	I1=I2=I3	<p>Connection between P2 and P0 are reserved. And CT side "2" and "3" are swapped.</p>						
	Forward 0.866				0	240	120										
	1				30	270	150										
	Delayed 0.866				60	300	180										
	Delayed 0.707				75	315	195										
40	Forward 0.707	0	60	30	285	165	45	W1=Positive value W2=Negative value W3=Positive value	V1N=V2N > V3N	I1=I2=I3	<p>Connection between P3 and P0 are reserved. And CT side "2" and "3" are swapped.</p>						
	Forward 0.866				300	180	60										
	1				330	210	90										
	Delayed 0.866				0	240	120										
	Delayed 0.707				15	255	135										
41	Forward 0.707	0	330	30	15	255	135	W1=Positive value W2=Positive value W3=Negative value	V1N < V2N = V3N	I1=I2=I3	<p>Connection between P1 and P0 are reserved. And CT side "1" and "3" are swapped.</p>						
	Forward 0.866				30	270	150										
	1				60	300	180										
	Delayed 0.866				90	330	210										
	Delayed 0.707				105	345	225										

Display example (connection example for three-phase 4-wire)

----- Indicates improper connection

No.	Power factor (input)	Phase angle display						At the average current ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$)									Wiring
					Electric power display			Voltage display			Current display						
		$\angle V_{1N}$	$\angle V_{2N}$	$\angle V_{3N}$	$\angle I_1$	$\angle I_2$	$\angle I_3$	W_1	W_2	W_3	V_{1N}	V_{2N}	V_{3N}	I_1	I_2	I_3	
42	Forward 0.707	0	330	300	225	105	345	W_1 =Negative value W_2 =Negative value W_3 =Positive value $W_1=0$ W_2 =Negative value $W_3=0$	$V_{1N}=V_{3N}>V_{2N}$	$I_1=I_2=I_3$	<p>Connection between P2 and P0 are reserved. And CT side "1" and "3" are swapped.</p>						
	Forward 0.866				240	120	0										
	1				270	150	30										
	Delayed 0.866				300	180	60										
	Delayed 0.707				315	195	75										
42	Forward 0.707	0	60	30	165	45	285	W_1 =Negative value W_2 =Positive value W_3 =Negative value W_1 =Negative value W_2 =Positive value $W_3=0$	$V_{1N}=V_{3N}>V_{2N}$	$I_1=I_2=I_3$	<p>Connection between P3 and P0 are reserved. And CT side "1" and "3" are swapped.</p>						
	Forward 0.866				180	60	300										
	1				210	90	330										
	Delayed 0.866				240	120	0										
	Delayed 0.707				255	135	15										

Energy Measuring Unit

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
Algeria	Mec Casa	Rue i N 125 Hay-Es-Salem, 02000, W-Chief, Algeria	+213-27798069
Bangladesh	PROGRESSIVE TRADING CORPORATION	HAQUE TOWER,2ND FLOOR,610/11,JUBILEE ROAD, CHITTAGONG, BANGLADESH	+880-31-624307
	ELECTRO MECH AUTOMATION& ENGINEERING LTD.	SHATABDI CENTER, 12TH FLOOR, SUITES: 12-B, 292, INNER CIRCULAR ROAD, FAKIRA POOL, MOTIJHEEL, DHAKA-1000, BANGLADESH	+88-02-7192826
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
Brazil	Mitsubishi Electric do Brasil Comércio e Serviços Ltda.	Avenida Adelino Cardana, 293 – 21º Andar, Bethaville, Barueri, SP, Brasil, CEP 06401-147	+55-11-4689-3000
Cambodia	DHINIMEX CO.,LTD	#245, St. Tep Phan, Phnom Penh, Cambodia	+855-23-997-725
Central America	Automation International LLC	7050 W. Palmetto Park Road Suite #15 PMB #555, Boca Raton, FL 33433	+1-561-237-5228
Chile	Rhona S.A. (Main office)	Vte. Agua Santa 4211 Casilla 30-D (P.O. Box) Vina del Mar, Chile	+56-32-2-320-600
China	Mitsubishi Electric Automation (China) Ltd.	Mitsubishi Electric Automation Building, No.1386 Hongqiao Road, Shanghai, China 200336	+86-21-2322-3030
	Mitsubishi Electric Automation (China) Ltd. Beijing	5/F, ONE INDIGO,20 Jiuxianqiao Road Chaoyang District,Beijing, China 100016	+86-10-6518-8830
	Mitsubishi Electric Automation (China) Ltd. ShenZhen	Level 8, Galaxy World Tower B, 1 Yabao Road, Longgang District, Shenzhen, China 518129	+86-755-2399-8272
	Mitsubishi Electric Automation (China) Ltd. GuangZhou	Rm.1006, A1 Times E-Park, No.276-282, Hanxi Road East, Zhongcun Street, Panyu Distric, Guangzhou, China 510030	+86-20-8923-6730
	Mitsubishi Electric Automation (China) Ltd. ChengDu	1501-1503,15F, Guang-hua Centre Building-C, No.98 North Guang Hua 3th Rd Chengdu, China 610000	+86-28-8446-8030
	Mitsubishi Electric Automation (Hong Kong) Ltd.	20/F., Cityplaza One, 1111 king's Road, Taikoo shing, Hong Kong	+852-2510-0555
Colombia	Proelectrico Representaciones S.A.	Carrera 42 Nº 75 – 367 Bodega 109, Itagüí, Medellín, Antioquia, Colombia	+57-4-4441284
Czech Republic	AUTOCONT CONTROL SYSTEMS S.R.O	Technologická 374/6, CZ-708 00 Ostrava - Pustkovec	+420 595 691 150
Denmark	BEIJER ELECTRONICS A/S	LYKKEGÅRDSVEJ 17, DK-4000 ROSKILDE, Denmark	+45 (0)46 75 76 66
Egypt	Cairo Electrical Group	9, Rostoum St. Garden City P.O. Box 165-11516 Maglis El-Shaab,Cairo - Egypt	+20-2-27961337
France	Mitsubishi Electric Europe B.V. French Branch	FR-92741 Nanterre Cedex	+33 (0)1 55 68 57 01
Germany	Mitsubishi Electric Europe B.V.	Mitsubishi-Electric-Platz 1, 40882 Ratingen, Germany	+49 (0) 2102 4860
Greece	KALAMARAKIS - SAPOUNAS S.A.	IONIAS & NEROMILOU STR., CHAMOMILOU ACHARNES, ATHENS, 13678 Greece	+30-2102 406000
	UTECO	5, MAVROGENOUS STR., 18542 PIRAEUS, Greece	+30-211-1206-900
Hungary	Meltrade Ltd.	Fertő utca 14, HU-1107 Budapest, Hungary	+36 (0)1-431-9726
India	Mitsubishi Electric India Private Limited	2nd Floor, Tower A&B, Cyber Greens, DLF Cyber City, DLF Phase-III, Gurgaon - 122 022 Haryana, India	+91-124-4630300
	Mitsubishi Electric India Private Limited Pune Sales Office	ICC-Devi Gaurav Technology Park, Unit no. 402, Fourth Floor, Survey no. 191-192 (P), Opp. Vallabh Nagar Bus Depot, Pune – 411018, Maharashtra, India	+91-20-68192100
	Mitsubishi Electric India Private Limited FA Center	204-209, 2nd Floor, 31FIVE, Corporate Road, Prahladnagar, Ahmedabad 380015,Gujarat, India	+91-79677-77888
Indonesia	PT.Mitsubishi Electric Indonesia	Gedung Jaya 8th floor, JL.MH. Thamrin No.12 Jakarta Pusat 10340, Indonesia	+62-21-3192-6461
	P.T. Sahabat Indonesia	P.O.Box 5045 Kawasan Industri Perumahan, Jakarta, Indonesia	+62-(0)21-6610651-9
Ireland	Mitsubishi Electric Europe B.V.	Westgate Business Park, Ballymount, IRL-Dublin 24, Ireland	+353 (0)1-4198800
Israel	Gino Industries Ltd.	26, Ophir Street IL-32235 Haifa, Israel	+972 (0)4-867 0656
Italy	Mitsubishi Electric Europe B.V.	Viale Colleoni 7, I-20041 Agrate Brianza (MI), Italy	+39 039-60531
Kazakhstan	Kazpromavtomatika	Ul. Zhambyla 28, KAZ - 100017 Karaganda	+7-7212-501000
Korea	Mitsubishi Electric Automation Korea Co., Ltd	9F Gangseo Hangang xi-tower A, 401 Yangcheon-ro, Gangseo-gu, Seoul 07528 Korea	+82-2-3660-9573
Laos	AROUNKIT CORPORATION IMPORT-EXPORT SOLE CO.,LTD	SAPHANMO VILLAGE. SAYSETHA DISTRICT, VIENTIANE CAPITAL, LAOS	+856-20-415899
Lebanon	Comptoir d'Electricite Generale-Liban	Cebaco Center - Block A Autostrade Dora, P.O. Box 11-2597 Beirut - Lebanon	+961-1-240443
Lithuania	Rifas UAB	Tinklu 29A, LT-5300 Panevezys, Lithuania	+370 (0)45-582-728
Malaysia	Mitric Sdn Bhd	No. 5, Jalan Pemberita U1/49, Temasya Industrial Park, Glenmarie 40150 Shah Alam, Selangor, Malaysia	+603-5569-3748
	Flexible Automation System Sdn Bhd	60, Jalan USJ 10/1B,UEP Subang Jaya.47620 Selangor Darul Ehsan,Malaysia	+603-5633-1280
Malta	ALFATRADE LTD	99 PAOLA HILL, PAOLA PLA 1702, Malta	+356 (0)21-697-816
Marocco	SCHIELE MAROC	KM 7,2 NOUVELLE ROUTE DE RABAT AIN SEBAA, 20600 Casablanca, Marocco	+212 661 45 15 96
Myanmar	Peace Myanmar Electric Co.,Ltd.	NO137/139 Botahtaung Pagoda Road, Botahtaung Town Ship 11161, Yangon, Myanmar	+95-(0)1-202589
Nepal	Watt&Volt House	KHA 2-65, Volt House Dillibazar Post Box:2108,Kathmandu, Nepal	+977-1-4411330
Netherlands	Imtech Marine & Offshore B.V.	Sluissjesdijk 155, NL-3087 AG Rotterdam, Netherlands	+31 (0)10-487-19 11
North America	Mitsubishi Electric Automation, Inc.	500 Corporate Woods Parkway, Vernon Hills, IL 60061 USA	+847-478-2100
Norway	Scanelec AS	Leirvikasen 43B, NO-5179 Godvik, Norway	+47 (0)55-506000
Mexico	Mitsubishi Electric Automation, Inc. Mexico Branch	Bvld. Miguel de Cervantes Saavedra 301, Torre Norte Piso 5, Col. Ampliación Granada, Miguel Hidalgo, Ciudad de México, CP 11520, México	+52-55-3067-7511
Middle East Arab Countries & Cyprus	Comptoir d'Electricite Generale-International-S.A.L.	Cebaco Center - Block A Autostrade Dora P.O. Box 11-1314 Beirut - Lebanon	+961-1-240430
Pakistan	Prince Electric Co.	2-P GULBERG II, LAHORE, 54600, PAKISTAN	+92-42-575232, 5753373
Peru	Rhona S.A. (Branch office)	Avenida Argentina 2201, Cercado de Lima	+51-1-464-4459
Philippines	MELCO Factory Automation Philippines Inc.	128, Lopez Rizal St., Brgy. Highway Hills, Mandaluyong City, Metro Manila, Philippines	+63-(0)2-256-8042
	Edison Electric Integrated, Inc.	24th Fl. Galleria Corporate Center, Edsa Cr. Ortigas Ave., Quezon City Metro Manila, Philippines	+63-(0)2-634-8691
Poland	Mitsubishi Electric Europe B.V. Polish Branch	Krakowska 48, 32-083 Balice, Poland	+48 12 347 65 00
Republic of Moldova	Intehsis SRL	bld. Traian 23/1, MD-2060 Kishinev, Moldova	+373 (0)22-66-4242
Romania	Sirius Trading & Services SRL	RO-060841 Bucuresti, Sector 6 Aleea Lacul Morii Nr. 3	+40-(0)21-430-40-06
Russia	Mitsubishi Electric (Russia) LLC	2 bld.1, Letnikovskaya street, Moscow, 115114, Russia	+7 495 721-2070
Saudi Arabia	Center of Electrical Goods	Al-Shuwayyer St. Side way of Salahuddin Al-Ayoubi St. P.O. Box 15955 Riyadh 11454 - Saudi Arabia	+966-1-4770149
Singapore	Mitsubishi Electric Asia Pte. Ltd.	307 Alexandra Road, Mitsubishi Electric Building, Singapore 159943	+65-6473-2308
Slovakia	PROCONT, Presov	Kupelna 1/, SK - 08001 Presov, Slovakia	+421 (0)51 - 7580 611
	SIMAP	Jana Derku 1671, SK - 91101 Trencin, Slovakia	+421 (0)32 743 04 72
Slovenia	Inea RBT d.o.o.	Stegne 11, SI-1000 Ljubljana, Slovenia	+386 (0)1-513-8116
South Africa	CBI-electric: low voltage	Private Bag 2016, ZA-1600 Isando Gauteng, South Africa	+27-(0)11-9282000
Spain	Mitsubishi Electric Europe B.V. Spanish Branch	Carretera de Rubí 76-80, E-08190 Sant Cugat del Vallés (Barcelona), Spain	+34 (0)93-565-3131
	Mitsubishi Electric Europe B.V. (Scandinavia)	Hedvig Möllers gata 6, 223 55 Lund, Sweden	+46 (0)8-625-10-00
Sweden	Euro Energy Components AB	Järnvägsgratan 36, S-434 24 Kungälv, Sweden	+46 (0)300-690040
Switzerland	TriElec AG	Muehlentalstrasse 136, CH-8201 Schaffhausen, Switzerland	+41-(0)52-6258425
Taiwan	Setsuyo Enterprise Co., Ltd	5th Fl., No.105, Wu Kung 3rd, Wu-Ku Hsiang, Taipei, Taiwan, R.O.C.	+886-(0)2-2298-8889
	United Trading & Import Co., Ltd.	77/12 Bamrungmuang Road,Klong Mahanak Pomprab Bangkok Thailand	+66-223-4220-3
Thailand	mitsubishi electric factory automation (THAILAND) CO.,LTD	101, True Digital Park Office, 5th Floor, Sukhumvit Road, Bangchak, Phara Khanong, Bangkok, 10260 Thailand	+662-092-8600
Tunisia	MOTRA Electric	3, Résidence Imen, Avenue des Martyrs Mourouj III, 2074 - El Mourouj III Ben Arous, Tunisia	+216-71 474 599
Turkey	Mitsubishi Electric Turkey A.Ş.	Şerifali Mahallesi Kale Sokak No: 41, 34775 Ümraniye, Istanbul, Turkey	+90-216-969-2666
United Kingdom	Mitsubishi Electric Europe B.V.	Travellers Lane, UK-Hatfield, Herts. AL10 8XB, United Kingdom	+44 (0)1707-276100
Uruguay	Fierro Vignoli S.A.	Avda. Uruguay 1274 Montevideo Uruguay	+598-2-902-0808
Vietnam	Mitsubishi Electric Vietnam Co.,Ltd. Head Office	11th & 12th Floor, Viettel Tower B, 285 Cach Mang Thang 8 Street, Ward 12, District 10, Ho Chi Minh City, Vietnam	+84-28-3910-5945
	Mitsubishi Electric Vietnam Co.,Ltd. Hanoi Branch	24th Floor, Handico Tower, Pham Hung Road, khu do thi moi Me Tri Ha, Nam Tu Liem District, Hanoi City, Vietnam	+84-24-3937-8075

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE: TOKYO BUILDING, 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN