MITSUBISHI ELECTRIC

Electronic Multi-Measuring Instrument

**MODEL**

# ME96SSEB-MB

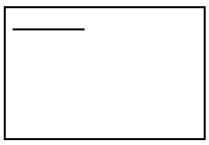
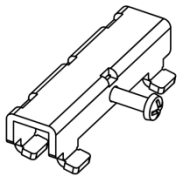
User's Manual: Detailed Edition


●Before use, you should read this user's manual carefully to properly use this instrument.

Be sure to forward the manual to the end user.

## Check your delivery

The following table shows a list of the instrument accessories.
When unpacking your package, check all the contents.

| Contents | Quantity | Specification |
|---|---|---|
| User's Manual<br>(Digest version) | 1 |  <br>A3 size |
| Attachment lug<br>(with a screw) | 2 |  |

## Optional plug-in module

The optional plug-in modules cannot be attached to this product.
If you need a function such as analog output, CC-Link communication, digital input/output, MODBUS TCP communication, or logging function, use other model, ME96SSHB-MB or ME96SSRB-MB which can be combined with the optional plug-in modules.

## Features

- The instrument measures load status by wiring the secondary sides of VT (Voltage Transformer) and CT (Current Transformer) in the power receiving and distribution system and displays various measured values.
- The instrument supports Active Energy Class 0.5S.
- The password protection prevents undesired setting change and measured data deletion.
- The transmission function, MODBUS RTU communication, transmits measured data to superior monitoring systems.
- The instrument fulfills the requirements of the CE marking, UL standards, KC mark, and FCC/IC.
- The support function for checking input wiring enables to determine the wiring condition in the test mode. When either a voltage input or current input is incorrectly wired, the incorrect wiring part is displayed on the screen and it also shows a current phase angle, a voltage phase angle, and each value of active power, voltage, and current.

## Trademark

## Table of Contents

## Table of Contents

## Safety Precautions

Before use, read these instructions carefully to properly operate the instrument.
Be sure to follow the precautions described here for personnel and product safety.
Keep this manual ready to hand and accessible for future use at all times.
Be sure to forward the manual to the end user.
If you consider using the instrument for a special purpose such as nuclear power plants, aerospace, medical care, or passenger vehicles, consult with our sales representative.

The instructional icon in the manual is described as follows.

| | |
|---|---|
| ⚠CAUTION | The caution icon (⚠) on the main unit indicates that incorrect handling may cause hazardous conditions. Always follow the subsequent instructions (⚠CAUTION) because they are important to personal safety. Failure to follow them may result in an electric shock, a fire, erroneous operation, or damage to the instrument. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired. |

| | |
|---|---|
| ⚠CAUTION | The terminals of auxiliary power (MA, MB) and voltage input (P1, P2, P3, PN) have hazards of electric shock, explosion, or arc flash. Turn off the power supply of auxiliary power and input circuit and then handle the instrument. |

■Precautions on use environment and conditions

Do not use the instrument in the following circumstances:
Failure to follow the instruction may cause a malfunction or reduced product life time.

- The ambient temperature exceeds the range -5°C to +55°C.
- The average daily temperature exceeds +35°C.
- The relative humidity exceeds the range 0 to 85% RH, or condensing.
- The altitude exceeds 2000 m.
- Pollution Degree: more than 2 *Note 1
- Exposed to much dust, corrosive gas, salty environment, or oil mist
- Transient over voltage: 4000 V *Note 1
- Exposed to excessive vibration or impact
- Exposed to rain or water drops
- Exposed to direct sunlight
- Pieces of metal or inductive substances are scattered.
- Exposed to strong magnetic fields or large exogenous noise

*Note1: For details about the Pollution Degree and the Transient over voltage category, refer to EN61010-1:2010.

Grit, dust, and small insects cause poor contact or a failure such as insulation decline that caused by deposition and moisture absorption. Furthermore, in the area where the air contains conductive dust, a failure such as a product malfunction or insulation deterioration occurs in a relatively short time. In this case, you must take measures against it such as putting the instrument in an enclosed board. In addition, if the temperature inside the board rises, the measures must be undertaken as well.

■Precautions on Installation and wiring

Be sure to read the instructions carefully before installation and wiring.

⚠CAUTION

- A qualified electrician must install and wire the instrument for safety.
- Supply power to the instrument after completing its assembly work on a cabinet door.
- The instrument is to be mounted on the cabinet door. All connections must be kept inside the cabinet.
- The following table shows the specifications on the input/output terminal.

■Auxiliary power supply and measuring element

| | | | | |
|---|---|---|---|---|
| Auxiliary power supply | | 100 to 240 V AC (±15%) 50 Hz to 60 Hz<br>100 to 240 V DC (-30% ＋15%) | | MA, MB terminals |
| Measuring element | Voltage | 3-phase 4-wire: max 277 V AC/480 V AC<br>3-phase 3-wire: (DELTA) max 220 V AC<br>(STAR) max 440 V AC<br>1-phase 3-wire: max 220 V AC/440 V AC<br>1-phase 2-wire: (DELTA) max 220 V AC<br>(STAR) max 440 V AC | Category III | P1, P2, P3, PN terminals |
| | Current | 5 A (CT secondary side),<br>max 30 V AC | Category III | +C1, C1, +C2, C2, +C3, C3 terminals |
| | Frequency | 50 Hz or 60 Hz | | |

The current input terminals must be connected to a CT, external equipment, with basic insulation.

Be sure to continuously connect the terminals for voltage-measuring purpose and current-measuring purpose during operation.

■Others

| | | |
|---|---|---|
| MODBUS RTU communication | T/R+,T/R-,SG terminals | max 35 V DC |

- Keep the protection sheet affixed to the front of the instrument during installation and wiring.
- Do not drop the instrument from high place. If it is dropped and the display cracks, do not touch the liquid leaking from the broken LCD or do not get it in your mouth. If you touch the liquid, rinse it off with soapy water at once.
- Do not work under live-line condition. Otherwise, an instrument failure, an electric shock, or a fire may be caused.
- When tapping or wiring, take care not to enter any foreign objects such as chips or wire pieces into the instrument.
- If you pull the wires with a strong force when connecting them to the terminals, the terminals may come off. (Tensile load: 39.2N or less)
- Check the wiring diagram carefully. Inappropriate wiring can cause a failure of the instrument, an electric shock, or a fire.
- Use appropriate size wires. The use of an inappropriate size wire can cause a fire due to heat generation.
- Use crimp-type terminals compatible with the wire size. For details, refer to **7.3.1 Specifications on the Applicable Electrical Wire**. The use of an inappropriate terminal can cause a malfunction, failure, or burnout of the instrument or a fire due to damage to the terminal or poor contact.
- Tighten the terminal screws with a specified torque and use a suitable pressure connector. For details, refer to **7.3.1Specifications on the Applicable Electrical Wire**. Excessive tightening can cause damage to the terminals and screws.
- Be sure to confirm the wiring connections strictly after the connection. Poor connection can cause a malfunction of the instrument, an electric shock, or a fire.
- In order to prevent invasion of noise, MODBUS RTU communication cables, auxiliary power supply cables, and other signal cables must not be placed close to or bound together with power lines or high voltage lines. When lying parallel to the power lines or high voltage lines, refer to the following table for the separation distance. (Except the input part of the terminal block)

| Conditions | Distance |
|---|---|
| Power lines of 600 V or less | 300 mm or more |
| Other power lines | 600 mm or more |

## Safety Precautions

■Precautions on preparation before use

- Observe the use conditions and environment requirements for installation place.
- You must set up the instrument before use. Read the manual carefully to set it up correctly. If the setup is incorrectly done, the instrument will not be properly operated.
- Check the power rating of the instrument and then apply proper voltage.

■Precautions on how to use

- When operating the instrument, check that active bare wires do not exist around it. If any bare wire exists, stop the operation immediately and then take appropriate action such as insulation protection.
- If a power outage occurs during the setup, the instrument will not be set up correctly. Set it up again after power recovery.

| | |
|---|---|
| ⚠CAUTION | ● Do not disassemble or modify the instrument to use. Otherwise, a failure, an electric shock, or a fire can be caused.<br>● Use the instrument within the rating specified in the manual. If you used it outside the rating, it might cause not only a malfunction or failure of the instrument but also ignition or burnout.<br>● Do not open the CT secondary side while the primary current is energized. When the CT secondary side circuit is open, the primary current flows. However, the secondary current does not flow. Therefore, a high voltage is generated at the CT secondary side and the temperature rises, resulting in insulation breakdown in the CT secondary winding. It may lead to burnout.<br>● When external equipment is connected to the external terminals, the instrument and external equipment must not be powered and be used after the definitive assembly on a cabinet door.<br>● The rating of the terminal of external equipment should satisfy that of the external terminal of the instrument. |

■Precautions on maintenance

- Wipe dirt off the surface with a soft dry cloth.
- Do not leave a chemical cloth in contact with the instrument for a long time or do not wipe it with benzene, thinner, or alcohol.
- In order to properly use the instrument for a long time, conduct the following inspections:

(1) Daily maintenance

①No damage in the instrument
②No abnormality with LCD indicator
③No abnormal noise, smell or heat generation

(2) Periodical maintenance

Inspect the following item every six months to once a year.
①No looseness of installation and terminal block connection

| | |
|---|---|
| ⚠CAUTION | Be sure to conduct periodic inspection under the electric outage condition. Failure to follow the instruction may cause a failure of the instrument, an electric shock, or a fire. Tighten the terminals regularly to prevent a fire. |

■Precautions on storage

To store the instrument, turn off the power supplies of auxiliary power and input circuit, remove the wires from the terminals, and then put them in a plastic bag.
For long-time storage, avoid the following places. Otherwise, there is danger of an instrument failure or reduced product life time.

- The ambient temperature exceeds the range -25°C to +75°C.
- The average daily temperature exceeds +35°C.
- The relative humidity exceeds the range 0 to 85% RH, or condensing.
- Exposed to much dust, corrosive gas, salty environment, or oil mist.
- Exposed to excessive vibration or impact.
- Exposed to rain or water drops.
- Exposed to direct sunlight.
- Pieces of metal or inductive substances are scattered.

## Safety Precautions

■Warranty

- The warranty period is for one year from the date of your purchase or 18 months after the manufacturing date, whichever is earlier.
- During the warranty period, if any failure occurred in standard use that the product is used in the condition, method, and environment followed by the conditions and precautions described in the catalog and user's manual, we would repair the product without charge.
- Even within the warranty period, non-free repair is applied to the following cases.
  ① Failures caused by the customer's improper storage, handling, carelessness, or fault.
  ② Failures caused by faulty workmanship
  ③ Failures due to faults in use or undue modification
  ④ Failures due to force majeure such as a fire or abnormal voltage or due to natural disasters such as earthquakes, windstorms, or floods.
  ⑤ Failures caused by the problem in question that could not be predicted with the technology available at the time the product was shipped.
- Our company shall not be liable to compensate for any loss arising from events not attributable to our company, customers' opportunity loss or lost earnings due to failure of the product, any loss, secondary loss, or accident caused by a special reason regardless of our company's predictability, damage to other products besides our products, or other operations

■Replacement cycle of product

It is recommend that you renew the product every ten years although it depends on your use condition. The long-term use of the product may cause discoloration of the LCD or a product malfunction.

■Disposal

- Treat the product properly as industrial waste.
- Batteries are not used for this product.

■Packaging materials and user's manual

For reduction of environment load, cardboard is used for packaging materials and the manual is printed with recycled papers.

## EMC Directive Instruction

This section summarizes the precautions to have the cabinet constructed with the instrument conform to the EMC Directive.
However, the method of conformance to the EMC Directive and the judgment on whether or not the cabinet conforms to the EMC Directive must be determined finally by the manufacturer.

This instrument complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This instrument may not cause harmful interference, and (2) this instrument must accept any interference received, including interference that may cause undesired operation.

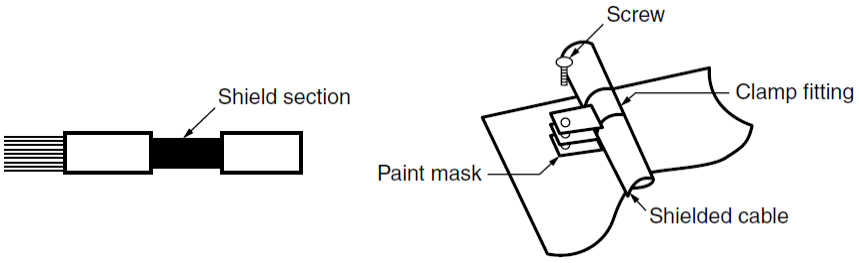
### 1. EMC Standards

- EN 61326-1
- EN 61000-3-2
- EN 61000-3-3

### 2. Installation (EMC directive)

The instrument is to be mounted on the panel of a cabinet.
Therefore, the installation to the cabinet is important not only for safety but also for conformance to EMC.
The instrument is examined in the following conditions.

- A conductive cabinet must be used.
- The conductivity of the six surfaces of the cabinet must be all ensured.
- The cabinet must be grounded by thick wires for low impedance.
- The hole drilling dimensions on the cabinet must be 10 cm or less in diameter.
- The terminals for protective earth and functional earth must be grounded by thick wires for low impedance. The use of the terminal for protective earth is important not only for safety but also for conformance to EMC.
- The connecting part of the terminal must be all placed inside the cabinet.
- Wiring outside the cabinet must be conducted with shielded cables, and the cables must be fixed to the panel with clamps. (Strip the covering of shielded cable by a portion of clamp installation and then mask the grounding part of the panel and clamp so as not to be painted.)




## Precautions for KC mark

사용자안내문

| 기 종 별 | 사 용 자 안 내 문 |
|---|---|
| A급 기기(업무용 방송통신기자재) | 이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다. |

■Precautionary note written in Korean

Distributors and users must understand that this product meets the electromagnetic compatibility requirements and is designed for industrial use (Class A).
Do not use the product in a residential area.

■Applicant for KC mark : MITSUBISHI ELECTRIC AUTOMATION KOREA CO.,LTD

■Manufacturer : MITSUBISHI ELECTRIC CORPORATION

Note 1: This is the notification for the KC mark (Korea Certification)

## Table for measuring element code

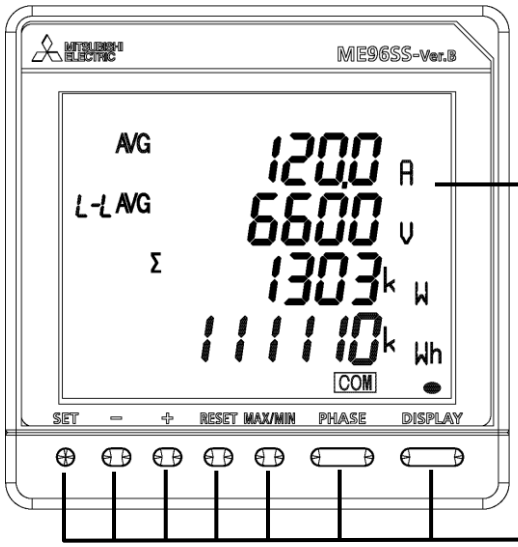
The following table shows a list of measuring element codes used in the manual.

| Measuring element code | Measuring element name |
|---|---|
| A1 | Current, 1-phase |
| A2 | Current, 2-phase |
| A3 | Current, 3-phase |
| AN | Current, N-phase |
| $A_{AVG}$ | Current, average |
| DA1 | Current demand, 1-phase |
| DA2 | Current demand, 2-phase |
| DA3 | Current demand, 3-phase |
| DAN | Current demand, N-phase |
| $DA_{AVG}$ | Current demand, average |
| V12 | Voltage, between 1-2 lines |
| V23 | Voltage, between 2-3 lines |
| V31 | Voltage, between 3-1 lines |
| $V_{AVG}$(L-L) | Voltage, average, line to line |
| V1N | Voltage,1N-phase |
| V2N | Voltage, 2N-phase |
| V3N | Voltage, 3N-phase |
| $V_{AVG}$(L-N) | Voltage, average, line to neutral |
| W1 | Active power, 1-phase |
| W2 | Active power, 2-phase |
| W3 | Active power, 3-phase |
| ΣW | Active power, total |
| var1 | Reactive power, 1-phase |
| var2 | Reactive power, 2-phase |
| var3 | Reactive power, 3-phase |
| Σvar | Reactive power, total |
| VA1 | Apparent power, 1-phase |
| VA2 | Apparent power, 2-phase |
| VA3 | Apparent power, 3-phase |
| ΣVA | Apparent power, total |
| PF1 | Power factor, 1-phase |
| PF2 | Power factor, 2-phase |
| PF3 | Power factor, 3-phase |
| ΣPF | Power factor, total |
| Hz | Frequency |
| Wh | Active energy |
| varh | Reactive energy |
| VAh | Apparent energy |
| HI | Harmonic current |
| $HI_N$ | Harmonic current, N-phase |
| HV | Harmonic voltage |
| $THD_i$ | Harmonic current total distortion ratio |
| $THD_v$ | Harmonic voltage total distortion ratio |

# 1. Name and Function of Each Section

## 1.1. Name of Each Part

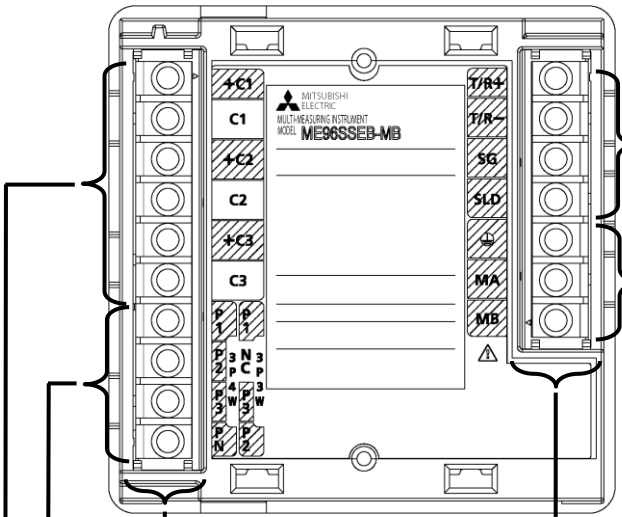
■The front of the unit




LCD with backlight

Operation buttons
*For details, refer to 1.3 **Function of Operation Buttons**.

■The back of the unit




MODBUS RTU communication terminals
T/R+: MODBUS RTU communication terminal
T/R-: MODBUS RTU communication terminal
SG: MODBUS RTU signal ground terminal
SLD: Shielded wire terminal (Ground resistance: 100 Ω or less)

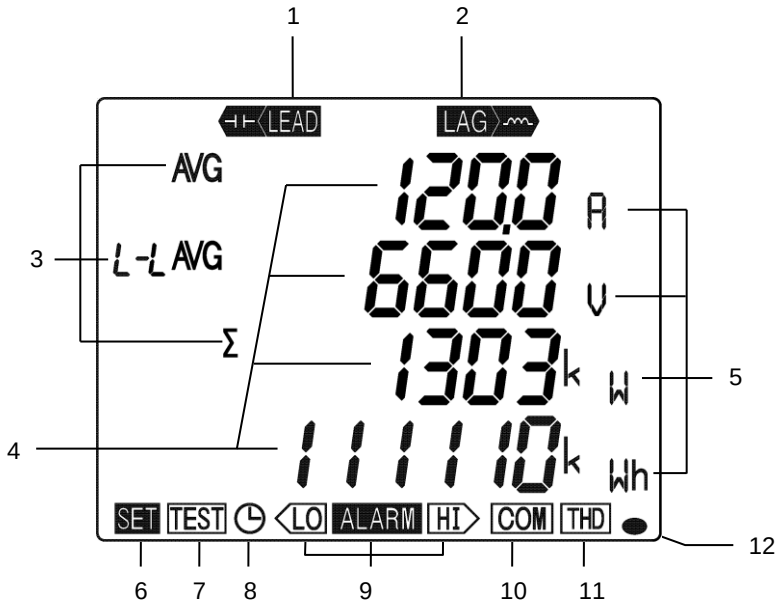
Auxiliary power input terminals
MA, MB: Auxiliary power is connected.
⏚: Ground terminal (Ground resistance: 100 Ω or less)

Terminal covers

Voltage Input terminals
P1, P2, P3, PN (P1, NC, P3, P2): Circuit voltage is input.

Current Input terminals
+C1, C1: Circuit current is input.
+C2, C2: Circuit current is input.
+C3, C3: Circuit current is input

## 1.2. LCD Function




Note: The above display is an example for explanation.

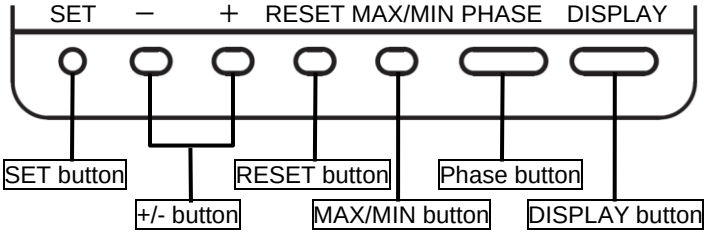
| No. | Name of each part | Function |
|---|---|---|
| 1 | LEAD display | Light up on the reactive energy (imported lead)/ (exported lead) screen. |
| 2 | LAG display | Light up on the reactive energy (imported lag)/ (exported lag) screen. |
| 3 | Digital element display | Display measuring elements expressed in digital numbers |
| 4 | Digital display | Display measured values in digital numbers |
| 5 | Unit | Display the units of measured values |
| 6 | Setup status | Light up in the setting mode<br>Blink in the setting confirmation mode |
| 7 | Test mode status | Light up in the test mode |
| 8 | Clock status | Light up when operating time is displayed |
| 9 | Upper/lower limit alarm status | Blink when the upper/lower limit alarm is generating |
| 10 | Communication status | <table><tr><th>Specification</th><th>ON</th><th>Blink</th><th>OFF</th></tr><tr><td>MODBUS RTU communication</td><td>Normal</td><td>Communication error such as wrong address *1</td><td>Hardware error</td></tr></table> *1. For details, refer to **6.5 Troubleshooting**. |
| 11 | Harmonics | Light up when harmonic is displayed |
| 12 | Metering status | Blink when imported active energy is measured *Note 1<br>*It appears on the active energy (imported) screen only. |

Note 1: The blinking cycle is constant regardless of measuring input size.

# 1. Name and Function of Each Section

## 1.3. Function of Operation Buttons

The function of each operation button varies depending on how to press the button.




<Meaning of marks>

○: Press, □: Press for 1 second or more, ◎: Press for 2 seconds or more, ——:Press simultaneously

| Mode \ Operation | | Button name | | | | | | | Function | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SET | − | + | RESET | MAX/MIN | PHASE | DISPLAY | | |
| Operating mode | Display switching | | | | | | | ○ | Switch the measurement screen. | |
| | | | ○ | —— | —— | —— | —— | ○ | Switch the measurement screen in the reverse direction. | |
| | | | | | | | | | Switch phase display. | |
| | | | | | | | ○ | | Switch between the harmonic RMS value and distortion ratio on the harmonics display screen. | |
| | | | | | | ○ | | | Enter/Exit the Max/Min value screen. | |
| | | | | | | | | ◎ | Enter the cyclic display mode for measurement screen. Refer to **5.1.3**. | |
| | | | | | | | | | Enter the cyclic display mode for phase. Refer to **5.1.3**. | |
| | | | | | | | ◎ | | Switch between the harmonic RMS value and distortion ratio in cyclic mode on the harmonics display screen. | |
| | | | ◎ | —— | ◎ | | | | Change the units such as Wh, varh, and VAh or display the lower-digit enlarged view. Refer to **5.1.9**. | |
| | Measured value clearness/ Alarm reset | | | | ◎ | | | | Clear the maximum and minimum values displayed on the screen. | They are available on the Max/Min value screen. |
| | | | | ◎ | —— | | | | Clear maximum and minimum values for every item in every screen. | |
| | | ◎ | —— | —— | —— | —— | —— | | Reset Wh, varh, and VAh to zero.<br>All measured values are reset to zero simultaneously. | |
| | | | | | ◎ | | | | Reset operating time to zero.<br>(The operating time displayed on the screen only) | |
| | | | | | ○ | | | | Reset the alarm displayed on the screen. | They are available only when set to manual alarm cancellation. |
| | | | | | ◎ | | | | Reset all alarms at once.<br>(For every item in every screen) | |
| | | | | | ○ | | | | Stop the backlight blinking caused by alarm only when set to backlight blinking. | |
| | Mode switch | ◎ | —— | —— | —— | | | | Enter the setting mode. | |
| | | ◎ | | | | | | | Enter the setting confirmation mode. | |
| | | | | | ◎ | —— | —— | | Enter the password protection screen. | |
| Setting mode/ Setting confirmation mode | Setting operation | ○ | | | | | | | Determine the settings and then shift to the next settings. | |
| | | | | | | | | ○ | Return to the previous setting item. | |
| | | | ○<br>□ | ○<br>□ | | | | | Round up/down the setting value.<br>Pressing for 1 second or more enables fast forward. | |
| | | □ | | | | | | | Skip the settings and return to the setting menu screen. | |
| | | ○ | | | | | | | Reflect the setting change on the END screen. | |
| | | ○ | | | | | | | Cancel the setting change on the CANCEL screen. | |
| | Special operation | | | | | □ | —— □ | | Restart the instrument on the CANCEL screen. | |
| | | | | | ◎ | —— | —— ◎ | | Initialize to the factory default settings on the CANCEL screen. Refer to **3.12**. | |

Note: During backlight off mode, pressing any operation button first turns on the backlight. In addition, pressing any button again enables the use of the functions in the above table.

## 1.3. Function of Operation Buttons

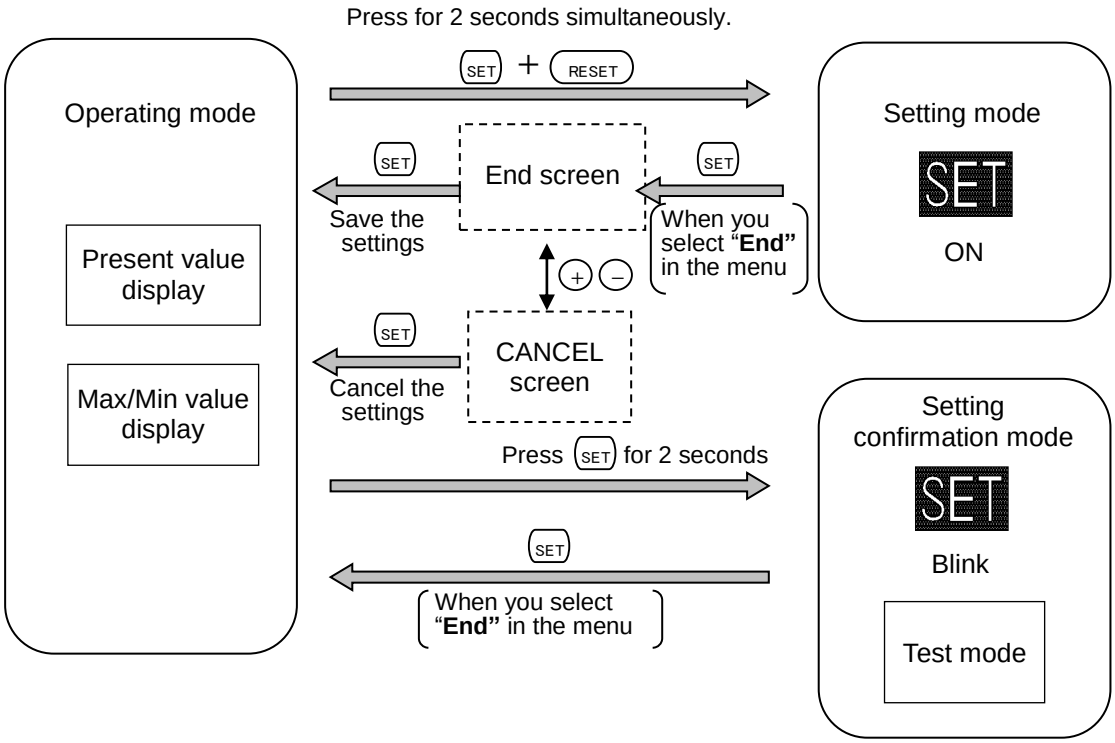
| | |
|---|---|
| ⚠CAUTION | ● When you execute a function such as ‘Reset Max/Min value’ or ‘Reset Wh, varh, and VAh to zero’, past data is deleted. If you need to keep the data, record the data before the reset operation.<br>● When you execute ‘Restart the instrument’, the entire measurement function (measurement display, communication) will stop for a few seconds. |

## 2. Each Mode Function

The instrument has the following operation modes.
When auxiliary power is supplied, the operating mode is first displayed.
Depending on the application, switch the operation mode to use.

| Mode | Description | Reference |
|---|---|---|
| Operating mode | This is a normal operation mode to display each measured value in digital numerical number. In the operating mode, there are 'Present value display' that shows values at present and 'Max/Min value display' that shows maximum and minimum values in the past.<br>In addition, on each display screen, the cyclic display mode, which automatically switches the display screen every 5 seconds, is available. | **5 Operation** |
| Setting mode | This is a mode where you can change the settings for measurement function.<br>In addition, on the CANCEL screen, which is the screen to cancel the setting change, the following special operations are available.<br>・Restart the instrument.<br>・Reset the settings to the factory default. | **3 How to Set up** |
| Setting confirmation mode (Test mode) | This is a mode where you can confirm the setting of each item.<br>In this mode, you cannot change the settings. Therefore, it is possible to prevent from accidentally changing the settings.<br>The mode provides test function available at startup of systems.<br>・Communication Test: Without measurement input (voltage/current), fixed numerical data can be returned.<br>・Support function for checking input wiring: When either a voltage input or current input is incorrectly wired, the incorrect wiring part is displayed on the screen. In addition, useful information is also displayed such as a current phase angle and voltage phase angle. | **3.10 or 4 How to Use Test Mode** |

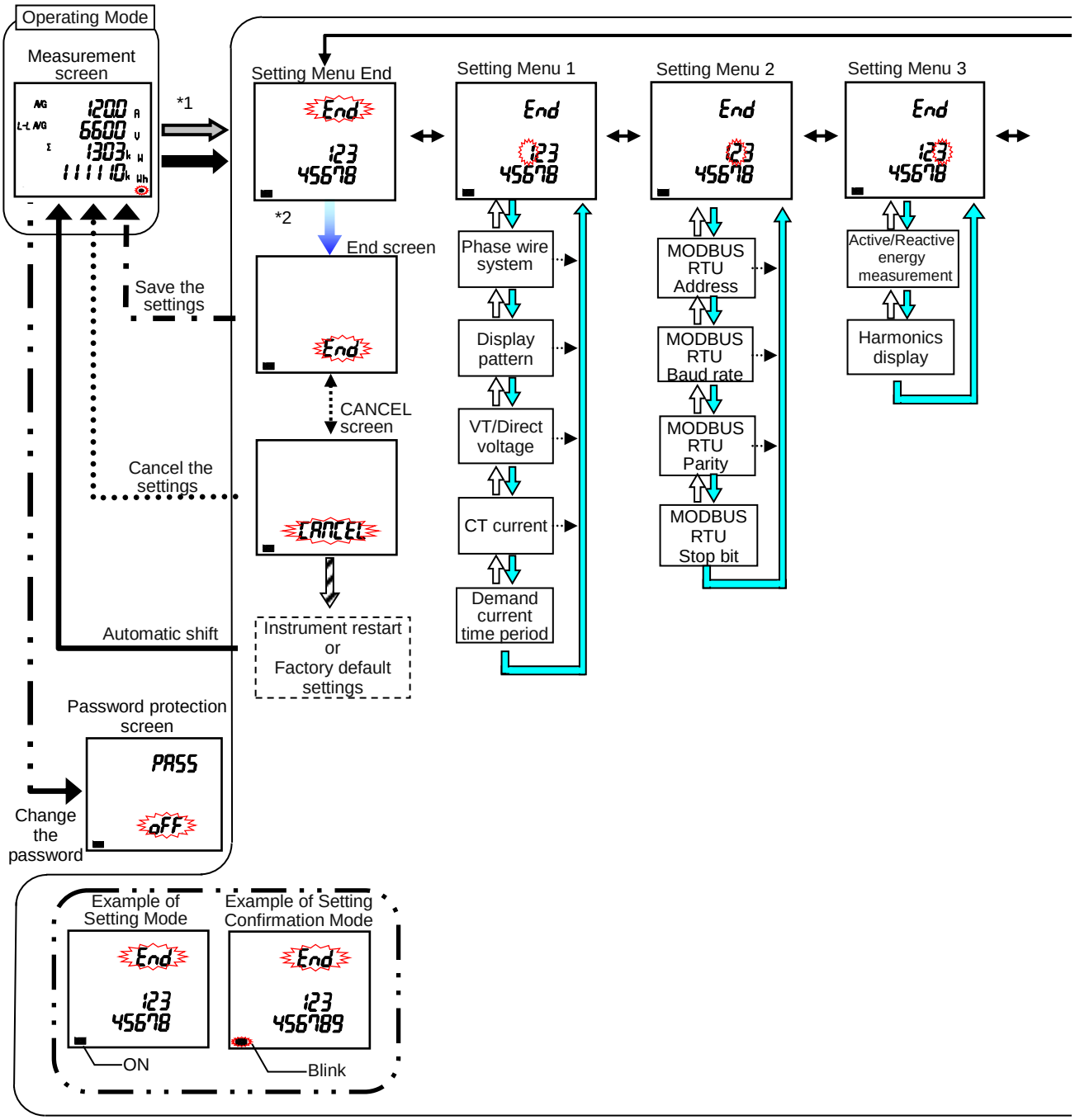
■Flow of each mode



# 3. How to Set up

## 3.1. Setting Flow

For measurement, you must set settings such as phase wire system, VT/Direct voltage, and CT primary current in the setting mode.
From the operating mode, enter the setting mode and then set necessary items. Any items not set remain in the factory default settings.
For normal use, only set up the items in the setting menu 1. For details on the settings, refer to **3.2**.
For details on the factory default settings, refer to **8.4**.



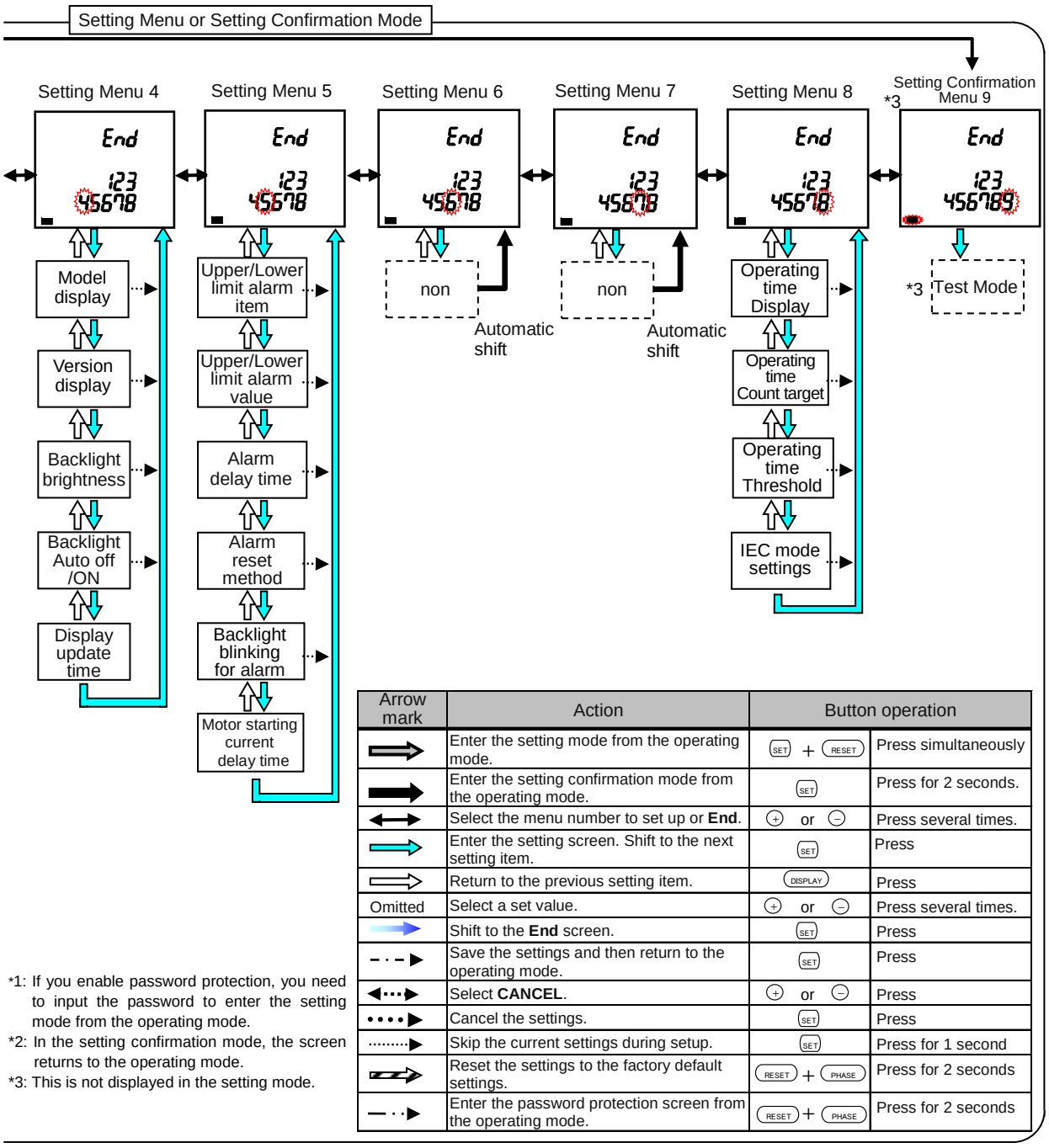

| | |
|---|---|
| ⚠CAUTION | The setting change provides the initialization of the related setting items and measured data. Therefore, check that beforehand. For details, refer to **3.11 Initialization of Related Items by Changing a Setting.** |

# 3. How to Set up

## 3.1. Setting Flow

**<Setting Procedure>**

(1) Press the [SET] and [RESET] buttons simultaneously for 2 seconds to enter the setting mode.
(2) Select the setting menu number with the ⊕ or ⊖ button.
(3) Press the [SET] button to determine the setting menu number.
(4) Set each setting item. (Refer to **3.2** to **3.9**.)
(5) After completing all the settings, select **End** in the setting menu and then press the [SET] button.
(6) When the **End** screen appears, press the [SET] button again.




| Arrow mark | Action | Button operation | |
|---|---|---|---|
| ⇒ | Enter the setting mode from the operating mode. | [SET] + [RESET] | Press simultaneously |
| ➡ | Enter the setting confirmation mode from the operating mode. | [SET] | Press for 2 seconds. |
| ⇔ | Select the menu number to set up or **End**. | ⊕ or ⊖ | Press several times. |
| → | Enter the setting screen. Shift to the next setting item. | [SET] | Press |
| ⇨ | Return to the previous setting item. | [DISPLAY] | Press |
| Omitted | Select a set value. | ⊕ or ⊖ | Press several times. |
| ⟶ | Shift to the **End** screen. | [SET] | Press |
| - - ▶ | Save the settings and then return to the operating mode. | [SET] | Press |
| ◀···▶ | Select **CANCEL**. | ⊕ or ⊖ | Press |
| • • • • ▶ | Cancel the settings. | [SET] | Press |
| ·····▶ | Skip the current settings during setup. | [SET] | Press for 1 second |
| ⇝ | Reset the settings to the factory default settings. | [RESET] + [PHASE] | Press for 2 seconds |
| — · ▶ | Enter the password protection screen from the operating mode. | [RESET] + [PHASE] | Press for 2 seconds |

*1: If you enable password protection, you need to input the password to enter the setting mode from the operating mode.
*2: In the setting confirmation mode, the screen returns to the operating mode.
*3: This is not displayed in the setting mode.

# 3. How to Set up

## 3.1. Setting Flow

### ■Basic operation for settings

The following table shows a list of basic operations for settings.

| Function | Operation | Note |
|---|---|---|
| Select a setting | Press (+) or (–) button | Fast-forward by pressing for 1 second or more |
| Determine a setting | Press (SET) button | When the setting is determined, the screen will shift to the next setting item. |
| Return to the previous setting item | Press (DISPLAY) button | The setting before return is enabled. |
| Return to the setting menu during setup | Press (SET) button for 1 second | |

# 3. How to Set up

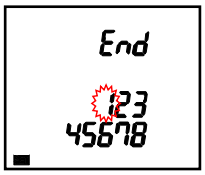
## 3.2. Setting Menu 1: Basic Setup (Settings for Phase Wire System, Display Pattern, VT/Direct Voltage, and CT Primary Current)

You will set the phase wire system, display pattern, VT/Direct voltage, CT primary current, and demand time period.
In the operating mode, press the SET and RESET buttons simultaneously for 2 seconds or more to enter the following operation.

Setting Menu

DISPLAY SET

Select 1 in the setting menu.
*Refer to the right figure.



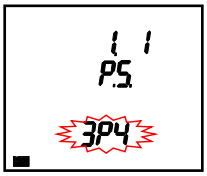

①Phase wire system

DISPLAY SET

Set the phase wire system
according to the measurement target circuit.

| | |
|---|---|
| 3P4: | 3-phase 4-wire |
| 3P3. 2CT: | 3-phase 3-wire(2CT) |
| 3P3. 3CT: | 3-phase 3-wire(3CT) |
| 1P3. 1N2: | 1-phase 3-wire(1N2 display) |
| 1P3. 1N3: | 1-phase 3-wire(1N3 display) |
| 1P2: | 1-phase 2-wire |

Note: The underlined shows the default setting.
(The same as below)



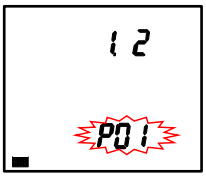

②Display Pattern

DISPLAY SET

Set the display pattern.

P01 ↔ P02 ↔ P00

<When 1-phase 2-wire is set at ①Phase wire system.>
P02 is not selectable.




The following table shows measuring elements displayed on each display pattern. The measuring elements displayed on P01 and P02 are the same. For P01, four elements are displayed in one screen. For P02, each phase is displayed in one screen. For details, refer to **6.1**.
P00 is a special display pattern to freely set display items. For details on the settings, refer to **3.13**.

○ : Displayable only by this setting
△ : Other additional settings are necessary to display.
☐ : Select 'P00' and set up the display order and position.

1) When set to 3-phase 4-wire system

| Display Pattern | Current | Current N-phase | Current Demand | Current demand N-phase | Voltage | Active Power | Reactive Power | Apparent Power | Power Factor | Frequency | Active Energy (Imported) | Reactive Energy | Apparent Energy | Additional Screen *Note | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | Active Energy (Imported/Exported) | Reactive Energy | Reactive Energy | Harmonic Current/Voltage | Operating Time |
| P01 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ | △ |
| P02 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ | △ |
| P00 | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | △ | △ | △ | △ | △ |

Continued to the next page.

Continued from the previous page

2）When set to other than 3-phase 4-wire system
*For 1-phase 2-wire system, P02 is not selectable.

| Display Pattern | Current | Current Demand | Voltage | Active Power | Reactive power | Apparent power | Power Factor | Frequency | Active Energy (Imported) | Reactive Energy | Apparent Energy | Additional Screen *Note: Active Energy (Imported/Exported) | Reactive Energy | Reactive Energy | Harmonic Current/Voltage | Operating Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P01 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ | △ |
| P02 | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | △ | △ |
| P00 | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | △ | △ | △ | △ | △ |

Note: The following settings are necessary to display the elements of additional screens.

| Measuring element of the additional screen | Setting item | Reference |
|---|---|---|
| Harmonic current/voltage | Setting Menu 3 Harmonics display | **3.4** |
| Operating time | Setting Menu 8 Operating time display | **3.9** |

*To display the additional screen of active/reactive/apparent energy of P00, you must set each item as display element.

DISPLAY SET

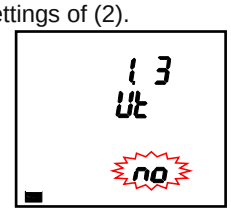
③VT/Direct voltage

Set the settings for VT.
・For direct measurement input (without VT) ⇒ Select no, and then press SET. Follow the settings of (1).
・For measurement with VT ⇒ Select yES and then press SET. Follow the settings of (2).

1. When set to 3-phase 4-wire system
no ⟷ yES

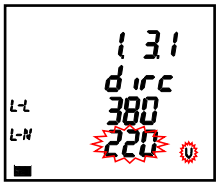
2. When set to 3-phase 3-wire/1-phase 2-wire system
yES ⟷ no

Note. VT is Voltage Transformer.




When you set 1-phase 3-wire at ①phase wire system, direct measurement input only is available. This setting will be skipped.

(1) For direct measurement input (without VT)




(a) When set to 3-phase 4-wire system
(Phase voltage/Line voltage)

63.5/110 V ⟷ 100/173 V ⟷ 110/190 V ⟷ 220/380 V ⟷ 230/400 V ⟷ 240/415 V
277/480 V ⟷ 254/440 V

(b) When set to 3-phase 3-wire system (2CT, 3CT) /1-phase 2-wire system
(Line voltage)

110 V ⟷ 220 V ⟷ 440 V

(c) When set to 1-phase 3-wire system (1N2, 1N3)
(Phase voltage/Line voltage)

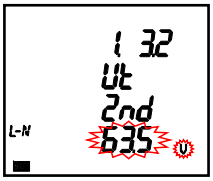
110/220 V ⟷ 220/440 V

DISPLAY SET

DISPLAY SET

Continued form the previous page.

(2) For measurement with VT

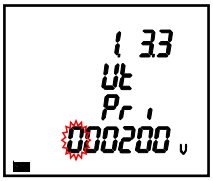



<Secondary voltage setting>
(a) When set to 3-phase 4-wire system (Phase voltage)

63.5 V ⟷ 100 V ⟷ 110 V ⟷ 115 V ⟷ 120 V

(b) When set to 3-phase 3-wire (2CT, 3CT) /1-phase 2-wire (Line voltage)

100 V ⟷ 110 V ⟷ 220 V




<Primary voltage setting>
The factory default settings:
・For 3-phase 4-wire system ⇒ 200 V (Phase voltage)
・For 3-phse 3-wire/1-phase 2-wire system ⇒ 10000 V (Line voltage)

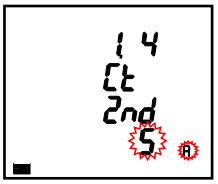
・From the upper digit, set the blinking digit with ⊕ or ⊖.
・By pressing SET, move the setting digit, blinking one, to a lower digit.
・By pressing DISPLAY, move the setting digit, blinking one, to an upper digit.
・The setting ranges from 60 V to 750000 V. The setting unit is V.
*If you set out of range, the error message (E05) will appear.
If the error message appears, press SET and then review the settings to set it again.
・By pressing SET at the lowest digit, shift to the next setting item.

④CT current

DISPLAY SET

Set the settings for CT.

You will set the primary and secondary current of CT.

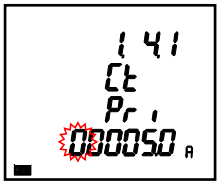



<Secondary current setting>

1 A ⟷ 5 A

Note: CT is Current Transformer.

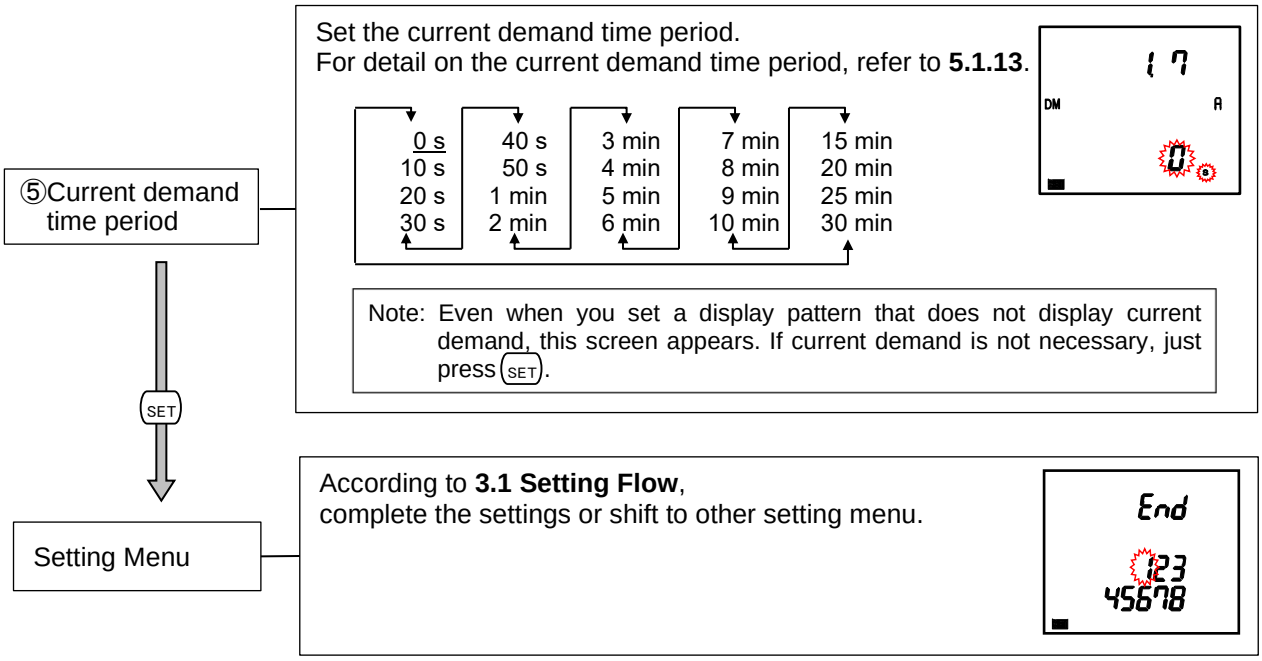
<Primary current setting>
The factory default setting: 5.0 A




・From the upper digit, set the blinking digit with ⊕ or ⊖.
・By pressing SET, move the setting digit, blinking one, to a lower digit.
・By pressing DISPLAY, move the setting digit, blinking one, to an upper digit.
・The setting ranges from 1.0 A to 30000.0 A.
The setting unit is A.
*If you set out of range, the error message (E05) will appear.
If the error message appears, press SET and then review the settings to set it again.
・By pressing SET at the lowest digit, shift to the next setting item.

DISPLAY SET

## 3.2 Setting Menu 1: Basic Setup (Settings for Phase Wire System, Display Pattern, VT/Direct Voltage, and CT Primary Current)




If only the settings in the setting menu 1 are necessary to use, move to **5 Operation**.
If you use an additional function, set it in the setting menu 2 to 8.

| | |
|---|---|
| **Note** | If you change a setting in the setting menu 1, the maximum and minimum values of the related measuring elements will be reset. However, active/reactive energy will not be reset.<br>For details, refer to **3.11 Initialization of Related Items by Changing a Setting**. |

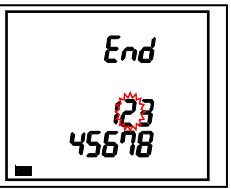
# 3. How to Set up

## 3.3. Setting Menu 2: Communication Settings (MODBUS RTU Communication Settings)

In the operating mode, press the SET and RESET buttons simultaneously for 2 seconds or more to enter the following operation.

Setting Menu

Select 2 in the setting menu.
*Refer to the right figure.

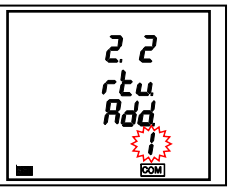



DISPLAY / SET

①MODBUS RTU Address

Set the address of MODBUS RTU communication.

Settable address: 1 to 255

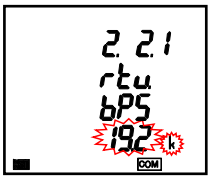



DISPLAY / SET

②MODBUS RTU Baud rate

Set the baud rate of MODBUS RTU communication.

2400 bps
4800 bps
9600 bps
19.2 kbps
38.4 kbps




DISPLAY / SET

③MODBUS RTU Parity

Set the parity of MODBUS RTU communication.

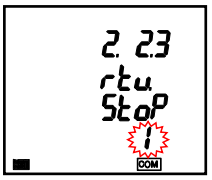
non
odd
even（EVEn）


DISPLAY / SET

④MODBUS RTU Stop bit

Set the stop bit of MODBUS RTU communication.

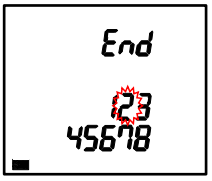
Stop bit 1 ⟷ Stop bit 2




SET

Setting Menu

According to **3.1 Setting Flow**,
complete the settings or shift to other setting menu.



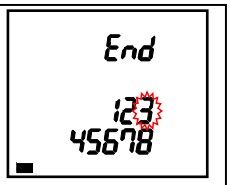
# 3. How to Set up

## 3.4. Setting Menu 3: Display Settings (Settings for Display of Active/Reactive Energy and Harmonic Measurement)

This section describes how to set the special measurement of active/reactive energy and harmonic display. In the operating mode, press the SET and RESET buttons simultaneously for 2 seconds or more to enter the following operation.

Setting Menu

Select 3 in the setting menu.
*Refer to the right figure.




DISPLAY SET

①Active/Reactive Energy measurement

Set the display combination of active energy and reactive energy (imported/exported, lag/lead) and the measurement method of reactive energy.

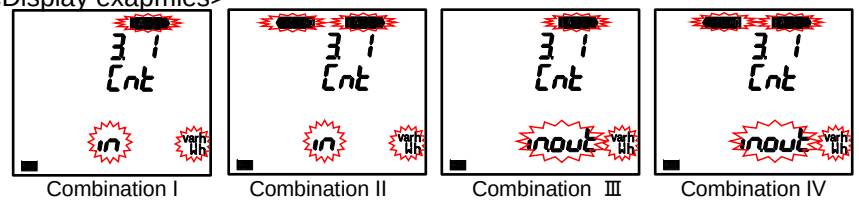
| Combination (Settings) | Active energy (Wh) | | Reactive energy (varh) | | | | Reactive energy measurement method |
|---|---|---|---|---|---|---|---|
| | Imported | Exported | Imported | | Exported | | |
| | | | lag | lead | lag | lead | |
| I | ○ | | ○ | | | | 2 quadrant measurement |
| II | ○ | | ○ | ○ | | | |
| III | ○ | ○ | ○ | | ○ | | 4 quadrant measurement |
| IV | ○ | ○ | ○ | ○ | ○ | ○ | |

Note: For details on how to measure reactive energy, refer to **5.1.11**.

Combination I, II ⇒ They are suitable for measuring systems without a private power generator or measuring reactive power of capacitor load where power factor is around zero generally.

Combination III, IV ⇒ They are suitable for measuring systems with a private power generator.

<Display exapmles>




in Imported out Exported ⊣⊢LEAD varh (lead) LAG varh (lag)

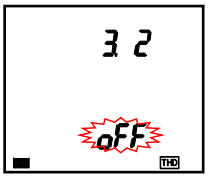
When 'Wh' or 'varh' is selected in the display pattern of P00, it is displayed.

DISPLAY SET

②Harmonics

Set the harmonic display.

oFF ⟷ on
(Not display) (Display)

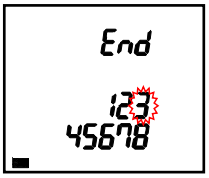



When you set to "on (Display)", harmonic measured values are displayed on the additional screen of display pattern.

SET

Setting Menu

According to **3.1 Setting Flow**, complete the settings or shift to other setting menu.



# 3. How to Set up

## 3.5. Setting Menu 4: LCD Settings (Settings for Model Display, Version Display, Backlight, and Update Time)

This section describes how to check the model and set the backlight and display update time. These settings are not necessary for normal use.
In the operating mode, press the SET and RESET buttons simultaneously for 2 seconds or more to enter the following operation.

Setting Menu

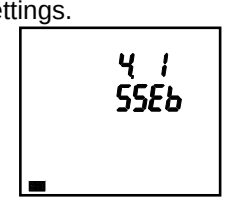
Select 4 in the setting menu.
*Refer to the right figure.


DISPLAY / SET

①Model Display

You can check the model.
*This is for display only and not possible to change the settings.
The following table shows the corresponding model.
(1)Second line

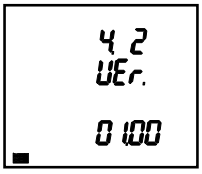
| Model | |
|---|---|
| 55Eb | ME96SSEB-MB |




DISPLAY / SET

②Version display

You can check the product version.
*This is for display only and not possible to change the settings.

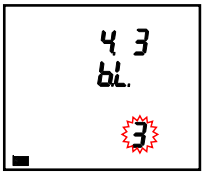



DISPLAY / SET

③Backlight brightness

It is possible to adjust the backlight brightness.

1 ⟷ 2 ⟷ 3 ⟷ 4 ⟷ 5
Dark ⟶ Bright




DISPLAY / SET

④Backlight Auto off/ON

Select a backlight setting from “Auto” or “HoLd.”

Auto (Auto off) ⟷ HoLd (ON)


<When the backlight is set to “Auto”>
No button operation for 5 minutes → OFF
Button operation during off *Note → ON for 5 minutes

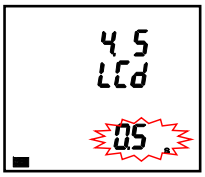
Note: During OFF mode, when you operate any button, the backlight lights up and the display remains as it is. When you press any button again, the display switches.

DISPLAY / SET

⑤Display update time

It is possible to change the setting for display update time of measured values. If the switch timing is too quickly for you to read the display value, set it to 1 second.
*The default setting is 0.5 second.

0.5 second ⟷ 1 second




SET

Setting Menu

According to **3.1 Setting Flow**, complete the settings or shift to other setting menu.

# 3. How to Set up

## 3.6. Setting Menu 5: Alarm Settings (Settings for Upper/Lower Limit Alarm and Motor Starting Current Mask Function)

This section describes how to set the upper/lower limit alarm, backlight blinking during alarm, and motor starting current.
In the operating mode, press the SET and RESET buttons simultaneously for 2 seconds or more to enter the following operation.

For details about each function, refer to the following:
- Upper/lower limit alarm → See **5.2.1** to **5.2.3**.
- Motor starting current → See **5.2.6**.

Setting Menu

Select 5 in the setting menu.
*Refer to the right figure.

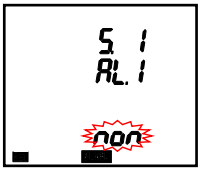

DISPLAY SET

①Upper/Lower limit alarm item 1

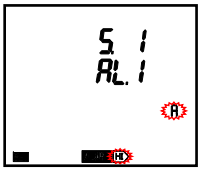
Set a measuring element of upper/lower limit alarm item 1.
This setting enables upper/lower limit monitoring of measured values.

(1) When set to 3-phase 4-wire system

non
A upper limit
A lower limit
AN upper limit
DA upper limit
DA lower limit
DAN upper limit
V (L-N) upper limit
V (L-N) lower limit
V (L-L) upper limit
V (L-L) lower limit
W upper limit
W lower limit
var upper limit
var lower limit
PF upper limit
PF lower limit
Hz upper limit
Hz lower limit
HI total upper limit
$HI_N$ total upper limit
$THD_V$ upper limit




Display for selection of "non"




Display for selection of "A upper limit"

(2) When set to other than 3-phase 4-wire system

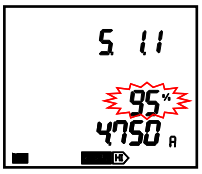
non
A upper limit
A lower limit
DA upper limit
DA lower limit
V upper limit
V lower limit
W upper limit
W lower limit
var upper limit
var lower limit
PF upper limit
PF lower limit
Hz upper limit
Hz lower limit
HI total upper limit
$THD_V$ upper limit

Note1. The measuring elements not included in the display pattern you set can be selected.

## 3.6 Setting Menu 5: Alarm Settings (Settings for Upper/Lower Limit Alarm and Motor Starting Current Mask Function)

②Upper/Lower limit alarm value 1

Set the alarm value of upper/lower limit alarm item 1.
The following table shows the setting range.




| Measuring element | Setting range | Setting Step *Note |
|---|---|---|
| A, AN, DA, DAN upper limit | 5 to 100 to 120 (%) | 1% |
| A, DA lower limit | 3 to 10 to 95 (%) | 1% |
| V (L-N), V (L-L) upper limit | 25 to 110 to 135 (%) | 1% |
| V (L-N), V (L-L) lower limit | 20 to 70 to 95 (%) | 1% |
| W upper limit, var upper limit | -95 to 100 to 120 (%) | 1% |
| W lower limit, var lower limit | -120 to 3 to 95 (%) | 1% |
| PF upper limit | -0.05 to 1 to 0.05 | 0.05 |
| PF lower limit | -0.05 to -0.5 to 0.05 | 0.05 |
| Hz upper limit | 45 to 65 (Hz) | 1Hz |
| Hz lower limit | 45 to 65 (Hz) | 1Hz |
| HI total upper limit | 1 to 35 to 120 (%) | 1% |
| $HI_N$ total upper limit | 1 to 35 to 120 (%) | 1% |
| $THD_V$ total upper limit | 0.5 to 3.5 to 20.0 (%) | 0.5% |

Note: W and var show the percentage ratio of a standard value.
For details about how to calculate the standard value, refer to **6.2 Standard Value**.
A, $A_N$, DA, $DA_N$, the total RMS value of harmonic current, and the total RMS value of harmonic current N-phase show the percentage ratio of the CT primary current setting.
V shows the percentage ratio of the VT primary voltage setting (or direct voltage).
*For 1-phase 3-wire system, V shows the percentage ratio of the phase voltage.
For 12-phase or 31-phase, alarm monitoring is executed based on twice the set upper/lower limit alarm value.

DISPLAY SET

③Upper/Lower limit alarm item 2 to 4

Set a measuring element of each of upper/lower limit alarm item 2 to 4.
The item you have already selected is not available repeatedly.
The setting method is the same as ①Upper/Lower limit alarm item 1.

DISPLAY SET

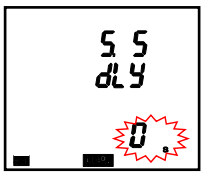
④Upper/Lower limit alarm value 2 to 4

Set the alarm value of each of upper/lower limit alarm item 2 to 4.
The setting method is the same as ②Upper/Lower limit alarm value 1.

DISPLAY SET

⑤Alarm delay time

Set the alarm delay time if you want to prevent an alarm caused by momentary overload or noise.
If you set this setting, an alarm will occur only when the upper/lower limit alarm value is exceeded and the situation continues for a period of alarm delay time.



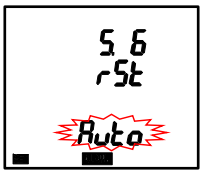

0 s → 5 s → 10 s → 20 s → 30 s → 40 s → 50 s → 1 min → 2 min → 3 min → 4 min → 5 min → 0 s

Note: When ①Upper/Lower limit alarm item 1 and ③Upper/Lower limit alarm item 2 to 4 are all set to “non”, this setting is skipped.

DISPLAY SET

⑥Alarm reset method

Set the reset method to cancel an alarm.




| Reset method (Settings) | Description (For details, refer to **5.2.1** to **5.2.2**.) |
|---|---|
| Automatic (Auto) | When alarm-generating conditions disappear, the alarm is automatically reset. |
| Manual (HoLd) | Even if alarm-generating conditions disappear, the alarm is retained. To cancel the alarm, you must execute button operation. |

Note: When ①Upper/Lower limit alarm item 1 and ③Upper/Lower limit alarm item 2 to 4 are all set to ‘non’, this setting is skipped.

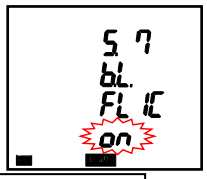
DISPLAY SET

## 3.6 Setting Menu 5: Alarm Settings (Settings for Upper/Lower Limit Alarm and Motor Starting Current Mask Function)

⑦Backlight blinking for alarm

It is possible to blink the backlight in case of alarm.

oFF ⟷ on
(Not blink) (Blink)




Note: When ①Upper/Lower limit alarm item 1 and ③Upper/Lower limit alarm item 2 to 4 are all set to “non”, this setting is skipped.

DISPLAY SET

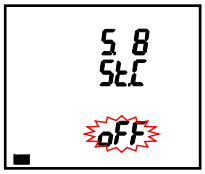
⑧Motor starting current delay time

For motor current monitoring, this setting enables to prevent unnecessary maximum value update and alarm generating caused by motor starting current.

・When this setting is not necessary ⇒ Select "oFF" and then press SET to move to the next setting item.

・When this setting is necessary ⇒ Select "on" and then press SET to move to (1) below.

oFF ⟷ on




(1) Motor starting current threshold
Set the threshold to detect motor starting current.

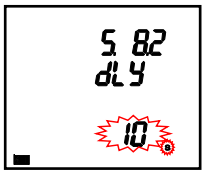
| Setting range | Setting step *Note |
|---|---|
| 3 to 5 to 120 (%) | 1% |

*Note: This is the percentage of the CT primary current setting.


(2) Motor starting current delay time
During the delay time after motor starting current is detected, neither a maximum value update nor an alarm is generated.

1 s → 3 s → 5 s → 10 s → 15 s → 20 s → 30 s → 45 s → 1 min → 1.5 min → 2 min → 3 min → 4 min → 5 min → 1 s

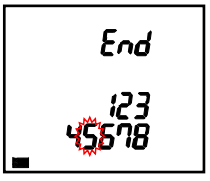
DISPLAY SET




DISPLAY SET

Setting Menu

According to **3.1 Setting Flow**,
complete the settings or shift to other setting menu.

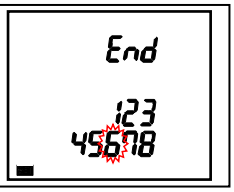


## 3.7. Setting Menu 6: No Settings

This setting item is not displayed because there is no corresponding function in this model.

Setting Menu

Even if you select 6 in the setting menu,
the item is not displayed.

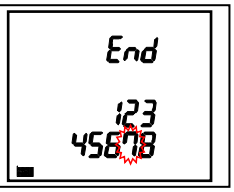



## 3.8. Setting Menu 7: No Settings

This setting item is not displayed because there is no corresponding function in this model.

Setting Menu

Even if you select 7 in the setting menu,
the item is not displayed.



# 3. How to Set up

## 3.9. Setting Menu 8: Special Settings (Settings for Operating Time and IEC Mode)

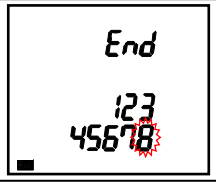
This section describes the settings of the operating time and IEC mode.
In the operating mode, press the SET and RESET buttons simultaneously for 2 seconds or more to enter the following operation.

For details about each function, refer to the corresponding section.
Operating time ⇒ See **5.2.4** to **5.2.5**.

**Setting Menu**

DISPLAY SET

Select 8 in the setting menu.
*Refer to the right figure.

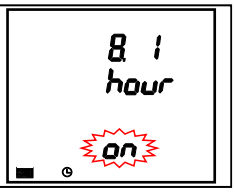



**①Operating time Display**

DISPLAY SET

Set whether to display the operating time, which integrates input time of count target and is displayed as load operating time.

oFF ⟷ on
（Not display） （Display）

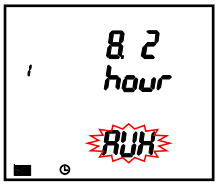



**②Operating time 1 Count target settings**

DISPLAY SET

Select a count target of operating time 1 from auxiliary power, current, or voltage.

AUX ⟷ A ⟷ V
(Auxiliary power) (Current) (Voltage)




| Item | 3-phase 4-wire | 1-phase 2-wire | Others |
|---|---|---|---|
| AUX | AUX | AUX | AUX |
| A | $A_{AVG}$ | A | $A_{AVG}$ |
| V | $V_{AVG}$（L-N） | V | $V_{AVG}$（L-L） |

**③Operating time 1 Threshold**

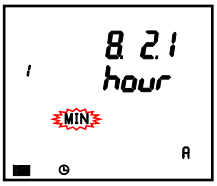
DISPLAY SET

Set the threshold of operating time 1 count.
When you select auxiliary power (AUX) at operating time1, this screen is not displayed.

(1) When you set the counting target of operating time 1 to current:

min ⟷ 1 to 120%
(Setting step 1%)

*If you select “min”, the operating time will be counted at current display of other than 0 A.




(2) When you set the counting target of operating time 1 to voltage.

min ⟷ 20 to 120%
(Setting step 1%)

*If you select “min”, the operating time will be counted at voltage display of other than 0 V.

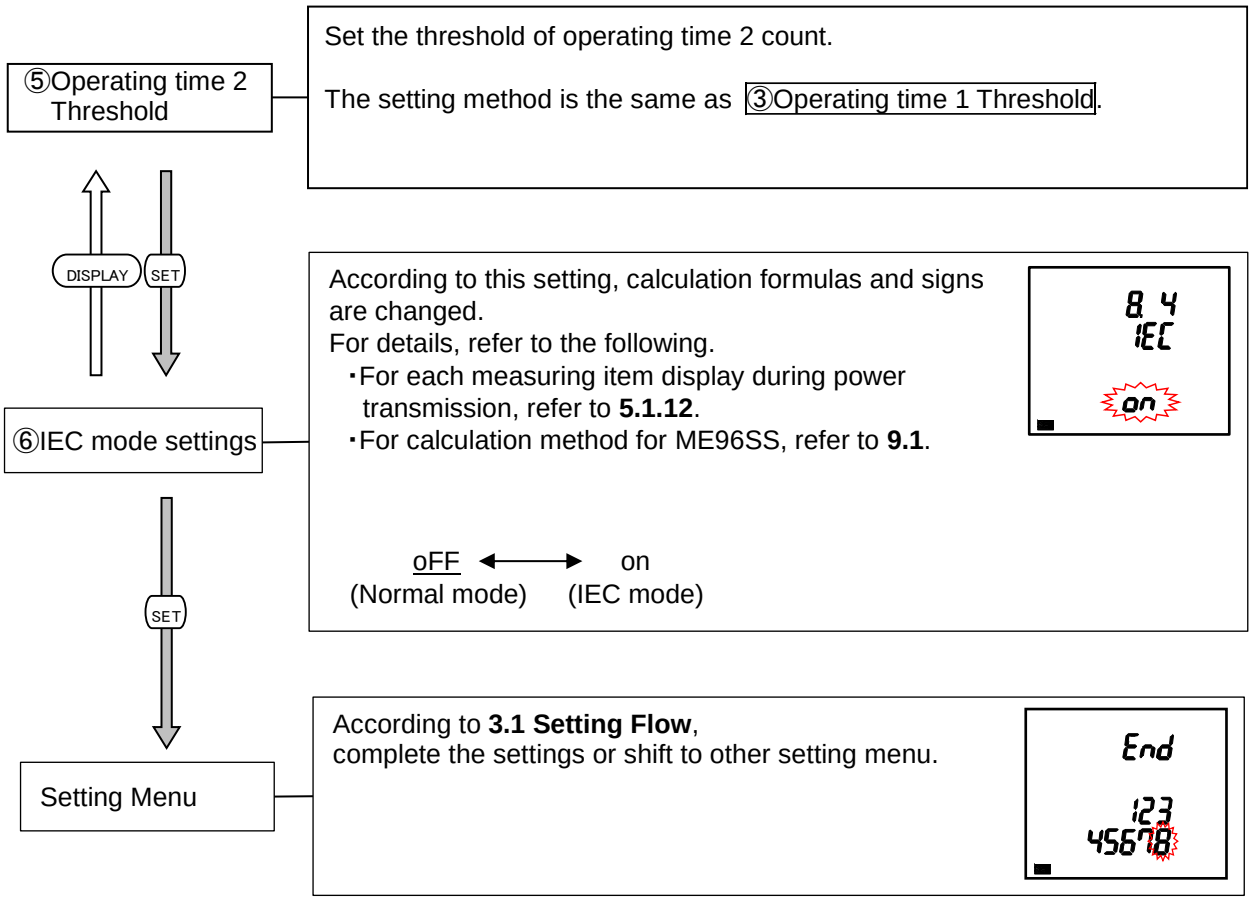
**④Operating time 2 Count target settings**

DISPLAY SET

Select a count target of operating time 2 from auxiliary power, current, or voltage.

The setting method is the same as ②Operating time 1 Counting target settings.

## 3.9. Setting Menu 8: Special Settings (Settings for Operating Time and IEC Mode)



# 3. How to Set up

## 3.10. Setting Confirmation Menu 1 to 9: How to Confirm the Settings in the Setting Menu 1 to 8, 9 Test Mode

### 1. Setting Confirmation

In the operating mode, press (SET) for 2 seconds or more to execute the operation.

Setting confirmation menu

In the setting confirmation menu, the screen switching and operation methods are the same as the setting menu 1 to 8. For details, refer to each setting menu.

Note: In the setting confirmation mode, setting change is not possible.


### 2. Test Mode

In the operating mode, press (SET) for 2 seconds or more and then set the setting confirmation menu number to '9' to enter the test mode.
For details on how to use the test mode, refer to **4 How to Use Test Mode**.

# 3. How to Set up

## 3.11. Initialization of Related Items by Changing a Setting

When you change a setting, the related setting items and measured data (maximum and minimum values) will be initialized. For details, refer to the following table.

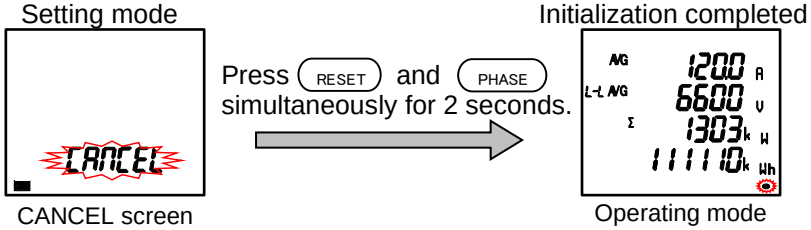
| Initialized item \ Setting item to be changed | | | Menu 1 | | | | Menu 5 | Menu 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Phase wire system *Note | VT/Direct voltage | CT current | | Upper/Lower limit alarm item | Operating time 1 count target | Operating time 2 count target | IEC mode settings |
| | | | | | CT secondary current | CT primary current | | | | |
| Setting item | Menu 1 | Phase wire system | | | | | | | | |
| | | Display pattern | ● | | | | | | | |
| | | VT/Direct voltage | ○ | | | | | | | |
| | Menu 5 | Upper/Lower limit alarm item | ● | | | | | | | |
| | | Upper/Lower limit alarm value | ● | | | | ● | | | |
| | Menu 8 | Threshold of Operating time 1 count target | | | | | | ● | | |
| | | Threshold of Operating time 2 count target | | | | | | | ● | |
| Measuring value | Current, Maximum/Minimum value | | ● | | ● | ● | | | | |
| | Current demand, Maximum/Minimum value | | ● | | ● | ● | | | | |
| | Voltage, Maximum/Minimum value | | ● | ● | | | | | | |
| | Active power, Maximum/Minimum value | | ● | ● | ● | ● | | | | |
| | Reactive power, Maximum/Minimum value | | ● | ● | ● | ● | | | | ● |
| | Apparent power, Maximum/Minimum value | | ● | ● | ● | ● | | | | ● |
| | Power factor, Maximum/Minimum value | | ● | ● | ● | ● | | | | ● |
| | Frequency, Maximum/Minimum value | | ● | | | | | | | |
| | Harmonic current, Maximum value | | ● | | ● | ● | | | | |
| | Harmonic voltage, Maximum value | | ● | ● | | | | | | |

●: It turns to the default setting.
○: It turns to the default setting according to the phase wire system.
Note: For 1-phase 3-wire system, the setting change between '1N2 display' and '1N3 display' does not cause initialization.

## 3.12. Initialization of All Settings

The following operation enables to reset all settings to the factory default. It is only for the settings. Measured active energy, reactive energy, and operating time are not changed.
For details on the initialization of maximum and minimum values, refer to **3.11 Initialization of Related Items by Changing a Setting**.
*For example, if the phase wire system is changed by initializing all settings, all maximum and minimum values will be reset.

To initialize all settings, display the CANCEL screen in the setting mode and then execute the following operation.
For details on how to display the CANCEL screen, refer to **3.1 Setting Flow**.



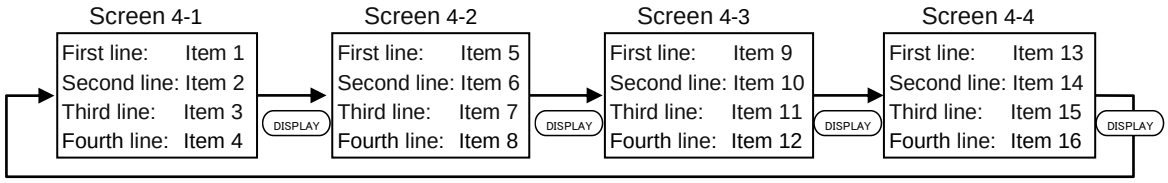
CANCEL screen
Operating mode

# 3. How to Set up

## 3.13. Settings for Special Display Pattern P00

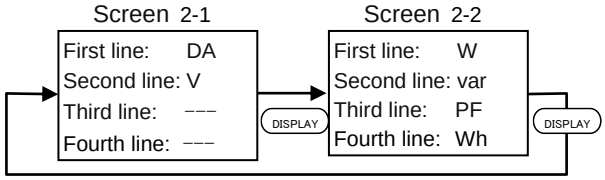
If you want to set a display pattern other than P01 or P02, P00 is available to freely set display items. This setting is conducted in the setting menu 1. The explanation here begins with the settings for P00 at ②Display pattern in the setting menu 1. For other operations, which are not explained here, refer to **3.2**.

(1) A maximum of 16 measuring items in four screens are available.




From the first line to the third line, each selectable item is A, DA, V, W, var, VA, PF, or Hz.
At the fourth line, Wh, - Wh, varh, and VAh are selectable.

(2) As an example, the following display pattern is used for explanation.

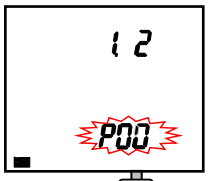



(3) How to set up

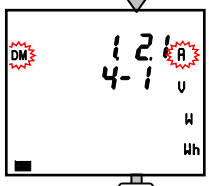
②Display pattern

You will set up a display pattern.

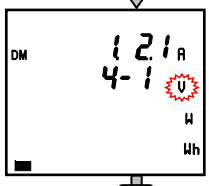
(1) Select “P00.”
Select “P00” with ⊕ or ⊖ and then press SET.



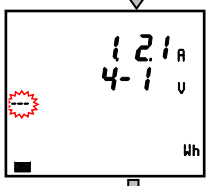

(2) Set the first line to “DM A” in the screen 4-1.
Select “DM A” with ⊕ or ⊖ and then press SET.



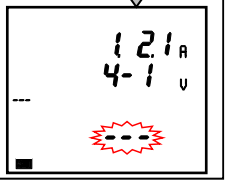

(3) Set the second line to “V” in the screen 4-1.
Select “V” with ⊕ or ⊖ and then press SET.




(4) Set the third line to no display in the screen 4-1.
Select “---” with ⊕ or ⊖ and then press SET.




(5) Set the fourth line to no display in the screen 4-1.
Select “---” with ⊕ or ⊖ and then press SET.

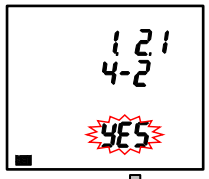


## 3.13. Settings for Special Display Pattern P00

Continued form the previous page.

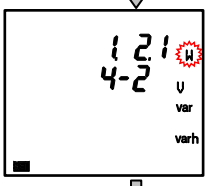
(6) You will set up the display of screen 4-2.
Select “yES” with ⊕ or ⊖ and then press SET.

∗When the screen 2 is not necessary to display, select “no” and press SET.



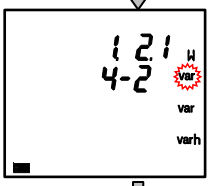

SET

(7) Set the first line to “W” in the screen 4-2.
Select “W” with ⊕ or ⊖ and then press SET.



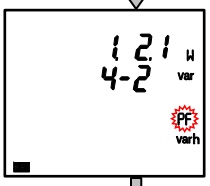

SET

(8) Set the second line to “var” in the screen 4-2.
Select “var” with ⊕ or ⊖ and then press SET.



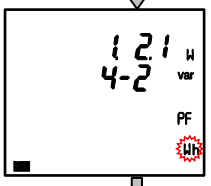

SET

(9) Set the third line to “PF” in the screen 4-2.
Select “PF” with ⊕ or ⊖ and then press SET.




SET

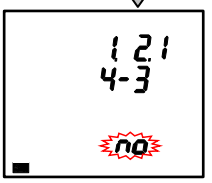
(10) Set the fourth line to “Wh” in the screen 4-2.
Select “Wh” with ⊕ or ⊖ and then press SET.




SET

(11) Set the screen 4-3 to hidden.
Select “no” with ⊕ or ⊖ and then press SET.

Note: When you set the screen 4-3 to hidden, the screen 4-4 is automatically set to hidden.




Return to the setting of the upper line in the screen 4-1.

DISPLAY

③VT/Direct voltage

(Hereafter same as the setting menu 1)

| | |
|---|---|
| **Note** | 1. The following measuring items cannot be set in the display pattern of P00. Set them in the setting menu 3 and 8.<br>・Harmonic current, Harmonic voltage, Operating time<br>2. It is not possible to specify phases of current and voltage. In the operating mode, press PHASE to switch the phase.<br>3. The following measuring items can be set for 3-phase 4-wire system only.<br>・Current N-phase, Current demand N-phase |

## 3.14. Example for Easy Setup

The following example illustrates an easy setup.

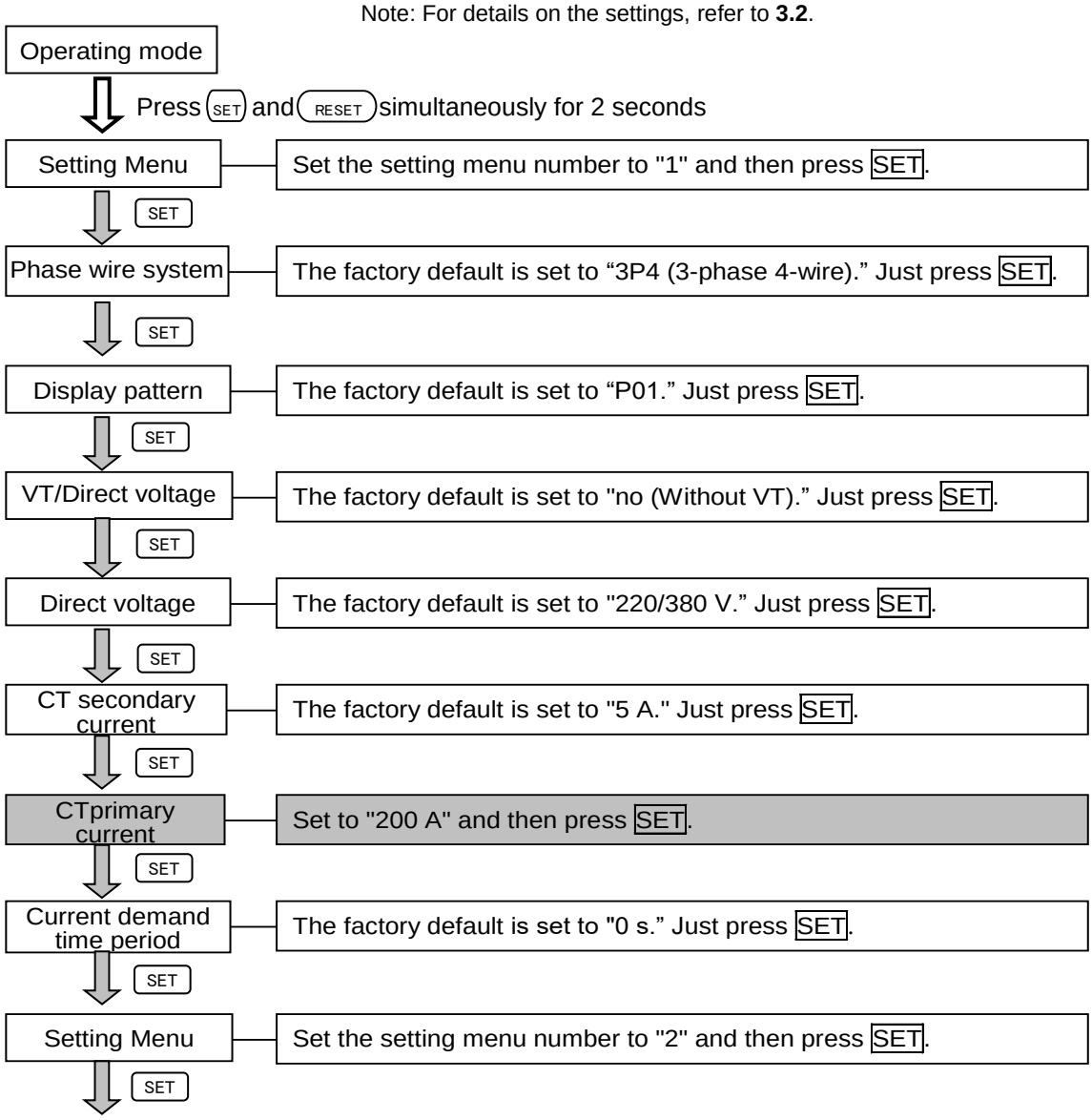
■Setting Example

- Model: ME96SSEB-MB
- Phase wire system: 3-phase 4-wire
- Measuring element: A, V, W, PF
- Input Voltage: 220/380 V
- CT primary current: 200 A
- CT Secondary current: 5 A
- MODBUS RTU: Address: 1, Baud rates: 19.2kbps, Parity: even, Stop bit: 1

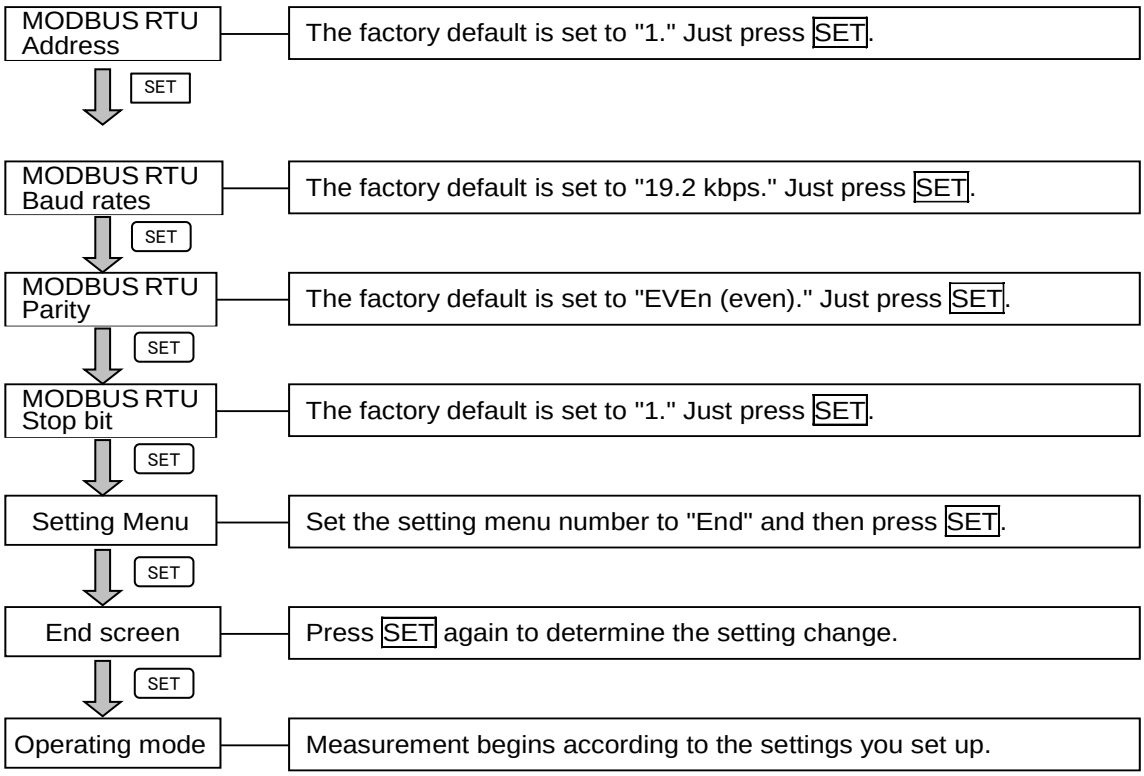
■Setting Procedure

shows the item where setting change is necessary.

Note: For details on the settings, refer to **3.2**.



## 3.14. Example for Easy Setup



## 4. How to Use Test Mode

The test mode has function useful for startup of systems.
The following table shows a list of functions in the test mode.

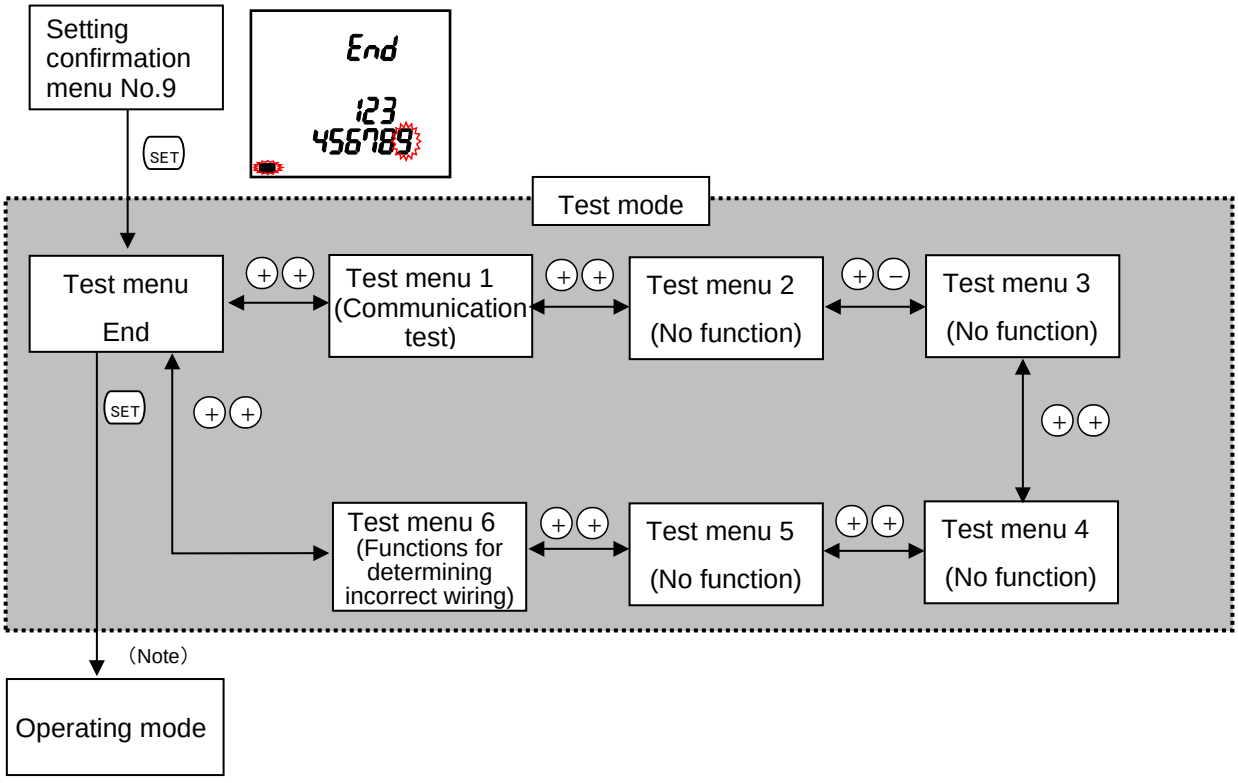
| Test menu | Description |
|---|---|
| 1. Communication test | For MODBUS RTU communication function, it is possible to return fixed numerical data without measurement (voltage/current) input. Use this for checking with the host system. |
| 2. to 5. No function | — |
| 6. Functions for determining incorrect wiring | ①Pattern display for incorrect wiring<br>When either a voltage input or current input is incorrectly wired, this function automatically determines incorrect wiring and displays its part on the screen. It is easier to find out the incorrect part and useful to check the connection. *Note<br>②Support display for determining incorrect wiring<br>This function displays a current phase angle, a voltage phase angle, and active power, voltage, and current value of each phase. By checking each display and **9.2 A List of Examples for Incorrect Wiring Display**, it is easier to determine incorrect wiring for measurement (voltage/current) input. |

*Note: The function cannot determine all incorrect wiring. If both a voltage input and a current input are incorrectly wired, a different pattern may be displayed.

■Test procedure

① Press (SET) for 2 seconds to enter the setting confirmation mode.
② With (+) or (–), select '9' in the setting confirmation menu number
③ Press (SET) to enter the test mode.
④ Execute the test in each test menu. For details, refer to **4 How to Use Test Mode**.

■Test mode flow




Note: The screen momentarily goes off.

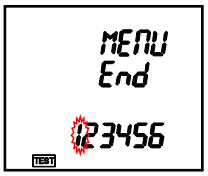
# 4. How to Use Test Mode

## 4.1. Test Menu 1: Communication Test

Set the setting confirmation menu number to '9' to enter the test mode
In the test mode, the following operation is available.

Test Menu

Set the test menu number to 1.
*Refer to the right figure.




SET

①Communication test

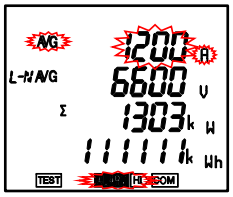
The communication test will be executed.
*Without current/voltage input, it is possible to monitor values other than zero.

■Monitor values by communication

・Monitor elements and values are measuring items and values displayed on the screen. The monitor values of measuring items that are not displayed on the screen are zero. The power factor only is 1.000.

・The measuring items set to alarm are displayed as alarm generating.

■Display screen




・As in the operating mode, the items are displayed according to settings such as display pattern.
・The Max/Min value display is also possible. (The cyclic display is not possible.)

■Button operation

| Operation | Function |
|---|---|
| Press DISPLAY | Switch the display screen. |
| Press PHASE | Switch phase display. Switch between the RMS value and distortion ratio on the harmonic screen. |
| Press MAX/MIN | Enter/Exit the Max/Min value screen. |
| Press + and − simultaneously for 2 seconds or more. | Change the unit such as Wh or change to lower-digit enlarged display. |
| Press SET | Return to the test menu. |

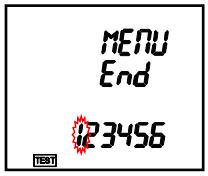
Note: When executing the communication test, read the following document as well as this user's manual.
・Electronic Multi-Measuring Instrument ME Series MODBUS Interface specifications (Reference No. LSPM-0075)

SET

Test Menu

<To shift to other test menu>
⇒ Select other test menu number and then press SET.

<To end the test mode>
⇒ Select End in the test menu number and then press SET. The screen will return to the operating mode.



## 4.2. Test Menu 2 to 5: No Test Menu

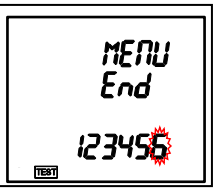
This test menu is not displayed because there is no corresponding function in this model.

## 4.3. Test Menu 6: Functions for Determining Incorrect Wiring

In the test mode, the following operation is available.

Test Menu

Set the test menu number to 6.
*Refer to the right figure.

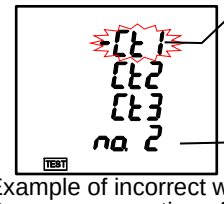



DISPLAY SET

①Pattern display of incorrect wiring

When either a voltage input or a current input is incorrectly wired, this function automatically determines incorrect wiring and the incorrect part is displayed on the screen. After checking it, press (SET) to return to the test menu.


Example of correct wiring




The incorrect wiring part blinks. *1
The correct one is ON.
The number of incorrect wiring pattern appears.
*For details on the pattern, refer to **4.3.1**.

Example of incorrect wiring:
Reverse connection of 1 side CT

*1. For 1-phase 3-wire system, the PN terminal is displayed as 'P2' on the screen. Read as 'PN.'

■Select a power factor condition (For 3-phase 3-wire system)

For 3-phase 3-wire system, the following screen may be displayed to select a power factor condition depending on the incorrect wiring situation.
With (+) or (−), select the power factor condition and then press (SET).
When the settings are determined, the incorrect wiring part is displayed on the screen.


Power factor: LAG　Power factor: Around 1　Power factor: LEAD

Note: Select a power factor condition by referring to the following points:

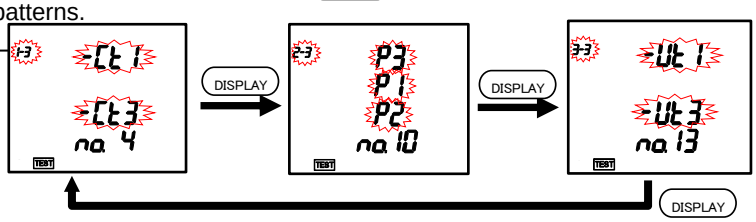
- ・Power factor: LAG→ Power factor is lagging for load of inductive machines. Assume 1 to lag 0.5.
- ・Power factor: Around 1 → Power factor is around 1 due to resistance load or power factor improvement. Assume lead 0.866 to lag 0.866.
- ・Power factor: LEAD→ Power factor is leading for capacitor panel. Assume lead 0 to 1.

*If the Err display appears at the bottom line of the LCD, press (−) and then select the power factor condition again.

■Check multiple alternatives (For 3-phase 3-wire/1-phase 3-wire/1-phase 2-wire system)

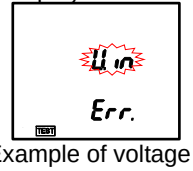
There may be multiple patterns of incorrect wiring depending on the incorrect wiring situation. For the above three systems, press (DISPLAY) to switch the screen and check the incorrect wiring patterns.

Display the first pattern in the three patterns

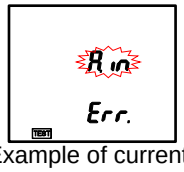



■There are multiple incorrect wiring parts (For 3-phase 4-wire system)

For this phase wire system, multiple incorrect wiring parts of voltage or those of current are detected and displayed on each screen.




Example of voltage




Example of current

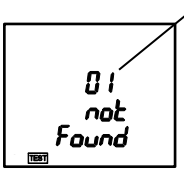
Continued to the next page.

## 4.3. Test Menu 6: Functions for Determining Incorrect Wiring

Continued from the previous page.

■It is not possible to detect incorrect wiring

If the screen is displayed as the following, it is not possible to detect incorrect wiring. Check measurement (voltage/current) input or press (+) to check ②Support display for determining incorrect wiring.

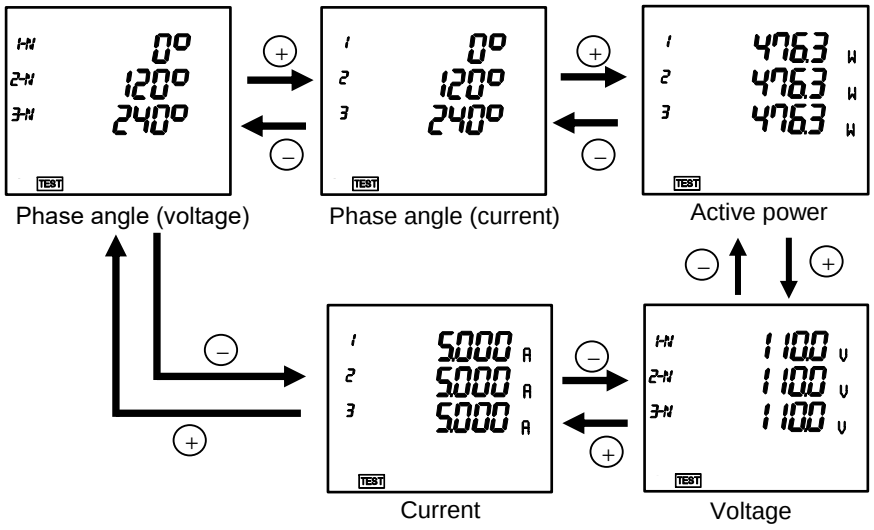



| Display | Description |
|---|---|
| 01 | This is low voltage. Apply about 70 percent or more of the direct voltage or secondary voltage setting. |
| 02 | This is low current. Apply about 5 percent or more of the rated current of the instrument. |
| 03 | This is in the unbalanced state. For 3-phase 3-wire system, it is not possible to detect incorrect wiring if there is a 10 percent or more difference between values in 1-phase and 3-phase of current. |
| 04 | There may be multiple incorrect wiring parts. Check ②Support display for determining incorrect wiring. |

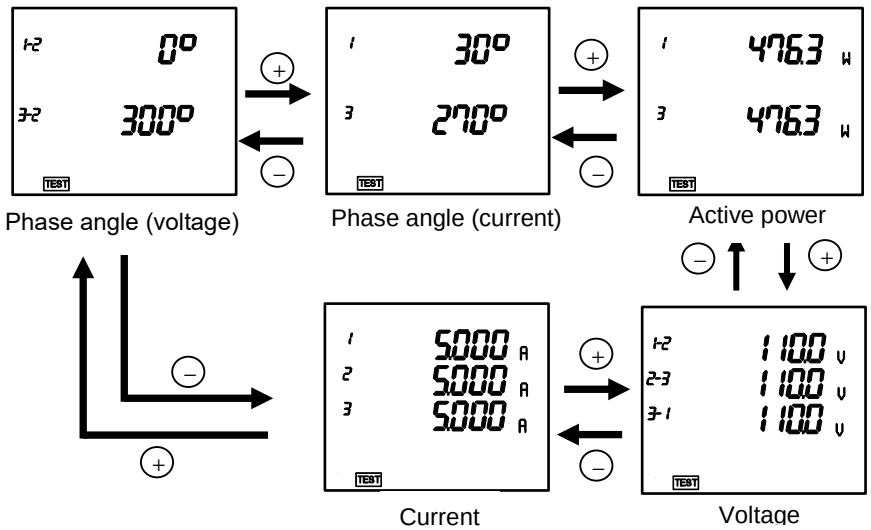
②Support display for determining incorrect wiring

Phase angle, active power, voltage, and current will be displayed.

<For 3-phase 4-wire system>




<For 3-phase 3-wire system>




SET

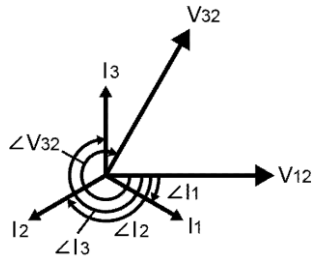
Continued to the next page.

## 4.3. Test Menu 6: Functions for Determining Incorrect Wiring

Continued from the previous page.

■Phase angle

The phase angle is displayed clockwise based on $V_{12}$ (0 degree).




∠$V_{32}$: Phase angle between $V_{32}$ and $V_{12}$
∠$I_1$: Phase angle between $I_1$ and $V_{12}$
∠$I_3$: Phase angle between $I_3$ and $V_{12}$

Note: For 1-phase 3-wire, read each phase as follows.
$V_{12} \rightarrow V_{1N}$
$V_{32} \rightarrow V_{3N}$
$I_3 \rightarrow I_2$ or $I_3$

■ Display examples for incorrect wiring support function
For display examples of each incorrect wiring, refer to **9.2 A List of Examples for Incorrect Wiring Display.**

Test Menu

<To shift to other test menu>
⇒ Select other test menu number and then press (SET).

<To end the test mode>
⇒ Select End in the test menu number and then press (SET).
The screen will return to the operating mode.

## 4.3. Test Menu 6：Functions for Determining Incorrect Wiring

### 4.3.1. Incorrect Wiring Patterns Detected by ①Pattern display of incorrect wiring

This function is designed with the assumption that either a current input or a voltage input is incorrectly wired in positive phase sequence. It is not possible to determine all incorrect wiring.
Dashed lines indicate incorrect wiring parts.

■For 3-phase 4-wire system

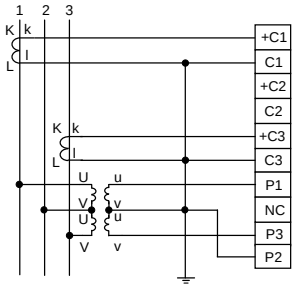
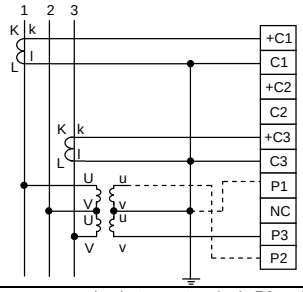
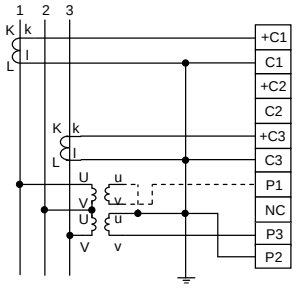
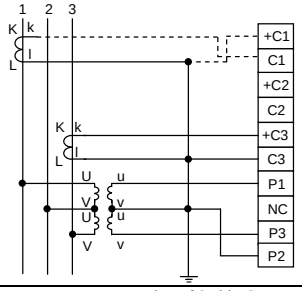
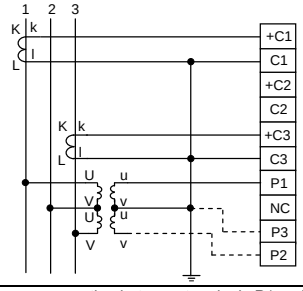
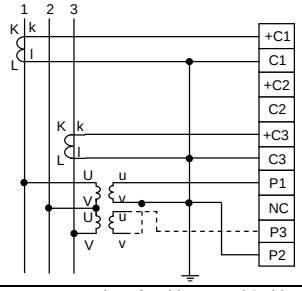
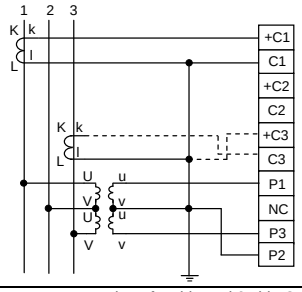
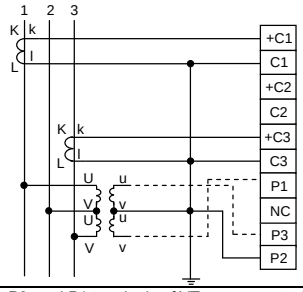
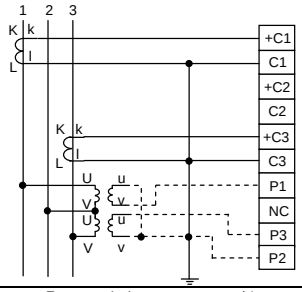
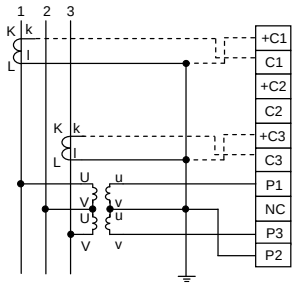
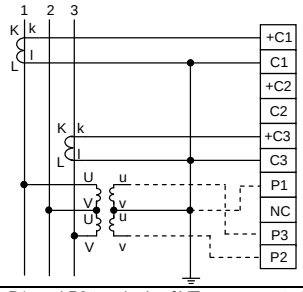
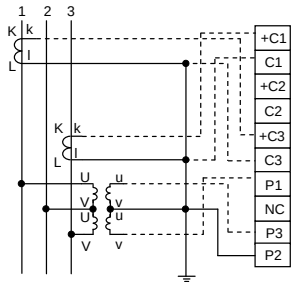
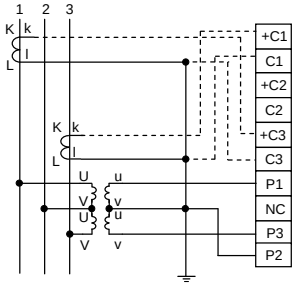
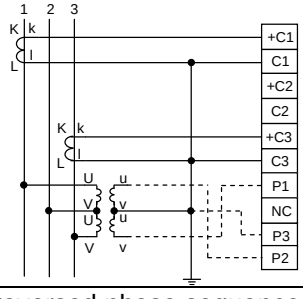
| No. | Wiring diagram | No. | Wiring diagram | No. | Wiring diagram | No. | Wiring diagram |
|---|---|---|---|---|---|---|---|
| 1 | Normal | 3 | Reverse connection of 2 side CT | 8 | Reverse connection of 1 side CT, 2 side CT, and 3 side CT | 13 | Reverse connection between terminals P2 and P3 |
| | Reversed phase sequence 1 *1 | 4 | Reverse connection of 3 side CT | 9 | Switch between 1 side CT and 2 side CT | 14 | Reverse connection between terminals P1 and P3 |
| | Reversed phase sequence 2 *1 | 5 | Reverse connection of 1 side CT and 2 side CT | 10 | Switch between 2 side CT and 3 side CT | 15 | Reverse connection between terminals P1 and PN |
| | Reversed phase sequence 3 *1 | 6 | Reverse connection of 2 side CT and 3 side CT | 11 | Switch between 1 side CT and 3 side CT | 16 | Reverse connection between terminals P2 and PN |
| 2 | Reverse connection of 1 side CT | 7 | Reverse connection of 1 side CT and 3 side CT | 12 | Reverse connection between terminals P1 and P2 | 17 | Reverse connection between terminals P3 and PN |

*1. Correct measurement is possible even in reversed phase sequence.
*2. For low voltage circuits, it is not necessary to ground the VT and CT secondary side circuits.

## 4.3. Test Menu 6：Functions for Determining Incorrect Wiring

### 4.3.1. Incorrect wiring patterns detected by ①Pattern display of incorrect wiring

■For 3-phase 3-wire system

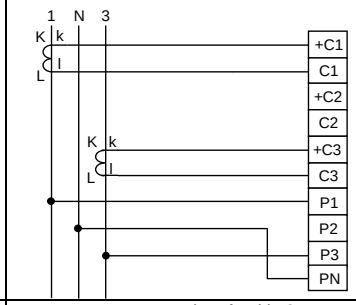
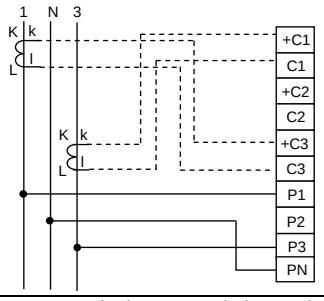
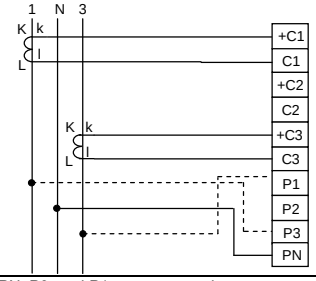
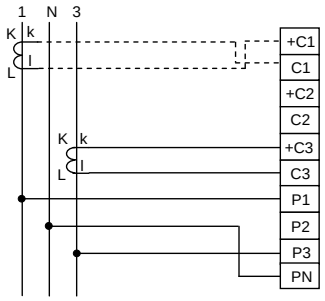
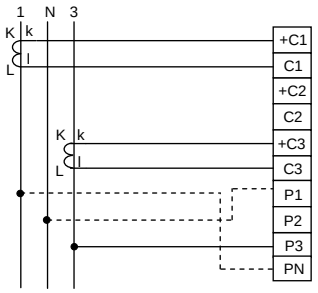
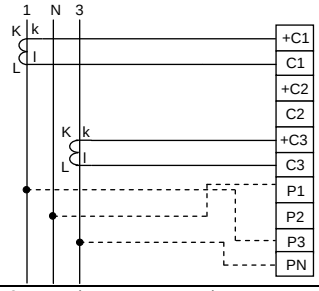
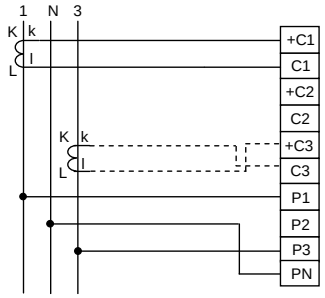
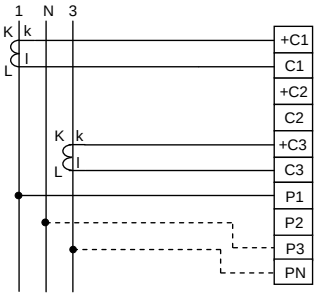
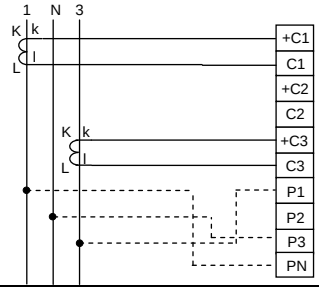
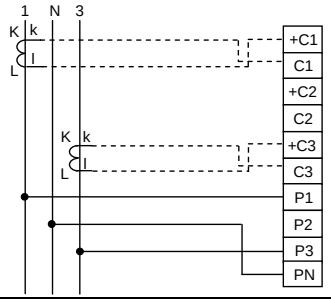
| No. | Wiring diagram | No. | Wiring diagram | No. | Wiring diagram |
|---|---|---|---|---|---|
| 1 | Normal  | 6 | Reverse connection between terminals P1 and P2  | 11 | Reverse connection of 1 side VT  |
| 2 | Reverse connection of 1 side CT  | 7 | Reverse connection between terminals P2 and P3  | 12 | Reverse connection of 3 side VT  |
| 3 | Reverse connection of 3 side CT  | 8 | Reverse connection between terminals P1 and P3  | 13 | Reverse connection of 1 side VT and 3 side VT  |
| 4 | Reverse connection of 1 side and 3 side CT  | 9 | P2, P3, and P1 terminals of VT are connected to P1, P2, and P3 terminals of the instrument in that order.  | 14 | Reversed phase sequence *1  |
| 5 | Switch between 1 side CT and 3 side CT  | 10 | P3, P1, and P2 terminals of VT are connected to P1, P2, and P3 terminals of the instrument in that order  | | |

*1. Correct measurement is possible even in reversed phase sequence.
*2. For low voltage circuits, it is not necessary to ground the VT and CT secondary side circuits.

## 4.3. Test Menu 6：Functions for Determining Incorrect Wiring

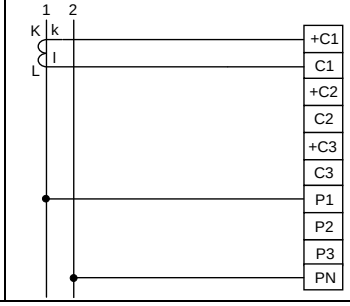
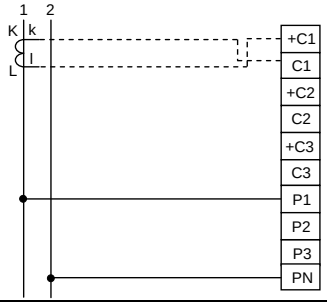
### 4.3.1. Incorrect wiring patterns detected by ①Pattern display of incorrect wiring

■For 1-phase 3-wire system *1

| No. | Wiring diagram | No. | Wiring diagram | No. | Wiring diagram |
|---|---|---|---|---|---|
| 1 | Normal  | 5 | Switch between 1 side CT and 3 side CT  | 8 | Reverse connection between terminals P1 and P3  |
| 2 | Reverse connection of 1 side CT  | 6 | Reverse connection between terminals P1 and PN  | 9 | PN, P3, and P1 are connected to P1, PN, and P3 terminals of the instrument in that order.  |
| 3 | Reverse connection of 3 side CT  | 7 | Reverse connection between terminals PN and P3  | 10 | P3, P1, and PN are connected to P1, PN, and P3 terminals of the instrument in that order.  |
| 4 | Reverse connection of 1 side and 3 side CT  | | | | |

*1. On the screen, the PN terminal is displayed as ‘P2’. Read as ‘PN.’

■For1-phase 2-wire system

| No. | Wiring diagram | No. | Wiring diagram |
|---|---|---|---|
| 1 | Normal  | 2 | Reverse connection of 1 side CT  |

# 5. Operation

## 5.1. Basic Operation

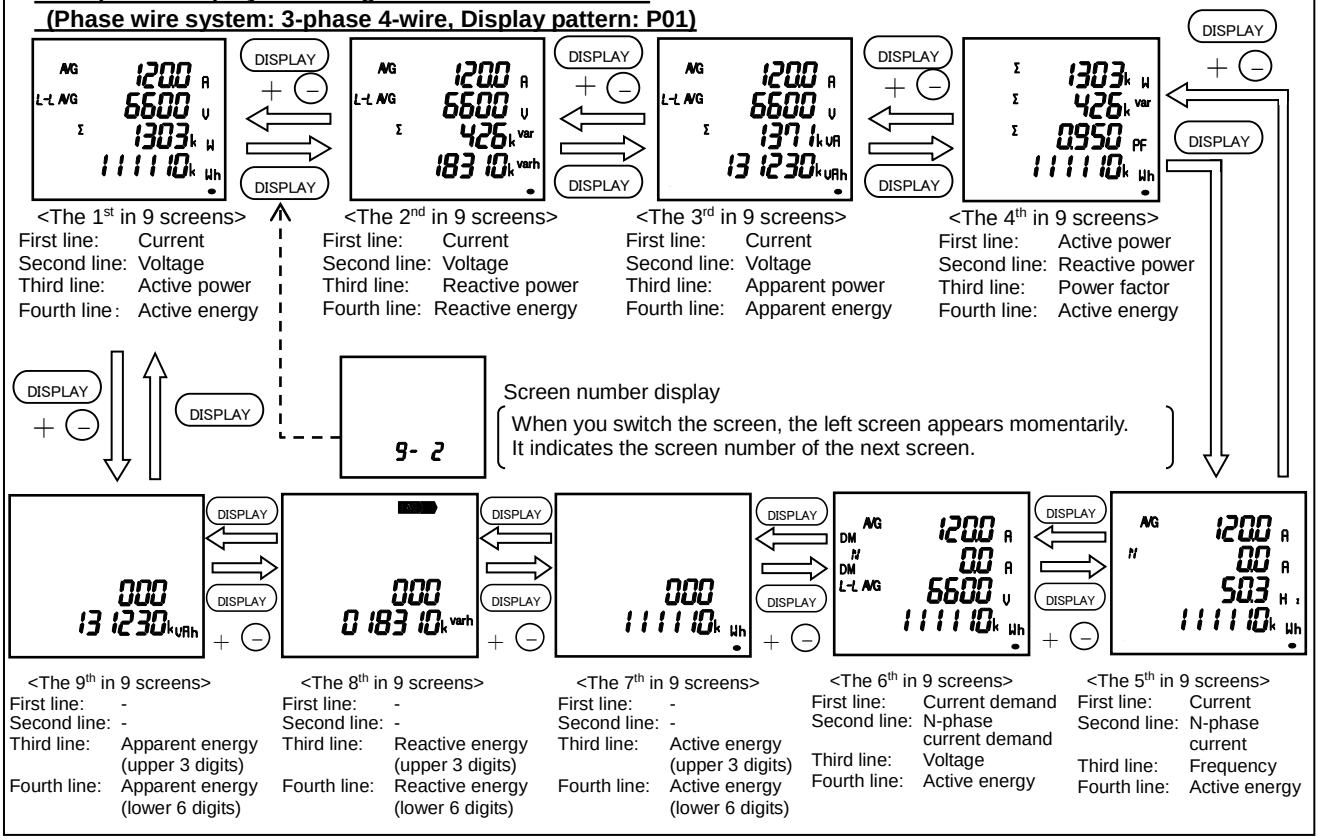
The following charts illustrate how to use basic operation.

> The display item and order vary depending on the phase wire system, display pattern, and additional screen.
> For details on the display pattern, refer to **6.1 Display Pattern List**.

### 5.1.1. How to Switch the Measurement Screen

Press (DISPLAY) to switch the measurement screen.
In addition, by pressing (DISPLAY) and (−), the measurement screen is switched in reverse.

**Example for display switching of measurement screen**
**(Phase wire system: 3-phase 4-wire, Display pattern: P01)**




<The 1st in 9 screens>
First line: Current
Second line: Voltage
Third line: Active power
Fourth line: Active energy

<The 2nd in 9 screens>
First line: Current
Second line: Voltage
Third line: Reactive power
Fourth line: Reactive energy

<The 3rd in 9 screens>
First line: Current
Second line: Voltage
Third line: Apparent power
Fourth line: Apparent energy

<The 4th in 9 screens>
First line: Active power
Second line: Reactive power
Third line: Power factor
Fourth line: Active energy

<The 5th in 9 screens>
First line: Current
Second line: N-phase current
Third line: Frequency
Fourth line: Active energy

<The 6th in 9 screens>
First line: Current demand
Second line: N-phase current demand
Third line: Voltage
Fourth line: Active energy

<The 7th in 9 screens>
First line: -
Second line: -
Third line: Active energy (upper 3 digits)
Fourth line: Active energy (lower 6 digits)

<The 8th in 9 screens>
First line: -
Second line: -
Third line: Reactive energy (upper 3 digits)
Fourth line: Reactive energy (lower 6 digits)

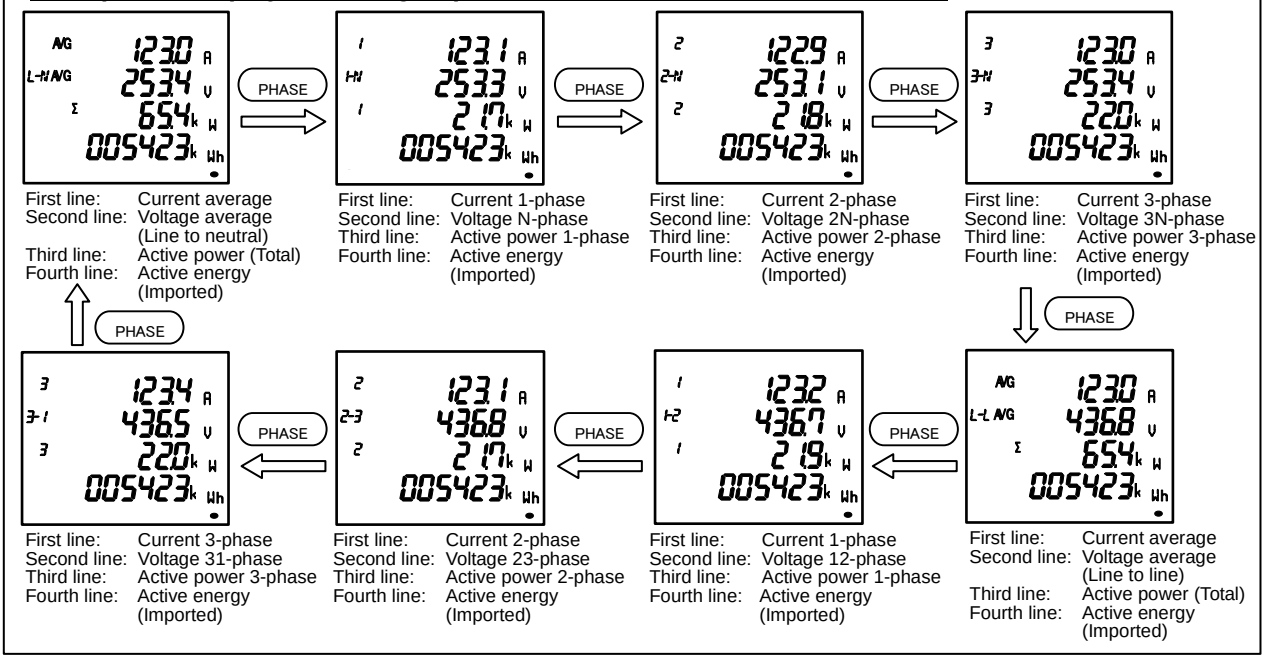
<The 9th in 9 screens>
First line: -
Second line: -
Third line: Apparent energy (upper 3 digits)
Fourth line: Apparent energy (lower 6 digits)

### 5.1.2. How to Switch Phase Display

Press (PHASE) to switch the phase of voltage/current.

> The phase switching is not available in the following cases:
> - Measuring element without phase (Frequency)
> - Active power, reactive power, apparent power, and power factor for other than 3-phase 4-wire system
> - 1-phase 2-wire system setting

**Example for display switching of phase (Phase wire system: 3-phase 4-wire)**




First line: Current average
Second line: Voltage average (Line to neutral)
Third line: Active power (Total)
Fourth line: Active energy (Imported)

First line: Current 1-phase
Second line: Voltage N-phase
Third line: Active power 1-phase
Fourth line: Active energy (Imported)

First line: Current 2-phase
Second line: Voltage 2N-phase
Third line: Active power 2-phase
Fourth line: Active energy (Imported)

First line: Current 3-phase
Second line: Voltage 3N-phase
Third line: Active power 3-phase
Fourth line: Active energy (Imported)

First line: Current 3-phase
Second line: Voltage 31-phase
Third line: Active power 3-phase
Fourth line: Active energy (Imported)

First line: Current 2-phase
Second line: Voltage 23-phase
Third line: Active power 2-phase
Fourth line: Active energy (Imported)

First line: Current 1-phase
Second line: Voltage 12-phase
Third line: Active power 1-phase
Fourth line: Active energy (Imported)

First line: Current average
Second line: Voltage average (Line to line)
Third line: Active power (Total)
Fourth line: Active energy (Imported)

# 5. Operation

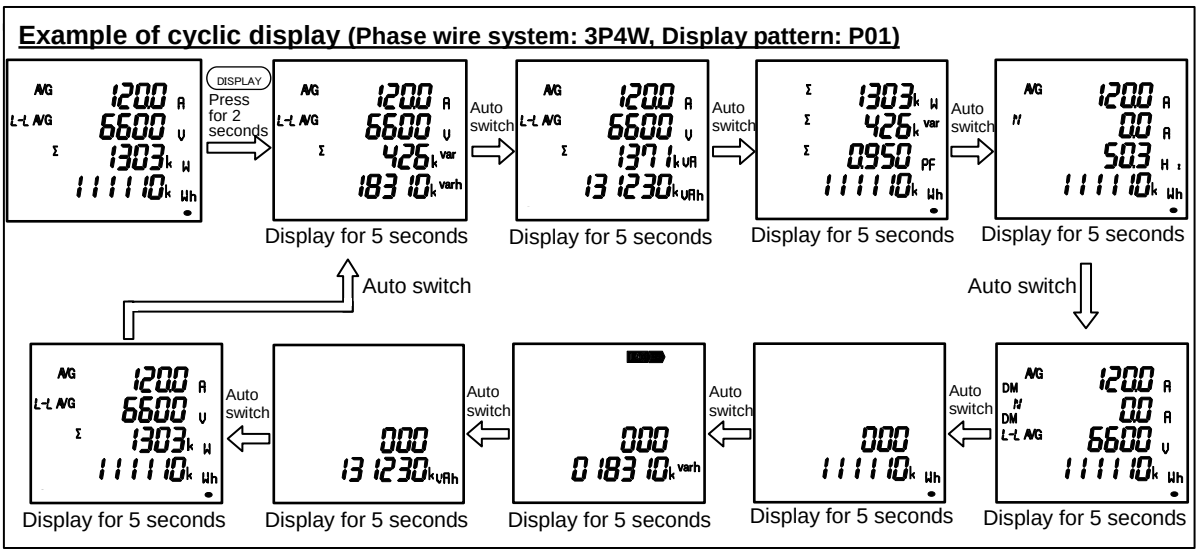
## 5.1. Basic Operation

### 5.1.3. How to Display in Cyclic Mode

In the cyclic mode, the measurement screen or phase display automatically switches every 5 seconds.
When you press (DISPLAY) for 2 seconds, the screen enters the cyclic display mode of measurement screen.
When you press (PHASE) for 2 seconds, the screen enters the cyclic display mode of phase.
To end the cyclic mode, press any button other than (SET).

Note 1: Before shift to the cyclic mode, the screen blinks 3 times.
Note 2: In the cyclic display mode of measurement screen, the screen number is not displayed at switching display.
Note 3: On the Max/Min value screen, the cyclic mode is available.

**Example of cyclic display (Phase wire system: 3P4W, Display pattern: P01)**




### 5.1.4. Harmonics Display

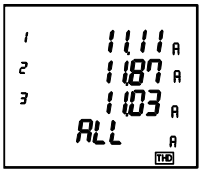
The harmonic RMS value and distortion ratio (content rate) can be displayed.
To display them, you must set the harmonics display. For details on the settings, refer to **3.4**.

■Measuring elements

| Degree | Harmonic current | | Harmonic current N-phase | | Harmonic voltage | |
|---|---|---|---|---|---|---|
| | RMS value | Distortion Ratio (Content rate) | RMS value | Distortion Ratio (Content rate) | RMS value | Distortion Ratio (Content rate) |
| Harmonic total | ○ | ○ | ○ | — | ○ | ○ |

■Display example

<Harmonic current total>

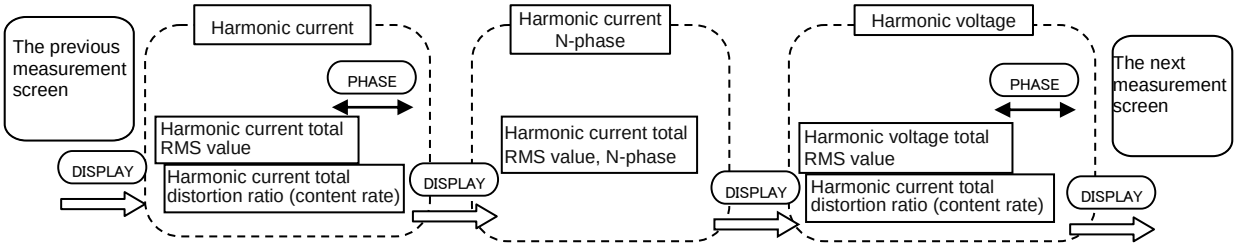


First: line: 1-phase RMS value
Second line: 2-phase RMS value
Third line: 3-phase RMS value
Fourth line: Degree

Note: Degree total is displayed as “ALL.”

■How to switch the phase (Phase wire system: 3-phase 4-wire)

By pressing (PHASE), the RMS value and distortion ratio (content rate) are switched.




Note: For harmonics measurement, the following phases are not measured to display.

| Phase wire system | | Harmonic current | Harmonic voltage |
|---|---|---|---|
| 3-phase 3-wire | 3CT | — | 31-phase |
| | 2CT | 2-phase | 31-phase |
| 1-phase 3-wire | 1N2 display | N-phase | 12-phase |
| | 1N3 display | N-phase | 13-phase |

# 5. Operation

## 5.1. Basic Operation

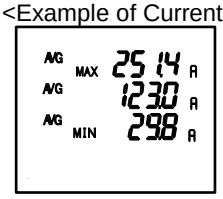
### 5.1.5. Maximum/Minimum Value Display

On the Max/Min value screen, a maximum value, present value, and minimum value are displayed in one screen by measuring item.

(However, for harmonics, the following maximum value only is displayed.
・Harmonic current: The total RMS value of the phase where a value was the largest in every phase.
・Harmonic voltage: The total distortion ratio of the phase where a value was the largest in every phase.)

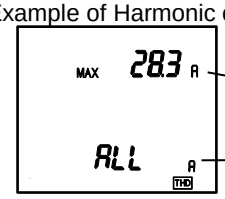
■Display examples

<Example of Current>




First line: Maximum value
Second line: Present value
Third line: Minimum value
Fourth line: -

<Example of Harmonic current>




Maximum value
Harmonic degree

### 5.1.6. How to Display Maximum/Minimum values

When you press (MAX/MIN), the screen switches to the Max/Min value display.
By pressing (MAX/MIN) again, the screen returns to the present value display.

Example for display switching between the present value and Max/Min value


Presentt value display　　Max/Min value display

On the Max/Min value screen, the following display switching is available as the present value screen.

| Button operation | Function |
|---|---|
| Press (DISPLAY) | Measuring items are switched in the following order.<br>However, measuring items that are not included in the phase wire system, display pattern, and additional screen are not displayed.<br>A→$A_N$→DA→$DA_N$→V→W→var<br>HV←$HI_N$←HI←Hz←PF←VA |
| Press (PHASE) | For 3-phase 4-wire system, phases are switched in the following order:<br>・A, DA: Average→1 Phase→2 Phase→3 Phase<br>・V: $V_{AVG}$(L-N)→$V_{1N}$→$V_{2N}$→$V_{3N}$→$V_{AVG}$(L-L)→$V_{12}$→$V_{23}$→$V_{31}$<br>・W, var, VA, PF: Total→1 Phase→2 Phase→3 Phase<br>・$A_N$, $DA_N$, and Hz do not have phase switching.<br>For 3-phase 3-wire/1-phase 3-wire system, the phases of A, DA and V are switched.<br>For 1-phase 2-wire system, no phase is switched. |
| Press (DISPLAY) for 2 seconds | Enter the cyclic display mode of measurement screen. |
| Press (PHASE) for 2 seconds | Enter the cyclic display mode of phase. |

### 5.1.7. How to Clear the Maximum/Minimum Values

On the Max/Min value screen, pressing (RESET) for 2 seconds clears the maximum and minimum values of the displayed measuring item and turns to the present values.
In addition, pressing (RESET) and (+) simultaneously for 2 seconds on the screen clears all maximum and minimum values and turns to the present values.
When password protection is enabled, the maximum and minimum values are cleared after you enter the password.
Communication function also enables to clear all maximum and minimum values. In this case, password input is not necessary.

# 5. Operation

## 5.1. Basic Operation

### 5.1.8. Active Energy/Reactive Energy/Apparent Energy Display

■Display type

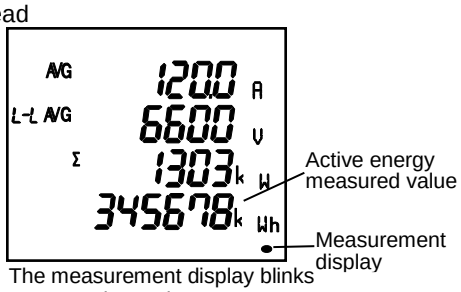
The following table shows the display type of active/reactive/apparent energy based on full-load power.

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

α: 1 1-phase 2-wire
2 1-phase 3-wire
√3 3-phase 3-wire
3 3-phase 4-wire

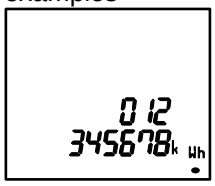
*1. For 3-phase 4-wire system, VT primary voltage and direct voltage are calculated using phase voltage.
*2. For 1-phase 3-wire system, VT primary voltage is calculated using phase voltage.
*3. For the direct voltage setting, direct voltage is used for calculation instead of VT primary voltage.
*4. For reactive energy and apparent energy, 'kW' in the above equation is read as 'kvar' and 'kVA' respectively.

| Full-load power [kW] | Display type | |
|---|---|---|
| | Digital Display | Unit |
| Below 10 | 888888 | kWh, kvarh, kVAh *The unit can be changed to 'M or none.' |
| 10 or more and below 100 | | |
| 100 or more and below 1000 | | |
| 1000 or more and below 10000 | | MWh, kvarh, kVAh *The unit can changed to 'k or none.' |
| 10000 or more and below 100000 | | |
| 100000 or more | | |

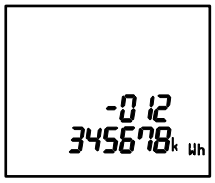



The measurement display blinks at measuring active energy (imported). It becomes OFF or ON at no measuring point.

■Display examples



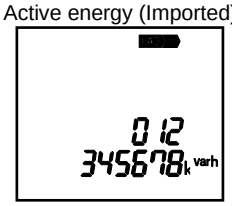

Active energy (Imported)



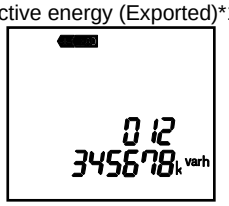

Active energy (Exported)*1


Apparent energy

To display the screen of *1, you must change the settings for active/reactive energy measurement in **3.4**.

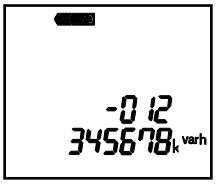



Reactive energy (Imported lag)




Reactive energy (Imported lead) *1


Reactive energy (Exported lag)*1

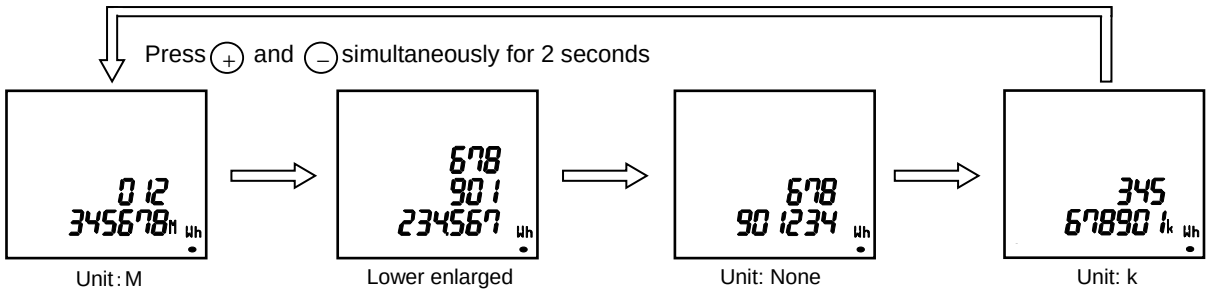



Reactive energy (Exported lead)*1

### 5.1.9. How to Change the Display Digit of Active/Reactive/Apparent Energy

By changing the unit (M, k, or none) of active/reactive/apparent energy or by displaying the lower enlarged view, you can check the upper or lower digit of a measured value.
Press ⊕ and ⊖ simultaneously for 2 seconds to switch.

Example of switching active energy (imported): 012,345,678,901,234.567Wh




Unit: M | Lower enlarged | Unit: None | Unit: k

Note1: Active, reactive, and apparent energy that are not displayed on the screen will be also all changed to the same unit.
Note2: If the set value of VT primary voltage or that of CT primary current is large, the lower digit less than the measurement range will indicate '0.'

# 5. Operation

## 5.1. Basic Operation

### 5.1.10. How to Reset Active/Reactive/Apparent Energy to Zero

Pressing (SET), (RESET), and (PHASE) simultaneously for 2 seconds resets active, reactive, and apparent energy values to zero.
When password protection is enabled, the values are reset after you enter the password.
In addition, communication function enables to reset all active, reactive, and apparent energy values to zero. In this case, password input is not necessary.

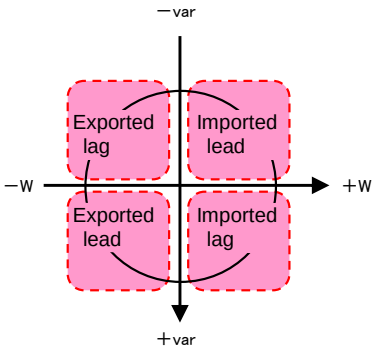
( Note1: This function is available on the present value screen only.
Note2: The values that are not displayed on the screen will be also all reset to zero. )

### 5.1.11. How to Measure Reactive Energy (2 quadrant/4 quadrant measurement)

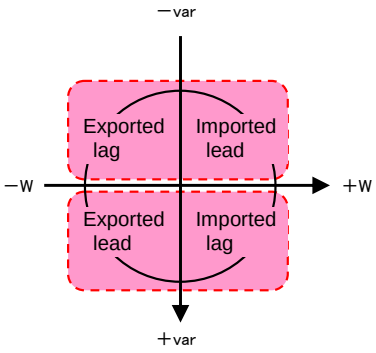
For measurement of reactive energy, there are two types on how to take a quadrant as follows.
The measurement method of reactive energy can be switched at the active/reactive energy measurement setting in the setting menu 3.
In addition, when you set to IEC mode in the setting menu 8, 2 quadrant measurement is executed even if you set to 'Combination Ⅲ' or 'Combination Ⅳ', which executes 4 quadrant measurement, at the active/reactive energy measurement setting.

When you select 4 quadrant measurement and IEC mode at each setting, 'Imported lag' and 'Exported lead' of reactive energy are displayed on the additional screen. However, they are not integrated.
For details on how to switch 2 quadrant/4 quadrant measurement, refer to **3.4**.
For details on how to switch the IEC mode setting, refer to **3.9**.

<4 quadrant measurement>




<2 quadrant measurement>



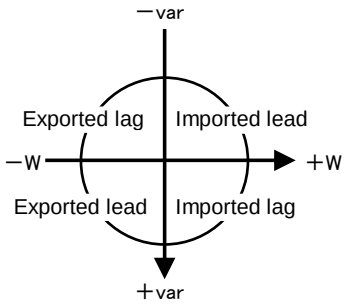

| Measurement method | Description |
|---|---|
| 4 quadrant measurement | Each of four quadrants (Imported lag, Imported lead, Exported lag, and Exported lead) is measured as one division. It is suitable to measure systems with a private power generator. However, a dead region occurs at the boundary of each division. Accordingly, reactive energy cannot be measured at where power factor is near 1 or zero. |
| 2 quadrant measurement | 'Imported lag' and 'Exported lead' are measured as one division, and in the same way, 'Imported lead' and 'Exported lag' are measured as one division. Therefore, a dead region does not occur at where power factor is near zero, and reactive energy can be measured even there. It is suitable to measure systems without a private power generator and reactive energy of capacitor load where power factor is zero generally. |

# 5. Operation

## 5.1. Basic Operation

### 5.1.12. Each Measuring Item Display during Power Transmission

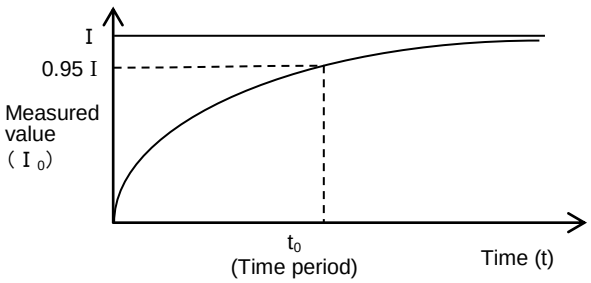
The following table shows symbol display (±) for each measured value according to the power transmission state.
For details on how to switch 2 quadrant/4 quadrant measurement, refer to **3.4**.
For details on how to switch the IEC mode setting, refer to **3.9**.




| Measuring item \ Power transmission state | | Imported lag | Imported lead | Exported lag | Exported lead |
|---|---|---|---|---|---|
| A, DA, AN, DAN, V, Hz, VA, HI, HV, $HI_N$ | | Unsigned | | | |
| W | | Unsigned | | ‘-‘ sign | |
| var | Normal mode (2 quadrant measurement) | Unsigned | ‘-‘ sign | ‘-‘ sign | Unsigned |
| | Normal mode (4 quadrant measurement) | Unsigned | ‘-‘ sign | Unsigned | ‘-‘ sign |
| | IEC mode (2 quadrant measurement) | Unsigned | ‘-‘ sign | ‘-‘ sign | Unsigned |
| PF | Normal mode (2 quadrant measurement) | Unsigned | ‘-‘ sign | ‘-‘ sign | Unsigned |
| | Normal mode (4 quadrant measurement) | Unsigned | ‘-‘ sign | Unsigned | ‘-‘ sign |
| | IEC mode (2 quadrant measurement) | Unsigned | ‘-‘ sign | Unsigned | ‘-‘ sign |

### 5.1.13. Demand Time Period and Demand Value of Current demand

The demand time period ($t_0$) represents a time period until a measured value ($I_0$) displays 95% of the input (I) when continuously energized by constant input (I). To display 100% of the input (I), approximately three times the time period (to) is required.




The demand value represents a measured display value with the above feature on time period and it indicates the overall average value within the demand time period.
The demand value changes over a relatively long time period. Therefore, it is not affected by input change for a short time. Accordingly, it is suitable to monitor overload of transformer.

# 5. Operation

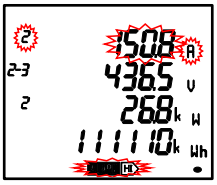
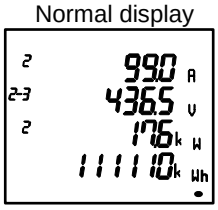
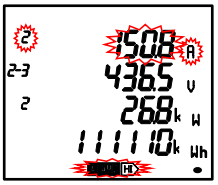
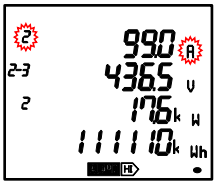
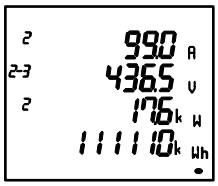
## 5.2. Usage Depending on the Application (Alarm, Operating Time, Password, etc.)

The following shows how to use the instrument depending on the application.

### 5.2.1. Upper/Lower Limit Alarm Display and Action

When the set upper/lower limit alarm value is exceeded, the display starts to blink.
*For details on how to set the upper/lower limit alarm, refer to **3.6**.

■Action in case of alarm
Alarm generating: When the set alarm value is exceeded, the display blinks. *Note
Alarm cancellation: When an alarm is cancelled, the display turns to the normal mode.
Note: When you set the alarm delay time, an alarm will generate if the set upper/lower limit alarm value is exceeded and this situation continues for the alarm delay time.

| Alarm reset method | | Measured value > Upper limit alarm value<br>Measured value < Lower limit alarm value | Measured value < Upper limit alarm value<br>Measured value > Lower limit alarm value | |
|---|---|---|---|---|
| Automatic (Auto) | Screen | ALARM and HI or LO blink<br>  | Normal display<br>  | |
| Manual (HoLd) | Screen | ALARM and HI or LO blink<br>  <br>(Alarm generating) | ALARM and HI or LO light up<br>  <br>(Alarm retention) | Normal display<br>  <br>(Alarm cancellation) |

Note1: If measuring elements of alarm generating are displayed on the screen, the digital value, unit (A, V, W, PF, Hz, %, DM, and THD), and phase (1, 2, 3, and N) will be displayed according to the alarm status as the following table.

| Alarm status | Digital value | Unit | Phase |
|---|---|---|---|
| Alarm generating | Blink* | Blink | Blink* |
| Alarm retention | Light up | Blink | Blink* |
| Alarm cancellation | Light up | Light up | Light up |

*When the phase of no alarm is displayed on the screen, it does not blink.

Note2: When the backlight blinking is set to 'on' in case of alarm, the backlight blinks at generating alarm.
Note3: On the Max/Min value screen, the present value, which is displayed at the middle line of digital display, ALARM and HI or LO blink.

■Monitored phase of upper/lower limit alarm item
The phase for monitoring the upper/lower limit alarm varies depending on the measuring item.
For details, refer to the following table.

| Upper/Lower limit alarm item | Monitored phase | | | |
|---|---|---|---|---|
| | 3-phase 4-wire | 3-phase 3-wire (3CT, 2CT) | 1-phase 3-wire (1N2) | 1-phase 3-wire (1N3) |
| A upper limit, DA upper limit | 1, 2, 3 | 1, 2, 3 | 1, N, 2 | 1, N, 3 |
| A lower limit, DA lower limit | 1, 2, 3 | 1, 2, 3 | 1, 2 | 1, 3 |
| $A_N$ upper limit, $DA_N$ upper limit | N | — | — | — |
| $A_N$ lower limit, $DA_N$ lower limit | N | — | — | — |
| V (L-L) upper limit Note1 | 12, 23, 31 | 12, 23, 31 | 1N, 2N, 12 | 1N, 3N, 31 |
| V (L-L) lower limit Note1 | 12, 23, 31 | 12, 23, 31 | 1N, 2N, 12 | 1N, 3N, 31 |
| V (L-N) upper limit | 1N, 2N, 3N | — | — | — |
| V (L-N) lower limit | 1N, 2N, 3N | — | — | — |
| W upper limit, var upper limit, PF upper limit | Total | Total | Total | Total |
| W lower limit, var lower limit, PF lower limit | Total | Total | Total | Total |
| Hz upper limit | 1N | 12 | 1N | 1N |
| Hz lower limit | 1N | 12 | 1N | 1N |
| HI total upper limit | 1, 2, 3 | 1, 2, 3 *Note2 | 1, 2 | 1, 3 |
| $HI_N$ total upper limit | N | — | — | — |
| $THD_V$ upper limit | 1N, 2N, 3N | 12, 23 | 1N, 2N | 1N, 3N |

Note1: For 12-phase or 31-phase of 1-phase 3-wire system, alarm monitoring is executed based on twice the set upper/lower limit alarm value.
Note2: Harmonic current 2-phase is measured for 3-phase 3-wire system (3CT) only.

### 5.2.2. How to Cancel the Upper/Lower Limit Alarm

The alarm cancellation method differs depending on the alarm reset setting. In addition to the following methods, communication function is available to cancel the upper and lower limit alarm.

| Alarm reset method | How to cancel |
|---|---|
| Automatic (Auto) | When a measured value is below the set upper/lower limit alarm value, the alarm is automatically reset. |
| Manual (HoLd) | Even after a measured value is below the set upper/lower limit alarm value, the alarm is retained. After the measured value is below the alarm value, operate the following alarm reset.<br>*Note: On the Max/Min value screen, it is not possible to operate the alarm reset.<br><To cancel the alarm of a selected item><br>Display the item of alarm generating and then press (RESET) to cancel the alarm.<br>( For the item that has phases such as current or voltage, you must press (RESET) on each phase to cancel the alarm. )<br><To cancel alarms of all items><br>In the operating mode, press (RESET) for 2 seconds to cancel all alarms at once. |

Note: To prevent chattering, the determination whether a measured value is below the upper/lower limit alarm value is conducted out of dead region below the setting step of the alarm value.

### 5.2.3. How to Stop Backlight Blinking Caused by the Upper/Lower Limit Alarm

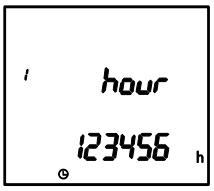
Press (RESET) to stop the backlight blinking.

### 5.2.4. Operating Time Display

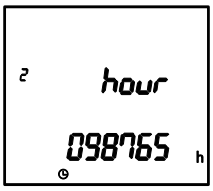
According to the value set to the operating time count target (AUX, A, and V), measuring time is counted and displayed as operating time of load. To display it, you must set the operating time display.
Even when the operating time display is set to 'oFF (Not display)', operating time is counted.
*For details on the settings, refer to **3.9**.

When the threshold of the following items you set for operating time count target is exceeded, operating time 1 and 2 are counted.

| Item | 3-phase 4-wire | 1-phase 2-wire | Others |
|---|---|---|---|
| AUX (Auxiliary power) | AUX | AUX | AUX |
| A (Current) | $A_{AVG}$ | A | $A_{AVG}$ |
| V (Voltage) | $V_{AVG}$(L-N) | V | $V_{AVG}$(L-L) |



Operating time 1



Operating time 2

In the operating mode, when you are switching the measurement screen with (DISPLAY), operating time is displayed.

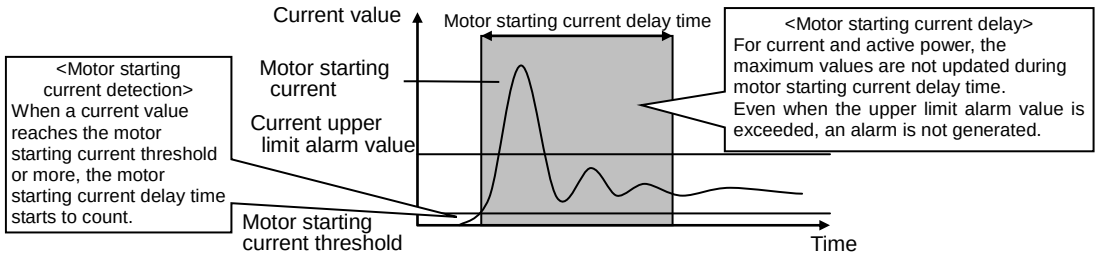
### 5.2.5. How to Reset Operating Time to Zero

When operating time 1 or operating time 2 is displayed on the screen, pressing (RESET) for 2 seconds resets the operating time to zero.
*The operating time displayed on the screen only is reset to zero.
When password protection is enabled, it is reset to zero after you enter the password.
In addition, communication function enables to reset all operating time to zero. In this case, password input is not necessary.

### 5.2.6. How to Prevent the Maximum Value Update by Motor Starting Current

For motor current monitoring, the use of motor starting current delay function prevents the maximum value update of current, active power, reactive power, apparent power, and power factor and alarm generating that are caused by motor starting current. To use the motor starting current delay function, you must set it. For details on the settings, refer to **3.6**.

■The action with motor starting current delay function



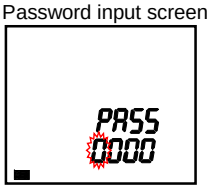

Note1: For motor starting current threshold, set a value lower than the lower limit value, considering a change in load current during operation.
Note2: When an input current value is below the motor starting current threshold, the minimum value update stops.

### 5.2.7. Password Protection Setting

In the operating mode, when you press (RESET) and (PHASE) simultaneously for 2 seconds or more and then enter the password, the password protection can be set.
The password of the factory default is '0000.' If you enter the wrong password, the screen will return to the password input display, where the highest digit blinks.
To switch from the password input screen to the operating mode, press (DISPLAY) at the highest digit in password input.
When the password protection is enabled, you must input the password when executing the following item such as setting mode switching or Max/Min value reset.

■Password input

Password input screen




- Set the number for the blinking digit from the highest digit by pressing (+) or (–).
- Press (SET) to move the setting digit, blinking one, to a lower digit.
- Press (DISPLAY) to move the setting digit, blinking one, to an upper digit.
- Press (SET) at the lowest digit to enable the items in the right table.
- If you enter the wrong password, the screen will return to the display where the highest digit is blinking.

■Password protected item

| No. | Item |
|---|---|
| 1 | Enter the setting mode |
| 2 | Clear Max/Min values |
| 3 | Reset Wh, var, etc. to zero |
| 4 | Reset operating time to zero |

■Password protection settings

(1) Set the password protection.

oFF ⟷ on
(Disable protection) (Enable protection)

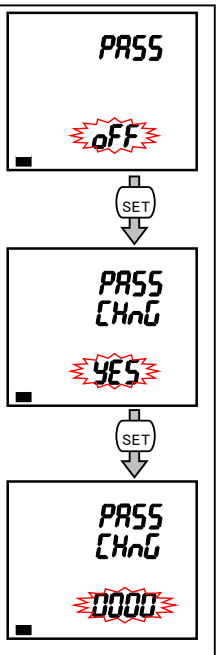
(2) Change the password.

no ⟷ yES
(Not change) (Change)

Note1: When you select "no", the screen returns to the operating mode.
Note2: When you select "yES", the setup password appears.

(3) Input a new password.

- Set the number for the blinking digit from the highest digit by pressing (+) or (–).
- Press (SET) to move the setting digit, blinking one, to a lower digit.
- Press (DISPLAY) to move the setting digit, blinking one, to a higher digit.
- Press (SET) to determine the password change.
- The setting range is 0000 to 9999.




| **Important** | If you forgot your password, you could not unlock the password by yourself in the field. Please contact your supplier. |
|---|---|

# 6. Others

## 6.1. Display Pattern List

When you set the display pattern in the setting menu 1 and the additional screens in the setting menu 3 and 8, the screen is switched from No.1 in the following table in ascending order by pressing DISPLAY

[When set to 3-phase 4-wire system]

| Display pattern | | Screen set by display pattern | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No.1 | No.2 | No.3 | No.4 | No.5 | No.6 | No.7 | No.8 | No.9 | No.10 |
| P01 | First | A | A | A | W | A | DA | | | | |
| | Second | V | V | V | var | AN | DAN | | | | |
| | Third | W | var | VA | PF | Hz | V | | | | |
| | Fourth | Wh | varh | VAh | Wh | Wh | Wh | | | | |
| P02 | First | A1 | DA1 | V1N | W1 | var1 | VA1 | PF1 | A | A | DA |
| | Second | A2 | DA2 | V2N | W2 | var2 | VA2 | PF2 | Hz | AN | DAN |
| | Third | A3 | DA3 | V3N | W3 | var3 | VA3 | PF3 | W | var | VA |
| | Fourth | Aavg | DAavg | VLN avg | WΣ | varΣ | VAΣ | PFΣ | Wh | varh | VAh |
| P00 | First | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | | | | | | |
| | Second | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | | | | | | |
| | Third | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | | | | | | |
| | Fourth | Arbitrary 2 | Arbitrary 2 | Arbitrary 2 | Arbitrary 2 | | | | | | |

Note1: For arbitrary 1, selectable items are A, AN, DA, DAN, V, W, var, VA, PF, and Hz.
For arbitrary 2, Wh, -Wh, varh, and VAh are selectable.

| Display pattern | | Additional screen (Set in the setting menu 3 and 8) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No.11 | No.12 | No.13 | No.14 | No.15 | No.16 | No.17 | No.18 | No.19 | No.20 | No.21 | No.22 |
| | | Wh | Wh (Exported) | varh | varh Imported (lead) | varh Exported (lag) | varh Exported (lead)) | VAh | Harmonic current | Harmonic current N-phase | Harmonic voltage | Operating time 1 | Operating time 2 |
| Common to display patterns from P00 to P02 | First | - | - | - | - | - | - | - | 1-phase value | N-phase value | 1-phase value | - | - |
| | Second | Wh | Wh Exported | varh | varh Imported (lead) | varh Exported (lag) | varh Exported (lead) | VAh | 2-phase value | - | 2-phase value | hour 1 | hour 2 |
| | Third | | | | | | | | 3-phase value | - | 3-phase value | - | - |
| | Fourth | | | | | | | | Degree | Degree | Degree | Operating time | Operating time |

Note 2: When you add an additional screen, the screen number is added.
Note 3: In the table, 'Wh' and 'varh' indicate active energy (imported) and reactive energy (imported lag) respectively.
Note 4: The additional screens of Wh, varh, and VAh of P00 are displayed by setting each item as display element.

# 6. Others

## 6.1. Display Pattern List

[When set to other than 3-phase 4-wire system]

| Display pattern | | Screen set by display pattern | | | | | |
|---|---|---|---|---|---|---|---|
| | | No.1 | No.2 | No.3 | No.4 | No.5 | No.6 |
| P01 | First | A | A | A | W | A | |
| | Second | V | V | V | var | DA | |
| | Third | W | var | VA | PF | Hz | |
| | Fourth | Wh | varh | VAh | Wh | Wh | |
| P02 | First | A1 | DA1 | V12 | W | A | A |
| | Second | A2 | DA2 | V23 | var | Hz | V |
| | Third | A3 | DA3 | V31 | PF | var | VA |
| | Fourth | Aavg | DAavg | Vavg | Wh | varh | VAh |
| P00 | First | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | | |
| | Second | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | | |
| | Third | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | Arbitrary 1 | | |
| | Fourth | Arbitrary 2 | Arbitrary 2 | Arbitrary 2 | Arbitrary 2 | | |

Note1: For 1-phase 2-wire system, it is not possible to set the display pattern of P02.
Note2: For arbitrary 1, selectable items are A, DA, V, W, var, VA, PF, and Hz.
For arbitrary 2, Wh, -Wh, varh, and VAh are selectable.
Note3: The phase shown in the display pattern of P02 is displayed on the screen according to the phase wire system as the following table.

| Phase display \ Phase wire system | | 1-phase 3-wire (1N2) | 1-phase 3-wire (1N3) | 3-phase 3-wire |
|---|---|---|---|---|
| Current | 1 | 1 | 1 | 1 |
| | 2 | N | N | 2 |
| | 3 | 2 | 3 | 3 |
| Voltage | 12 | 1N | 1N | 12 |
| | 23 | 2N | 3N | 23 |
| | 31 | 12 | 13 | 31 |

| Display pattern | | Additional screen (Set in the setting menu 3 and 8) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No.7 | No.8 | No.9 | No.10 | No.11 | No.12 | No.13 | No.14 | No.15 | No.16 | No.17 |
| | | Wh | Wh (Exported) | varh | varh Imported (lead) | varh Exported (lag) | varh Exported (lead)) | VAh | Harmonic current | Harmonic voltage | Operating time 1 | Operating time 2 |
| Common to display patterns from P00 to P02 | First | - | - | - | - | - | - | - | 1-phase value | 1-phase value | - | - |
| | Second | Wh | Wh Exported | varh | varh Imported (lead) | varh Exported (lag) | varh Exported (lead)) | VAh | 2-phase value | 3-phase value | hour 1 | hour 2 |
| | Third | | | | | | | | 3-phase value | - | - | - |
| | Fourth | | | | | | | | Degree | Degree | Operating time | Operating time |

Note4: When you add an additional screen, the screen number is added.
Note5: In the table, 'Wh' and 'varh' indicate active energy (imported) and reactive energy (imported lag) respectively.
Note6: The additional screens of Wh, varh, and VAh of P00 are displayed by setting each item as display element.
Note7: The display of additional screens of No.14 and 15 in the above table varies depending on the setting of the phase wire system as the following table.

| Phase display \ Phase wire system | | 1-phase 2-wire | 1-phase 3-wire | 3-phase 3-wire (2CT) | 3-phase 3-wire (3CT) |
|---|---|---|---|---|---|
| Harmonic current | 1-phase value | ○ | ○ | ○ | ○ |
| | 2-phase value | — | — | — | ○ |
| | 3-phase value | — | ○ | ○ | ○ |
| Harmonic voltage | 1-phase value | ○ | ○ | ○ | ○ |
| | 3-phase value | — | ○ | ○ | ○ |

## 6.2. Standard Value

When you set active power and reactive power as alarm element, the setting range is determined by the standard value calculated using the following calculation formula.

■The standard value of active power/reactive power

| Measuring element | Calculation method for standard value |
|---|---|
| Active power | VT ratio × CT ratio × Intrinsic power (100%) kW |
| Reactive power | |

Note1: When you set to 'Without VT (Voltage direct input)', the VT ratio is 1. For intrinsic power, refer to the following table.
Note2: The calculated value is round to the nearest number as the table in the next page.

■Intrinsic power

| Phase wire system | CT secondary current | Rated voltage | | Intrinsic power value (100%) |
|---|---|---|---|---|
| 1-phase 2-wire | 5 A | Direct input (Line voltage) | 110 V | 0.5 kW |
| | | | 220 V | 1.0 kW |
| | | | 440 V | 2.0 kW |
| | | With VT (Line voltage) | 100 V, 110 V | 0.5 kW |
| | | | 220 V | 1.0 kW |
| | 1 A | Direct input (Line voltage) | 110 V | 0.1 kW |
| | | | 220 V | 0.2 kW |
| | | | 440 V | 0.4 kW |
| | | With VT (Line voltage) | 100 V, 110 V | 0.1 kW |
| | | | 220 V | 0.2 kW |
| 1-phase 3-wire | 5 A | Without VT (Line voltage) | 220 V | 1.0 kW |
| | | | 440 V | 2.0 kW |
| | 1 A | | 220 V | 0.2 kW |
| | | | 440 V | 0.4 kW |
| 3-phase 3-wire | 5 A | Direct input (Line voltage) | 110 V | 1.0 kW |
| | | | 220 V | 2.0 kW |
| | | | 440 V | 4.0 kW |
| | | With VT (Line voltage) | 100 V, 110 V | 1.0 kW |
| | | | 220 V | 2.0 kW |
| | 1 A | Direct input (Line voltage) | 110 V | 0.2 kW |
| | | | 220 V | 0.4 kW |
| | | | 440 V | 0.8 kW |
| | | With VT (Line voltage) | 100 V, 110 V | 0.2 kW |
| | | | 220 V | 0.4 kW |
| 3-phase 4-wire | 5 A | Direct input | 63.5/110 V | 1.0 kW |
| | | | 100/173 V<br>110/190 V | 2.0 kW |
| | | | 220/380 V<br>230/400 V<br>240/415 V<br>254/440 V | 4.0 kW |
| | | | 277/480 V | 5.0 kW |
| | | With VT (Phase voltage) | 63.5 V | 1.0 kW |
| | | | 100 V, 110 V,<br>115 V, 120 V | 2.0 kW |
| | 1 A | Direct input | 63.5/110 V | 0.2 kW |
| | | | 100/173 V<br>110/190 V | 0.4 kW |
| | | | 220/380 V<br>240/415 V<br>254/440 V | 0.8 kW |
| | | | 277/480 V | 1.0 kW |
| | | With VT (Phase voltage) | 63.5 V | 0.2 kW |
| | | | 100 V, 110 V,<br>115 V, 120 V | 0.4 kW |

Note: For reactive power and apparent power, read 'kW' in the above table as 'kvar' and 'kVA' respectively.

# 6. Others

## 6.2. Standard Value

The calculated value in the previous page is rounded to the nearest number as the following table.

| Unit: W | Unit: W | Unit: kW | Unit: kW | Unit: MW | Unit: MW |
|---|---|---|---|---|---|
| 8 W | 300 W | 9 kW | 320 kW | 9 MW | 320 MW |
| 9 W | 320 W | 9.6 kW | 360 kW | 9.6 MW | 360 MW |
| 9.6 W | 360 W | 10 kW | 400 kW | 10 MW | 400 MW |
| 10 W | 400 W | 12 kW | 450 kW | 12 MW | 450 MW |
| 12 W | 450 W | 15 kW | 480 kW | 15 MW | 480 MW |
| 15 W | 480 W | 16 kW | 500 kW | 16 MW | 500 MW |
| 16 W | 500 W | 18 kW | 600 kW | 18 MW | 600 MW |
| 18 W | 600 W | 20 kW | 640 kW | 20 MW | 640 MW |
| 20 W | 640 W | 22 kW | 720 kW | 22 MW | 720 MW |
| 22 W | 720 W | 24 kW | 750 kW | 24 MW | 750 MW |
| 24 W | 750 W | 25 kW | 800 kW | 25 MW | 800 MW |
| 25 W | 800 W | 30 kW | 900 kW | 30 MW | 900 MW |
| 30 W | 900 W | 32 kW | 960 kW | 32 MW | 960 MW |
| 32 W | 960 W | 36 kW | 1000 kW | 36 MW | 1000 MW |
| 36 W | 1000 W | 40 kW | 1200 kW | 40 MW | 1200 MW |
| 40 W | 1200 W | 45 kW | 1500 kW | 45 MW | 1500 MW |
| 45 W | 1500 W | 48 kW | 1600 kW | 48 MW | 1600 MW |
| 48 W | 1600 W | 50 kW | 1800 kW | 50 MW | 1800 MW |
| 50 W | 1800 W | 60 kW | 2000 kW | 60 MW | 2000 MW |
| 60 W | 2000 W | 64 kW | 2200 kW | 64 MW | 2200 MW |
| 64 W | 2200 W | 72 kW | 2400 kW | 72 MW | 2400 MW |
| 72 W | 2400 W | 75 kW | 2500 kW | 75 MW | 2500 MW |
| 75 W | 2500 W | 80 kW | 3000 kW | 80 MW | 3000 MW |
| 80 W | 3000 W | 90 kW | 3200 kW | 90 MW | 3200 MW |
| 90 W | 3200 W | 96 kW | 3600 kW | 96 MW | 3600 MW |
| 96 W | 3600 W | 100 kW | 4000 kW | 100 MW | 4000 MW |
| 100 W | 4000 W | 120 kW | 4500 kW | 120 MW | 4500 MW |
| 120 W | 4500 W | 150 kW | 4800 kW | 150 MW | 4800 MW |
| 150 W | 4800 W | 160 kW | 5000 kW | 160 MW | 5000 MW |
| 160 W | 5000 W | 180 kW | 6000 kW | 180 MW | 6000 MW |
| 180 W | 6000 W | 200 kW | 6400 kW | 200 MW | 6400 MW |
| 200 W | 6400 W | 220 kW | 7200 kW | 220 MW | 7200 MW |
| 220 W | 7200 W | 240 kW | 7500 kW | 240 MW | 7500 MW |
| 240 W | 7500 W | 250 kW | 8000 kW | 250 MW | 8000 MW |
| 250 W | 8000 W | 300 kW | | 300 MW | |

Note: For reactive power and apparent power, read ‘W’ in the above table as ‘var’ and ‘VA’ respectively.

# 6. Others

## 6.3. Measuring Item

The following table shows measuring items.

○: Measurement display is possible. －: Measurement display is not possible. Inst: Instantaneous value

| Measuring item | | | Measurement display item | | | | | | | | | | | | Communication |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3-phase 4-wire system | | | 3-phase 3-wire system (3CT) | | | 3-phase 3-wire (2CT)/ 1-phase 3-wire system | | | 1-phase 2-wire system | | | |
| | | | Inst | Max | Min | Inst | Max | Min | Inst | Max | Min | Inst | Max | Min | |
| Current | 1-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ Note3 |
| | 2-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | 3-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | AVG | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | N-phase | | ○ | ○ | ○ | | | | | | | | | | |
| Current demand | 1-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| | 2-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | 3-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | AVG | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | N-phase | | ○ | ○ | ○ | | | | | | | | | | |
| Voltage | 1N-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 2N-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 3N-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | AVG (L-N) | | ○ | ○ | ○ | | | | | | | | | | |
| | 12-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| | 23-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | 31-phase | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| | AVG (L-L) | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | | |
| Active power | 1-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 2-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 3-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | Σ | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| Reactive power | 1-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 2-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 3-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | Σ | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| Apparent power | 1-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 2-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 3-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | Σ | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| Power factor | 1-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 2-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | 3-phase | | ○ | ○ | ○ | | | | | | | | | | |
| | Σ | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| Frequency | | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | |
| Harmonic current Note1 | RMS value | 1-phase | ○ | Max Phase | | ○ | Max Phase | | ○ | Max Phase | | ○ | ○ | | |
| | | 2-phase | ○ | | | ○ | | | | | | | | | |
| | | 3-phase | ○ | | | ○ | | | ○ | | | | | | |
| | | N-phase | ○ | ○ | | | | | | | | | | | |
| | Distortion ratio | 1-phase | ○ | | | ○ | | | ○ | | | ○ | | | |
| | | 2-phase | ○ | | | ○ | | | | | | | | | |
| | | 3-phase | ○ | | | ○ | | | ○ | | | | | | |
| | | N-phase | - | | | | | | | | | | | | |
| Harmonic voltage Note1 | RMS value | 1N-phase | ○ | | | | | | | | | | | | |
| | | 2N-phase | ○ | | | | | | | | | | | | |
| | | 3N-phase | ○ | | | | | | | | | | | | |
| | | 12-phase | | | | ○ | | | ○ | | | ○ | | | |
| | | 23-phase | | | | ○ | | | ○ | | | | | | |
| | | 31-phase | | | | | | | | | | | | | |
| | Distortion ratio | 1N-phase | ○ | Max Phase | | | | | | | | | | | |
| | | 2N-phase | ○ | | | | | | | | | | | | |
| | | 3N-phase | ○ | | | | | | | | | | | | |
| | | 12-phase | | | | ○ | Max Phase | | ○ | Max Phase | | ○ | ○ | | |
| | | 23-phase | | | | ○ | | | ○ | | | | | | |
| | | 31-phase | | | | | | | | | | | | | |
| Active energy | | Imported | | ○ | | | ○ | | | ○ | | | ○ | | |
| | | Exported | | ○ | | | ○ | | | ○ | | | ○ | | |
| Reactive energy | 2 quadrant | Positive Note2 | | ○ | | | ○ | | | ○ | | | ○ | | |
| | | Negative Note2 | | ○ | | | ○ | | | ○ | | | ○ | | |
| | 4 quadrant | Imported lag | | ○ | | | ○ | | | ○ | | | ○ | | |
| | | Imported lead | | ○ | | | ○ | | | ○ | | | ○ | | |
| | | Exported lag | | ○ | | | ○ | | | ○ | | | ○ | | |
| | | Exported lead | | ○ | | | ○ | | | ○ | | | ○ | | |
| Apparent energy | | Imported + Exported | | ○ | | | ○ | | | ○ | | | ○ | | |
| Operating time | | 1 | | ○ | | | ○ | | | ○ | | | ○ | | |
| | | 2 | | ○ | | | ○ | | | ○ | | | ○ | | |
| Phase angle Note4 | | | ○ | | | ○ | | | ○ | | | ○ | | | |

# 6. Others

## 6.3. Measuring Item

Note1: For harmonics, the total RMS value and total distortion ratio are measured.
Note2: Reactive energy (imported) represents a positive value, which is imported lag + exported lead.
Reactive energy (exported) represents a negative value, which is imported lead + exported lag.
Note3: For the measuring items monitored by communication function, refer to the user's manual of each communication function.
Note4: The phase angle can be measured only with the support function for determining incorrect wiring.
Note5: For 1-phase 3-wire system, the phases of measuring items are read as the following table.

| Phase wire system | 1-phase | 2-phase | 3-phase | 12-phase | 23-phase | 31-phase |
|---|---|---|---|---|---|---|
| 1-phase 3-wire (1N2) | 1-phase | N-phase | 2-phase | 1N-phase | 2N-phase | 12-phase |
| 1-phase 3-wire (1N3) | 1-phase | N-phase | 3-phase | 1N-phase | 3N-phase | 13-phase |

# 6. Others

## 6.4. Instrument Operation

■The instrument operation in other than operating mode

| Situation | Measurement | Display |
|---|---|---|
| For a few seconds just after turning on auxiliary power<br>*The backlight is lit and the LCD is not lit. | Not measure | Not display |
| In the setting mode<br>In the setting confirmation mode<br>In the password protection screen | The action is the same in the operating mode. | Not display a measured value |
| Under power failure | Not measure | Not display |

■The instrument operation under input

| Measuring element | Instrument action | |
|---|---|---|
| Current (A)<br>Current demand (DA) | The CT secondary current setting is 5 A.<br>When input current is below 0.005 A (0.1%), 0 A is displayed. | When the upper limit of display range (9999) is exceeded, the upper limit (9999) is displayed. |
| | The CT secondary current setting is 1 A.<br>When input current is below 0.005 A (0.5%), 0 A is displayed. | |
| Voltage (V) | When input voltage (Line voltage) is below 11 V, 0 V is displayed.<br>・For 1-phase 3-wire system, when the voltage between P1 and P3 is below 22 V, 0 V is displayed.<br>・For 3-phase 4-wire system, when phase voltage is below 11 V or line voltage is below 19 V, 0 V is displayed. | When the upper limit of display range (9999) is exceeded, the upper limit (9999) is displayed. |
| Active power (W)<br>Reactive power (var)<br>Apparent power (VA) | ・When each of three phases of current is 0 A or when each of three phases of voltage is 0 V, 0W, 0 var, and 0 VA are displayed.<br>・When current N-phase is 0 A or when voltage N-phase is 0 V, 0 W, 0 var, and 0 VA are displayed for each N-phase. | When the upper limit of display range (9999) is exceeded, the upper limit (9999) is displayed. |
| Power factor (PF) | ・When each of three phases of current is 0 A or when each of three phases of voltage is 0 V, 1.0 is displayed.<br>・When current N-phase is 0 A or when voltage N-phase is 0 V, 1.0 is displayed for each N-phase. | |
| Frequency (Hz) | ・When voltage 1-phase is low voltage, - - - - is displayed.<br>Apply a voltage above approximately 22 V. | When frequency is below 44.5 Hz and above 99.5 Hz, - - - - is displayed. |
| Harmonic current | For RMS value measurement:<br>・When current is 0 A, 0 A is displayed. (for each phase)<br>・When voltage 1-phase is 0 V or when frequency is below 44.5 Hz, - - - - is displayed for every phase. | For distortion ratio (content rate) measurement:<br>・When harmonic current 1st is 0 A, 0 A is displayed. (for each phase)<br>・When voltage 1-phase is 0 V or when frequency is below 44.5 Hz, - - - - is displayed for every phase. |
| Harmonic voltage | For RMS value measurement:<br>・When voltage is 0 V, 0 V is displayed. (for each phase)<br>・When voltage 1-phase is 0 V or when frequency is below 44.5 Hz, - - - - is displayed for every phase. | For distortion ratio (content rate) measurement:<br>・When voltage is 0 V, - - - - is displayed. (for each phase)<br>・When voltage 1-phase is 0 V or when frequency is below 44.5 Hz, - - - - is displayed for every phase. |
| Operating Time | When the count exceeds 999999-hour, it is fixed at 999999-hour. | |

Note1: Current/voltage/active power input represents input to the instrument. It does not input to the primary side of VT/CT.

Note2: The expression of 'When current is 0 A' includes the case when the measured value described in the item of Current (A) is 0 A.

Note3: The expression of 'When voltage is 0 V' includes the case when the measured value described in the item of Voltage (V) is 0 V.

Note4: Use the instrument within the rating of the instrument.

# 6. Others

## 6.5. Troubleshooting

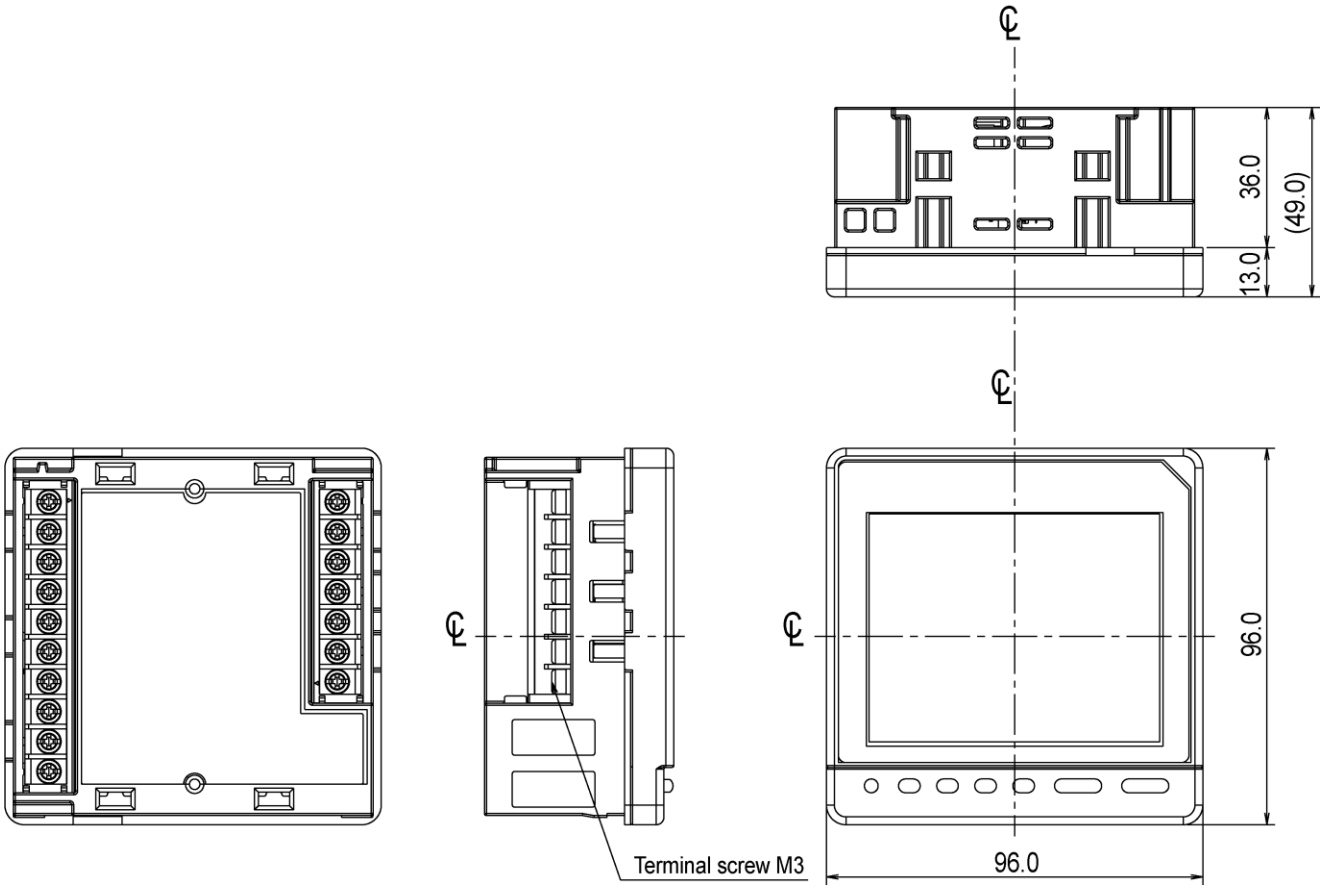
If you observe abnormal sound, odor, smoke, or heat generation from the instrument, turn off the power at once.
In addition, if you consider sending the instrument in for repair, check the following points before it.

| | Situation | Possible cause | Solution |
|---|---|---|---|
| Display | The display does not light up. | Auxiliary power is not applied to MA and MB terminals. | Apply auxiliary power supply. |
| | When auxiliary power is applied, the display does not light up for a short time. | This is not an error. For a few seconds after charging auxiliary power, the internal circuit is being initialized. | Use it as it is. |
| | The backlight does not light up. | The backlight may be set to 'auto off (Auto).'<br>*When it lights up by pressing any operation button, it is set to 'auto off.' | When it is set to auto off, it automatically goes off in 5 minutes.<br>Use it as it is or change the setting to 'ON (Hold).'<br>For details, refer to **3.5**. |
| | The display becomes black. | It may become black due to static electricity. | It will go off after a while. |
| | The 'End' display remains. | It is in the setting mode. | Press the SET button. |
| Measurement error | The current and voltage errors are large. | The settings for VT/Direct voltage and CT primary current may be incorrect. | Check the settings for VT/Direct voltage and CT primary current. |
| | Current and voltage are correct, but active power and power factor errors are large. | The wiring for VT/CT and the instrument may be incorrect. | Check the wiring for VT/CT and the instrument. |
| | The power factor error is large. | If input current is smaller than the rating, the error will become large. (approximately 5% or less of the rated current) | This is not an error. Use it as it is, or if the error is troublesome, change the CT according to the actual current. |
| | The displayed active power is different from that calculated by multiplying the displayed current, voltage, and power factor. | If the current and voltage AC waveforms distort due to harmonics, the value will not be the same as the calculated value. (For current waveforms without harmonics, the calculated value matches with the displayed value.) | Use the instrument as it is. |
| | The total harmonic RMS value of harmonic current is quite different from the current value. | The distortion ratio (content rate) is well over 100%.<br>(For measurement of inverter secondary side output) | Check the measured item. |
| | The current value measured by this instrument is different from that measured by other measuring instrument, such as a clamp meter. The difference exceeds an acceptable level. | If the comparative measuring instrument uses the average value method, the AC waveform will distort due to harmonics, and the error of the comparative instrument will become large. (This instrument uses the RMS value method.) | Compare with a current value of a measuring instrument that uses the RMS value method. |
| | On the Max/Min value screen, the present value is displayed beyond the range of maximum and minimum values. | During the starting current delay time, the maximum value is not updated. Therefore, the displayed present value may exceed the maximum value. | Use the instrument as it is. |
| Operation | In the setting mode, setting change is not possible. | When SET blinks at the bottom left of the screen, it is in the setting confirmation mode. Therefore, setting change is not possible. | Enter the setting mode to change the settings. |
| | When the screen enters the setting mode, the PASS 0000 display appears | The password protection is enabled. | Enter the password you set up. The factory default password is '0000.'<br>For details, refer to **5.2.7 Password Protection Setting**. |
| Others | Maximum and minimum values change. | The values will be cleared if you change a setting such as phase wire system, VT/Direct voltage, or CT primary current. | It is necessary to record the data before changing the setting. |
| | The settings you have not changed change. | If you change a setting such as phase wire system, VT/Direct voltage, or CT primary current, some items will return to the default settings. | Set up the item, where settings have returned to the default, again. For details, refer to **3.11 Initialization of Related Items by Changing a Setting** |
| | When Max/Min value or active energy values are cleared, the PASS 0000 display appears | The password protection is enabled. | Enter the password you set up. The factory default password is '0000.'<br>For details, refer to **5.2.7 Password Protection Setting**. |
| Communication | COM on the LCD blinks.<br>(ON for 0.25 second/OFF for 0.25 second) | Communication errors may be occurring in MODBUS RTU such as register address error or communication rate setting error | Check the register address and communication settings.<br>If a correct MODBUS RTU communication message is received, COM will light up. |

# 7. Installation

## 7.1. Dimensions

■ME96SSEB-MB



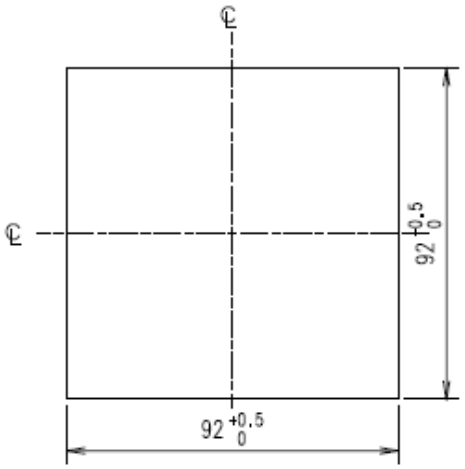

[mm]

# 7. Installation

## 7.2. How to Install

### 7.2.1. Mounting Hole Dimensions

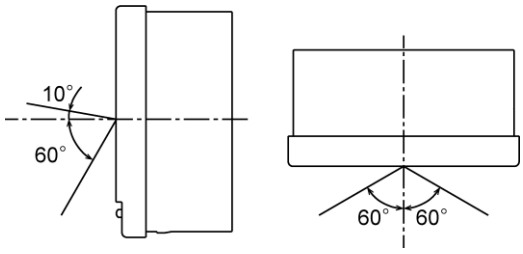
The right figure shows the hole drilling dimensions of the panel. The instrument can be installed on a panel with a thickness of 1.6 mm to 4.0 mm.




[mm]

### 7.2.2. Mounting Position

The contrast of LCD display changes depending on the angle of view. Install the instrument in a location where you can easily see it.

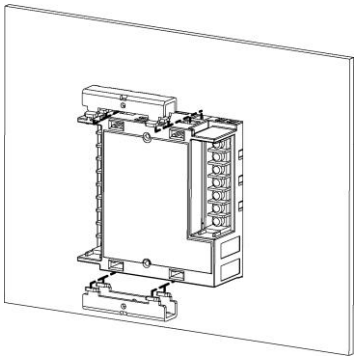



Side view Top view

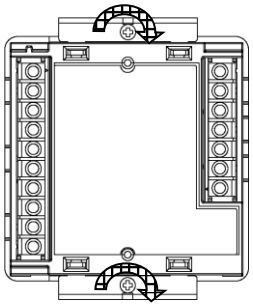
### 7.2.3. Mounting and Fixing

You will install the instrument on a panel according to the following procedure.

①Install the two attachment lugs on the top and bottom of the unit.



②Tighten the screws of the attachment lugs to fix them to the panel.



The mounting screw type: M3

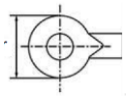
| | |
|---|---|
| Note | To prevent damage to the panel and screws, do not overtighten the screws.<br>Tighten the two screws evenly.<br>The recommended torque for this product is 0.3 N•m to 0.5 N•m (about half the normal torque). |

| | |
|---|---|
| **Note** | **Protection sheet**<br>The protection sheet is attached to the LCD display to prevent scratches on the display during installation. Before starting operation, remove the sheet. When you remove the sheet, the LCD display may light up due to static electricity generation. However, this is not abnormal. After a while, the lighting will go off due to self-discharge.<br>**Mounting position**<br>When you install the instrument on the edge of the panel, check the work space for wiring to determine the mounting position. |

# 7. Installation

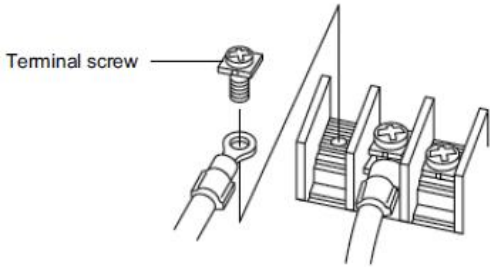
## 7.3. How to Connect Wiring

### 7.3.1. Specifications on the Applicable Electrical Wire

| Parts | Screw type | Wire for use | Tightening torque |
|---|---|---|---|
| The terminals of the unit:<br>・Auxiliary power<br>・Voltage input<br>・Current input<br>・MODBUS RTU communication | M3 | ・Used with crimp-type terminals: AWG 26 to 14<br>*Two-wire connection is possible.<br>Applicable crimp-type terminals: For M3 screw with an outer diameter of 6.0 mm or less.<br>Outer diameter  | 0.5 N・m |

### 7.3.2. Wiring of the Unit

Be sure to securely tighten the terminal screws to the terminal block.




| | |
|---|---|
| ⚠CAUTION | ・ Do not connect three or more electric wires to one terminal. This can cause heat generation or a fire due to imperfect contact.<br>・ If you use a bare crimp-type terminal, you should secure a necessary insulation distance using an insulation tube not to expose the charging part for prevention of electric shock and short circuits. |

### 7.3.3. Check the connection

After wiring, check the following points:
・The electric wires are securely connected.
・There is no wrong wiring.

⚠CAUTION

**Do not work under live wires**

Do not work for wiring under live line conditions.
It may cause an electric shock, burn injury, burnout of the instrument, or a fire.
We recommend that you install protection fuses for VT and auxiliary power unit.

**Do not open the secondary side of CT circuit**

Connect the CT secondary-side signal correctly to the terminal for CT.
If the CT were incorrectly connected or if the CT secondary side were open, it could result in a high voltage generation at the CT secondary side and insulation breakdown in the CT secondary winding. It might cause burnout.

**Do not short the secondary side of VT circuit**

Connect the VT secondary-side signal correctly to the terminal for VT.
If the VT were incorrectly connected or if a short occurred at the VT secondary side, an overcurrent would flow through the VT secondary side and it would cause burnout in the VT secondary winding. The burnout of the secondary winding would lead to insulation breakdown in the secondary winding. Finally, it might cause short circuit between phases.

**Securely connect to the connection terminal**

Connect electrical wires properly to the connection terminal.
Otherwise, heat generation or measurement errors may occur.

**Do not forget to connect wiring of '$C_1$', '$C_2$' and '$C_3$'**

When a common wire is used for L side (load side) of the CT circuit of a 3-phase instrument, it is necessary to short-circuit the C1, C2, and C3 terminals of the instrument.

**Do not use improper electrical wires**

Be sure to use an appropriate size wire compatible with the rated current and voltage.
The use of inappropriate size wire may cause a fire.

**Do not pull connecting wires with a strong force**

If you pulled the terminal wires with a strong force, the input terminal part might come off. (Tensile load: 39.2N or less)

**Do not apply an abnormal voltage.**

If the pressure test of a high-pressure device is performed, ground the input lines of CT and VT secondary sides in order to prevent damage to the instrument. If a high voltage of AC 2000 V were applied to the instrument for over one minute, it might cause a failure.

**Do not connect to Non-Connection (NC) terminal.**

Do not connect to the Non-Connection (NC) terminal for the purpose of relay.

**Supply voltage properly to the auxiliary power source.**

Supply proper voltage to the auxiliary power terminal.
If an improper voltage were applied, it might cause a failure of the instrument or a fire.

# 7. Installation

## 7.4. Wiring Diagram

■Rated voltage by phase wire system

| Phase wire system | Type | Rated voltage | Figure |
|---|---|---|---|
| 3-phase 4-wire | STAR | max 277 V AC (L-N) /480 V AC (L-L) | Figure 1 |
| 3-phase 3-wire | DELTA | max 220 V AC (L-L) | Figure 2 |
| | STAR | max 440 V AC (L-L) | Figure 3 |
| 1-phase 3-wire | — | max 220 V AC (L-N) /440 V AC (L-L) | Figure 4 |
| 1-phase 2-wire *1 | DELTA | max 220 V AC (L-L) | Figure 5 |
| | STAR | max 440V AC (L-L) | Figure 6 |

Note1: For the DELTA connection circuit of 3-phase 3 wire system and transformer circuit of 1-phase 2-wire system, the maximum rating is '220 V AC.'
For the STAR connection circuit of 3-phase 4-wire/3-phase 3-wire system and 1-phase 3-wire circuit, the maximum rating is '440 V AC.'

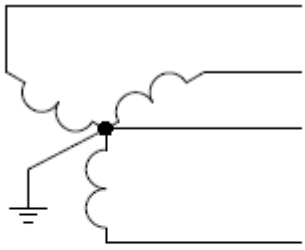


Figure1. 3-PHASE 4-WIRE(STAR)

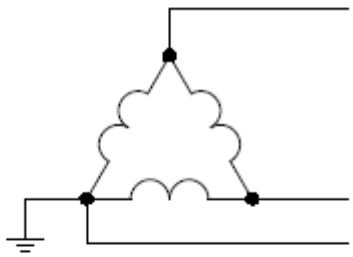


Figure2. 3-PHASE 3-WIRE(DELTA)

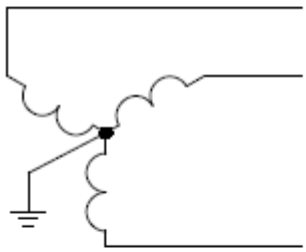


Figure3. 3-PHASE 3-WIRE(STAR)

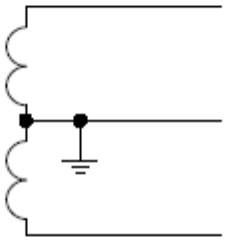


Figure4. 1-PHASE 3-WIRE

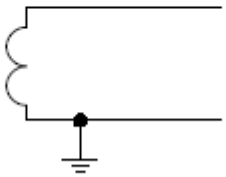


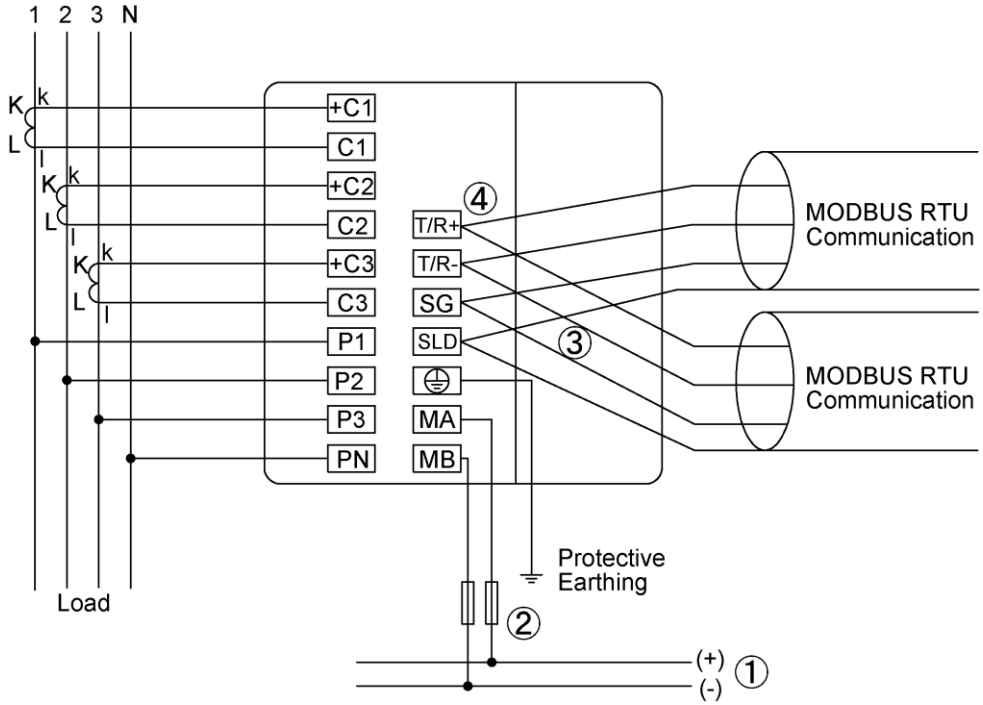
Figure5. 1-PHASE 2-WIRE(DELTA)

Figure6. 1-PHASE 2-WIRE(STAR)

# 7. Installation

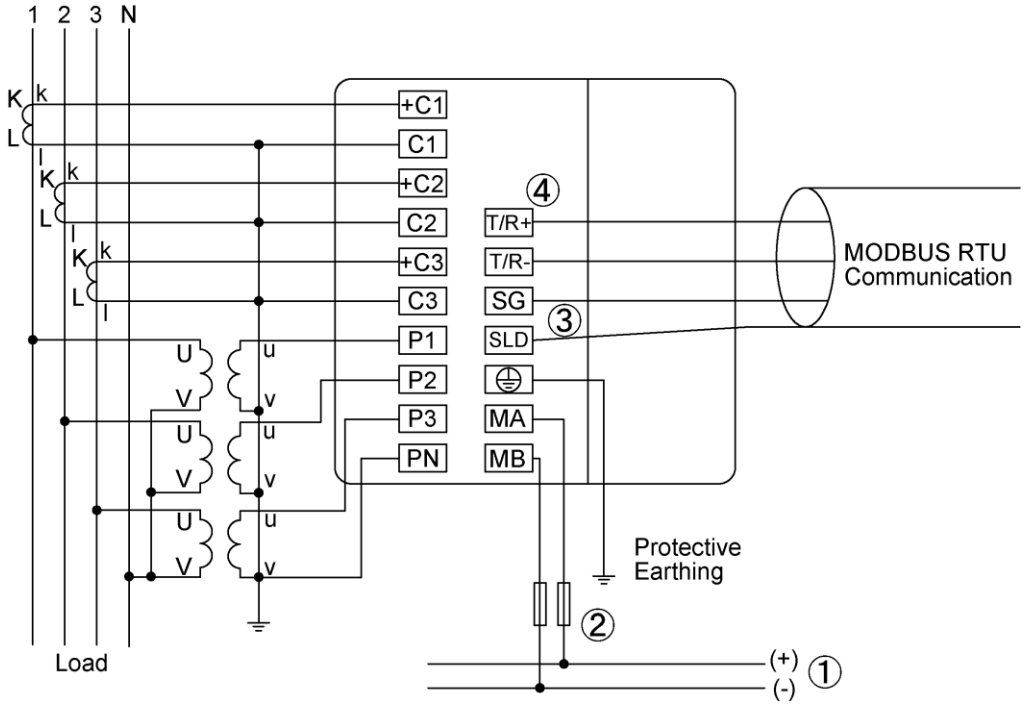
## 7.4. Wiring Diagram

■3-phase 4-wire system, Direct input




①Auxiliary power supply
100 to 240 V AC or 100 to 240 V DC
②Fuse (recommendation)
Rated current: 0.5 A, Rated breaking capacity: 250 V AC 1,500 A / 250 V DC 1,500 A (a UL certified product)
③If MODBUS RTU devices do not have the SG terminal, the wiring between SG terminals is not necessary.
④Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.
*Note1: For low voltage circuits, it is not necessary to ground the VT and CT secondary sides.

■3-phase 4-wire system, With VT

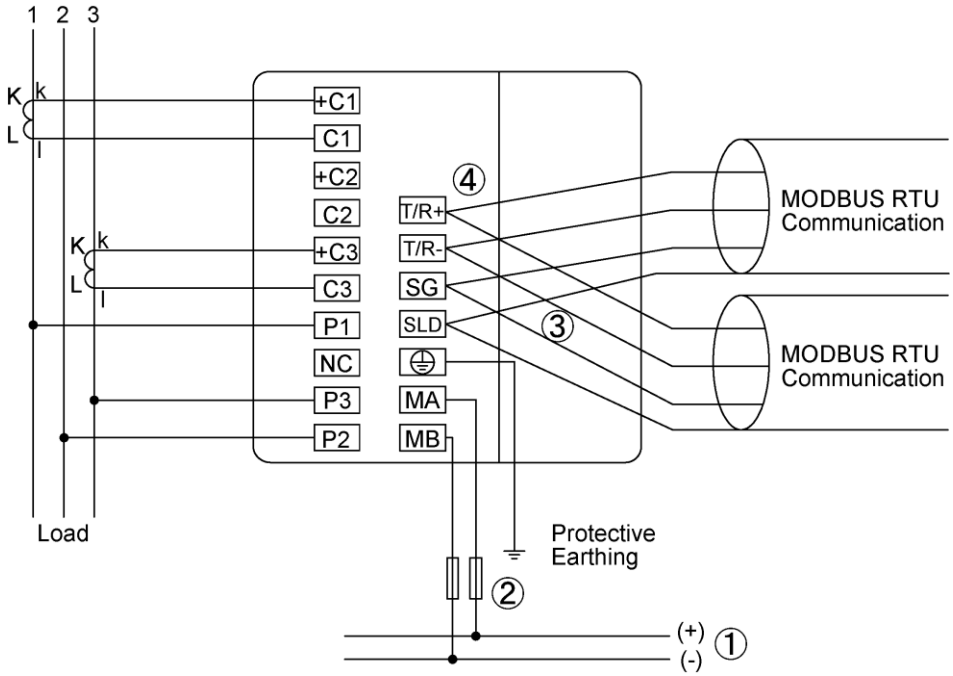



①Auxiliary power supply
100 to 240 V AC or 100 to 240 V DC
②Fuse (recommendation)
Rated current: 0.5 A, Rated breaking capacity: 250 V AC 1,500 A / 250 V DC 1,500 A (a UL certified product)
③If MODBUS RTU devices do not have the SG terminal, the wiring between SG terminals is not necessary.
④Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.
*Note1: For low voltage circuits, it is not necessary to ground the VT and CT secondary sides.

# 7. Installation

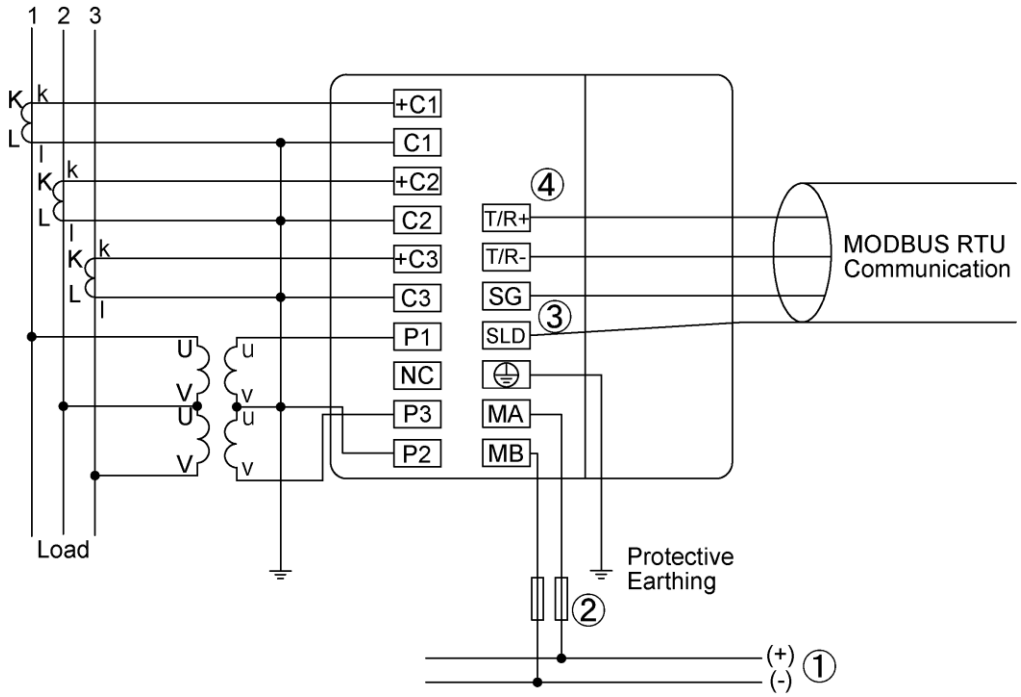
## 7.4. Wiring Diagram

■3-phase 3-wire system, Direct input, 2CT




①Auxiliary power supply
100 to 240 V AC or 100 to 240 V DC
②Fuse (recommendation)
Rated current: 0.5 A, Rated breaking capacity: 250 V AC 1,500 A / 250 V DC 1,500 A (a UL certified product)
③If MODBUS RTU devices do not have the SG terminal, the wiring between SG terminals is not necessary.
④Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.
*Note1: For low voltage circuits, it is not necessary to ground the VT and CT secondary sides.
*Note2: Do not connect the NC terminal.

■3-phase 3-wire system, With VT, 3CT

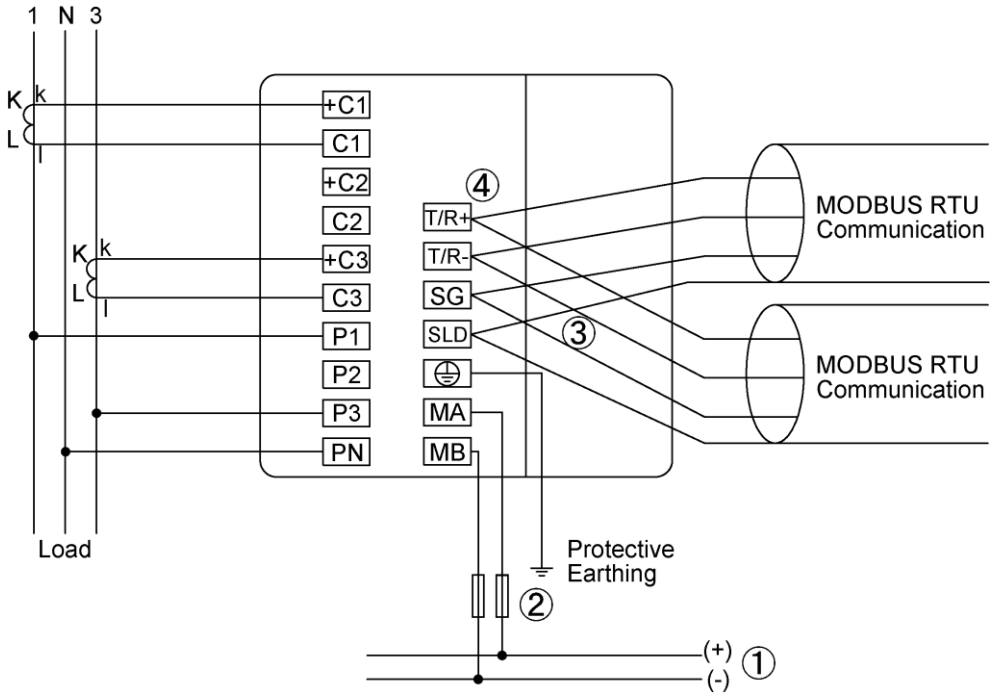



①Auxiliary power supply
100 to 240 V AC or 100 to 240 V DC
②Fuse (recommendation)
Rated current: 0.5 A, Rated breaking capacity: 250 V AC 1,500 A / 250 V DC 1,500 A (a UL certified product)
③If MODBUS RTU devices do not have the SG terminal, the wiring between SG terminals is not necessary.
④Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.
*Note1: For low voltage circuits, it is not necessary to ground the VT and CT secondary sides.
*Note2: Do not connect the NC terminal.

# 7. Installation

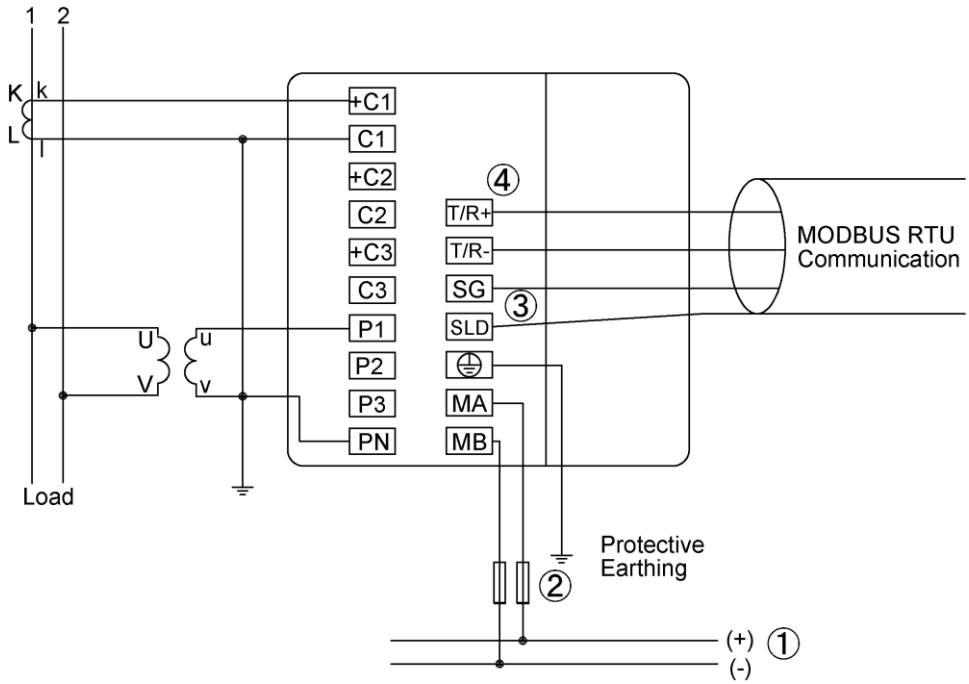
## 7.4. Wiring Diagram

■1-phase 3-wire system




①Auxiliary power supply
100 to 240 V AC or 100 to 240 V DC
②Fuse (recommendation)
Rated current: 0.5 A, Rated breaking capacity: 250 V AC 1,500 A / 250 V DC 1,500 A (a UL certified product)
③If MODBUS RTU devices do not have the SG terminal, the wiring between SG terminals is not necessary.
④Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.
*Note1: For low voltage circuits, it is not necessary to ground the VT and CT secondary sides.
*Note2: Do not connect the NC terminal.

■1-phase 2-wire system, With VT




①Auxiliary power supply
100 to 240 V AC or 100 to 240 V DC
②Fuse (recommendation)
Rated current: 0.5 A, Rated breaking capacity: 250 V AC 1,500 A / 250 V DC 1,500 A (a UL certified product)
③If MODBUS RTU devices do not have the SG terminal, the wiring between SG terminals is not necessary.
④Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.
*Note1: For low voltage circuits, it is not necessary to ground the VT and CT secondary sides.
*Note2: Do not connect the NC terminal.

## 7.4. Wiring Diagram

For Input

| | |
|---|---|
| **Note** | 1. The voltage input terminals of 3-phase 3-wire system are different from those of other systems.<br>2. If the VT and CT polarities are incorrect, measurement will not be correctly executed.<br>3. Do not wire the NC terminal.<br>4. For low voltage, it is not necessary to ground the VT and CT secondary sides.<br>5. Be sure to ground the earth terminal (⏚) to use. The ground resistance is 100 ohm or less. Improper ground may cause a malfunction. |

For MODBUS RTU Communication

| | |
|---|---|
| **Note** | 1. Use a shielded twisted pair cable for transmission signal line.<br>*For recommended cables, refer to **8.3 MODBUS RTU Communication Specifications**.<br>2. Install 120-Ohm terminating resistors between terminals 'T/R+' and 'T/R-' for devices at both ends of MODBUS RTU communication line.<br>3. Use wires as thick as possible to ground for low impedance.<br>4. The transmission signal lines of MODBUS RTU communication must not be placed close to or bound together with high voltage lines.<br>5. Perform one point grounding for the SLD terminal. |

# 8. Specifications

## 8.1. Product Specifications

| Type | | | ME96SSEB-MB | |
|---|---|---|---|---|
| Phase wire system | | | 3-phase 4-wire, 3-phase 3- wire (3CT, 2CT), 1-phase 3- wire, 1-phase 2- wire (common use) | |
| Rating | | Current | 5 A AC, 1 A AC (common use) | |
| | | Voltage | 3-phase 4- wire: max 277/480 V AC<br>3-phase 3- wire: (DELTA) max 220 V AC, (STAR) max 440 V AC<br>1-phase 3- wire: max 220/440 V AC<br>1-phase 2- wire: (DELTA) max 220 V AC, (STAR) max 440 V AC | |
| | | Frequency | 50 Hz or 60 Hz (common use) | |
| Item | | | Measuring Item | Class |
| Measuring element | Current (A) | | A1, A2, A3, AN, $A_{AVG}$ | ±0.5% |
| | Current demand (DA) | | DA1, DA2, DA3, DAN, $DA_{AVG}$ | |
| | Voltage (V) | | V12, V23, V31, $V_{AVG}$ (L-L), V1N, V2N, V3N, $V_{AVG}$ (L-N) | |
| | Active power (W) | | W1, W2, W3, ΣW | |
| | Reactive power (var) | | var1, var2,var3, Σvar | |
| | Apparent power (VA) | | VA1, VA2, VA3, ΣVA | |
| | Power factor (PF) | | PF1, PF2, PF3, ΣPF | |
| | Frequency (Hz) | | Hz | ±0.2% |
| | Active energy (Wh) | | Imported, Exported | Class 0.5S (IEC62053-22) |
| | Reactive energy (varh) | | Imported lag, Imported lead, Exported lag, Exported lead | Class 1S (IEC62053-24) |
| | Apparent energy (VAh) | | Imported + Exported | ±2.0% |
| | Harmonic current (HI) | | Total | ±2.0% |
| | Harmonic voltage (HV) | | Total | |
| | Operating time (h) | | Operating time 1, Operating time 2 | (Reference) |
| Measuring method | | Instantaneous value | A, V: RMS value calculation; W, var, VA, Wh, varh, VAh: Digital multiplication; PF: Power ratio calculation; Hz: Zero-cross; HI, HV: FFT | |
| | | Demand value | DA: Thermal type calculation | |
| Display | Type | | LCD with LED backlight | |
| | The number of display digits or The number of segments | | First to third line display: 4 digits, Fourth line display: 6 digits | |
| | | Digital section | A, DA, V, W, var, VA, PF: 4 digits; Hz: 3 digits;<br>Wh, varh, VAh: 9 digits (6-digit or 12-digit is also possible.);<br>Harmonic distortion ratio/content rate: 4 digits; Harmonic RMS value: 4 digits;<br>Operating time: 6 digits | |
| | Display update time interval | | 0.5 s, 1 s (selectable) | |
| Communication | | | MODBUS RTU communication | |
| Connectable optional plug-in module | | | Cannot connect optional module | |
| Power interruption backup | | | Non-volatile memory is used (Item: Setup value, Max/Min value, Active energy, Reactive energy, Apparent energy, Periodic active energy, Rolling demand, Operating time) | |
| VA consumption | | Voltage circuit | 0.1 VA/phase (at 110 V AC), 0.2 VA/phase (at 220 V AC), 0.4 VA/phase(at 440 V AC) | |
| | | Current circuit | 0.1 VA / phase | |
| | | Auxiliary power circuit | 4 VA (at 110 V AC), 5 VA (at 220 V AC), 3 W (at 100 V DC) | |
| Auxiliary power | | | 100 to 240 V AC (±15%), 100 to 240 V DC (-30% +15%) | |
| Weight | | | 0.3 kg | |
| Dimensions W × H × D [protrusion from cabinet] | | | 96 × 96 × 36 mm (depth of meter from housing mounting flange) [13 mm] | |
| Mounting method | | | Embedded type | |
| Operating temperature/humidity | | | -5℃ to +55℃ (Daily average temperature: 35℃ or less), 0 to 85% RH, Non-condensing | |
| Storage temperature/ humidity | | | -25℃ to +75℃ (Daily average temperature: 35℃ or less), 0 to 85% RH, Non-condensing | |

Note1: The class represents the ratio to the rated value (100%).
Note2: For measurement where the harmonic distortion ratio (content rate) is 100% or more, the class can exceed ±2.0%.
Note3: Harmonic current cannot be measured without voltage input.

PMD characteristics (specified by IEC61557-12)

| Type of characteristic | Characteristic value | Other complementary characteristic |
|---|---|---|
| Power quality assessment function according to 4.3 | PMD-Ⅱ | - |
| Classification of PMD according to 4.4 | SD | - |
| Temperature | K55 | - |
| Humidity + altitude | Standard conditions | - |
| Active power or active energy function (If function available) performance class | 0.5 | - |

## 8.2. Compatible Standards

| | | |
|---|---|---|
| Electromagnetic Compatibility | | |
| | Emissions | |
| | Radiated Emission | EN61326-1/ EN 55011/CISPR 11,<br>FCC Part15 Subpart B Class A |
| | Conducted Emission | EN61326-1/ EN 55011/CISPR 11<br>FCC Part15 Subpart B Class A |
| | Harmonics Measurement | EN61000-3-2 |
| | Flicker Meter Measurement | EN61000-3-3 |
| | Immunity | |
| | Electrostatic discharge Immunity | EN61326-1, EN IEC 61000-6-2/EN61000-4-2 |
| | Radio Frequency Electromagnetic field Immunity | EN61326-1, EN IEC 61000-6-2/EN61000-4-3 |
| | Electrical Fast Transient/Burst Immunity | EN61326-1, EN IEC 61000-6-2/EN61000-4-4 |
| | Surge Immunity | EN61326-1, EN IEC 61000-6-2/EN61000-4-5 |
| | Conducted Disturbances, Induced By Radio Frequency Fields Immunity | EN61326-1, EN IEC 61000-6-2/EN61000-4-6 |
| | Power Frequency Magnetic Field Immunity | EN61326-1, EN IEC 61000-6-2/EN61000-4-8 |
| | Voltage Dips and Short Interruptions | EN61326-1, EN IEC 61000-6-2/EN61000-4-11 |

| | | |
|---|---|---|
| Safety | | |
| | Europe | CE, as per EN61010-1: 2010（3rd Edition） |
| | U.S. and Canada | UL, cUL Recognized<br>as per UL61010-1: 2012（3rd Edition）<br>IEC61010-1: 2010（3rd Edition） |
| | Installation Category | III |
| | Measuring Category | III |
| | Pollution Degree | 2 |

## 8.3. MODBUS RTU Communication Specifications

| Item | Specifications |
|---|---|
| Physical interface | RS-485 2wires half duplex |
| Protocol | RTU mode |
| Transfer method | Start-stop synchronization |
| Transmission wiring type | Multi-point bus (either directly on the trunk cable, forming a daisy-chain) |
| Baud rate | 2400, 4800, 9600, 19200, 38400 bps (Default is 19200 bps) |
| Data bit | 8 |
| Stop bit | 1 or 2 (Default is 1) |
| Parity | ODD,EVEN or NONE (Default is EVEN) |
| Slave address | 1 to 255 (FFh) (Default is 1, 0 is for broadcast mode)<br>(248 to 255 are reserved) |
| Distance | 1200 m |
| Max. number | 31 |
| Response time | 1 s or less (time to response after query data is received) |
| Terminate | 120 Ω 1/2 W |
| Recommended cable | Shielded twisted pair cable, AWG 24 to 14 |

■Read the following document as well as this user's manual.

・Electronic Multi-Measuring Instrument ME Series MODBUS Interface specifications (Ref. No. LSPM-0075)

# 8. Specifications

## 8.4. Setting Table (Factory Default Settings and Customer's Notes Settings)

| Setting menu No. | | | Setting item | Factory default setting | Customer's notes |
|---|---|---|---|---|---|
| 1 | 1.1 | | Phase wire system | 3P4 (3-phase 4-wire) | |
| | 1.2 | | Display pattern | P01 | |
| | | 1.2.1 | Pattern P00 | — | |
| | 1.3 | | VT/Direct voltage | no (Without VT) | |
| | | 1.3.1 | Direct voltage | 220/380 V | |
| | | 1.3.2 | VT secondary voltage | — | |
| | | 1.3.3 | VT primary voltage | — | |
| | 1.4 | | CT secondary current | 5 A | |
| | | 1.4.1 | CT primary current | 5 A | |
| | 1.7 | | Current demand time period | 0 s | |
| 2 | 2.2 | | MODBUS RTU address | 1 | |
| | | 2.2.1 | MODBUS RTU baud rate | 19.2 kbps | |
| | | 2.2.2 | MODBUS RTU parity | EVEn (even) | |
| | | 2.2.3 | MODBUS RTU stop bit | 1 | |
| 3 | 3.1 | | Active/Reactive energy measurement | Combination Ⅰ | |
| | 3.2 | | Harmonics display | on (Display) | |
| 4 | 4.1 | | Model display | (By model) | |
| | 4.2 | | Version display | (By version) | |
| | 4.3 | | Backlight brightness | 3 | |
| | 4.4 | | Backlight Auto off/ON | Auto (Auto off) | |
| | 4.5 | | Display update time | 0.5 s | |
| 5 | 5.1 | | Upper/Lower limit alarm item 1 | non | |
| | | 5.1.1 | Upper/Lower limit alarm value 1 | — | |
| | 5.2 | | Upper/Lower limit alarm item 2 | non | |
| | | 5.2.1 | Upper/Lower limit alarm value 2 | — | |
| | 5.3 | | Upper/Lower limit alarm item 3 | non | |
| | | 5.3.1 | Upper/Lower limit alarm value 3 | — | |
| | 5.4 | | Upper/Lower limit alarm item 4 | non | |
| | | 5.4.1 | Upper/Lower limit alarm value 4 | — | |
| | 5.5 | | Alarm delay time | — | |
| | 5.6 | | Alarm reset method | — | |
| | 5.7 | | Backlight blinking during alarm | — | |
| | 5.8 | | Motor starting current delay function | oFF (Not display) | |
| | | 5.8.1 | Motor starting current threshold | — | |
| | | 5.8.2 | Motor starting current delay time | — | |
| 8 | 8.1 | | Operating time display | oFF (Not display) | |
| | 8.2 | | Operating time 1 count target | AUX (Auxiliary power) | |
| | | 8.2.1 | Operating time 1 threshold | — | |
| | 8.3 | | Operating time 2 count target | AUX (Auxiliary power) | |
| | | 8.3.1 | Operating time 2 threshold | — | |
| | 8.4 | | IEC mode settings | oFF (Normal mode) | |

# 9. Appendix

## 9.1. ME96SS Calculation Method (3-phase Unbalanced System with Neutral)

The following table shows general calculation definitions of electric energy measurement this instrument employs.

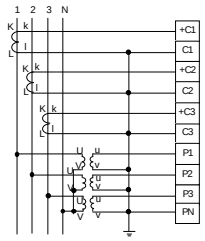
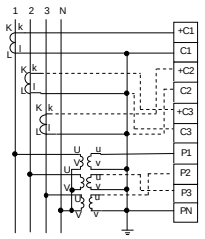
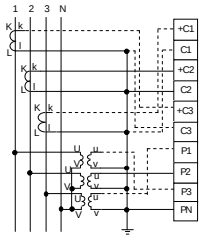
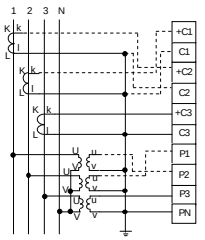
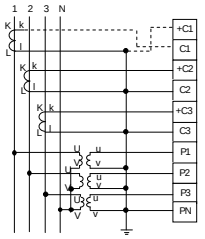
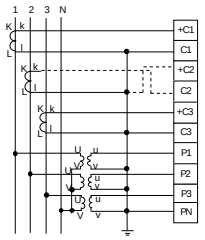
| Item | Normal mode | IEC mode | Notes |
|---|---|---|---|
| RMS current in phase *p* | $I_p = \sqrt{\frac{\sum_{k=0}^{M-1} i_{p_k}^2}{M}}$ | | |
| Calculated RMS neutral current | $I_N = \sqrt{\frac{\sum_{k=0}^{M-1} \left(i_{1_k} + i_{2_k} + i_{3_k}\right)^2}{M}}$ | | |
| Phase *p* to neutral RMS voltage | $V_p = \sqrt{\frac{\sum_{k=0}^{M-1} v_{p_k}^2}{M}}$ | | |
| Phase *p* to phase *g* RMS voltage | $U_{pg} = \sqrt{\frac{\sum_{k=0}^{M-1} \left(v_{p_k}^2 - v_{g_k}^2\right)^2}{M}}$ | | |
| Active power for phase *p* | $P_p = \frac{1}{M} \cdot \sum_{k=0}^{M-1} \left(v_{p_k} \times i_{p_k}\right)$ | | |
| Apparent power for phase *p* | $S_p = V_p \times I_p$ | | |
| Reactive power for phase *p* | $Q_p = Qp_{quad} = \frac{1}{M} \cdot \sum_{k=0}^{M-1} \left(v_{p_{k-N/4}} \times i_{p_k}\right)$ | $Q_p = \sqrt{S_p{}^2 - P_p{}^2}$ | For the sign, refer to **5.1.12.** |
| Power factor for phase *p* | $PF_p = \frac{P_p}{\sqrt{P_p{}^2 + Q_p{}^2}}$ | $PF_p = \frac{P_p}{S_p}$ | For the sign, refer to **5.1.12.** |
| Total active power | $P = \sum_{p=1}^{N_{ph}} P_p$ | | |
| Total reactive power | $Q = \sum_{p=1}^{N_{ph}} Q_p$ | | For the sign, refer to **5.1.12.** |
| Total apparent power | $S = \sum_{p=1}^{N_{ph}} S_p$ | $S = \sqrt{P^2 + Q^2}$ | |
| Total power factor | $PF = \frac{P}{\sqrt{P^2 + Q^2}}$ | $PF = \frac{P}{S}$ | For the sign, refer to **5.1.12.** |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

### 9.2.1. 3-phase 4-wire System

*The shaded parts indicate influential parts caused by incorrect wiring.
The dashed lines show incorrect wiring parts.

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | | | | | | | |
| | | | | | | | | | | | | | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 1 | LEAD 0.707 | | | | 315 | 75 | 195 | | | | | | | | | | | | | | | | Normal  |
| | LEAD 0.866 | | | | 330 | 90 | 210 | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 0 | 120 | 240 | $W_1=W_2=W_3$ | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | |
| | LAG 0.866 | | | | 30 | 150 | 270 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 165 | 285 | | | | | | | | | | | | | | | | |
| | LEAD 0.707 | | | | 315 | 195 | 75 | | | | | | | | | | P1 | P3 | P2 | PN | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | Reversed phase sequence 1  |
| | LEAD 0.866 | | | | 330 | 210 | 90 | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 240 | 120 | 0 | 240 | 120 | $W_1=W_2=W_3$ | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | PN | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | Reversed phase sequence 2  |
| | LAG 0.866 | | | | 30 | 270 | 150 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 285 | 165 | | | | | | | | | | P2 | P1 | P3 | PN | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | Reversed phase sequence 3  |
| 2 | LEAD 0.707 | | | | 135 | 75 | 195 | | | | | | | | | | | | | | | | Reverse connection of 1 side CT  |
| | LEAD 0.866 | | | | 150 | 90 | 210 | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 180 | 120 | 240 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | |
| | LAG 0.866 | | | | 210 | 150 | 270 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 165 | 285 | | | | | | | | | | | | | | | | |
| 3 | LEAD 0.707 | | | | 315 | 255 | 195 | | | | | | | | | | | | | | | | Reverse connection of 2 side CT  |
| | LEAD 0.866 | | | | 330 | 270 | 210 | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 0 | 300 | 240 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | |
| | LAG 0.866 | | | | 30 | 330 | 270 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 345 | 285 | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

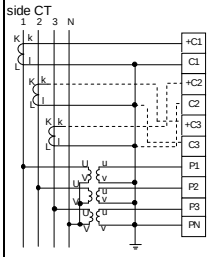
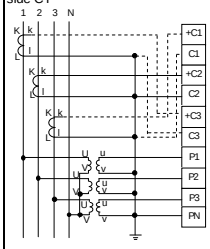
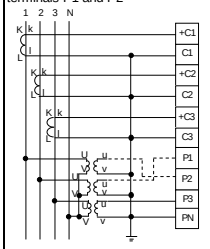
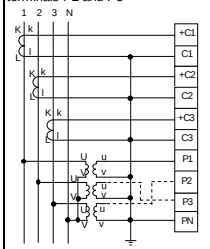
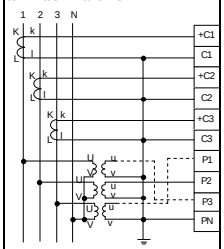
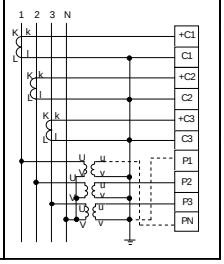
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 4 | LEAD 0.707 | | | | 315 | 75 | 15 | | | | | | | | | | | | | | | | | Reverse connection of 3 side CT |
| | LEAD 0.866 | | | | 330 | 90 | 30 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 0 | 120 | 60 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 30 | 150 | 90 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 165 | 105 | | | | | | | | | | | | | | | | | |
| 5 | LEAD 0.707 | | | | 135 | 255 | 195 | | | | | | | | | | | | | | | | | Reverse connection of 1 side CT and 2 side CT |
| | LEAD 0.866 | | | | 150 | 270 | 210 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 180 | 300 | 240 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Reverse | +C2-C2 Reverse | +C3-C3 Normal | |
| | LAG 0.866 | | | | 210 | 330 | 270 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 345 | 285 | | | | | | | | | | | | | | | | | |
| 6 | LEAD 0.707 | | | | 315 | 255 | 15 | | | | | | | | | | | | | | | | | Reverse connection of 2 side CT and 3 side CT |
| | LEAD 0.866 | | | | 330 | 270 | 30 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 0 | 300 | 60 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 30 | 330 | 90 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 345 | 105 | | | | | | | | | | | | | | | | | |
| 7 | LEAD 0.707 | | | | 135 | 75 | 15 | | | | | | | | | | | | | | | | | Reverse connection of 1 side CT and 3 side CT |
| | LEAD 0.866 | | | | 150 | 90 | 30 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 180 | 120 | 60 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 210 | 150 | 90 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 165 | 105 | | | | | | | | | | | | | | | | | |
| 8 | LEAD 0.707 | | | | 135 | 255 | 15 | | | | | | | | | | | | | | | | | Reverse connection of 1 side CT, 2 side CT, and 3 side CT |
| | LEAD 0.866 | | | | 150 | 270 | 30 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 180 | 300 | 60 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Reverse | +C2-C2 Reverse | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 210 | 330 | 90 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 345 | 105 | | | | | | | | | | | | | | | | | |
| 9 | LEAD 0.707 | | | | 75 | 315 | 195 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | Switch between 1 side CT and 2 side CT |
| | LEAD 0.866 | | | | 90 | 330 | 210 | $W_1$=0<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 120 | 240 | 120 | 0 | 240 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | |
| | LAG 0.866 | | | | 150 | 30 | 270 | $W_1$=Negative value<br>$W_2$=0<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 165 | 45 | 285 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

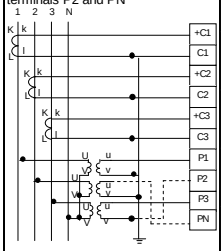
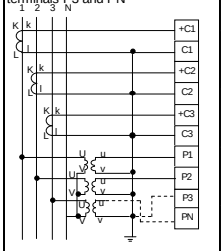
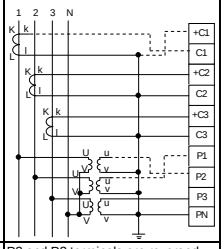
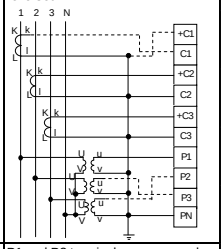
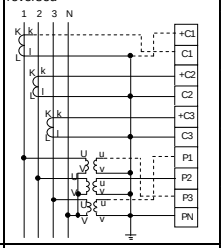
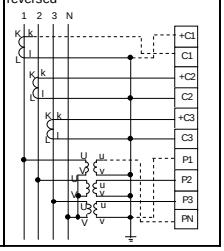
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 10 | LEAD 0.707 | 0 | 120 | 240 | 315 | 195 | 75 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Negative value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | Switch between 2 side CT and 3 side CT  |
| | LEAD 0.866 | | | | 330 | 210 | 90 | $W_1$=Positive value | $W_2$=0 | $W_3$=Negative value | | | | | | | | | | | | | | |
| | 1.000 | | | | 0 | 240 | 120 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 30 | 270 | 150 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=0 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 285 | 165 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Positive value | | | | | | | | | | | | | | |
| 11 | LEAD 0.707 | 0 | 120 | 240 | 195 | 75 | 315 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Positive value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | PN | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | Switch between 1 side CT and 3 side CT  |
| | LEAD 0.866 | | | | 210 | 90 | 330 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=0 | | | | | | | | | | | | | | |
| | 1.000 | | | | 240 | 120 | 0 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 270 | 150 | 30 | $W_1$=0 | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 285 | 165 | 45 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| 12 | LEAD 0.707 | 0 | 240 | 120 | 195 | 315 | 75 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Positive value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and P2  |
| | LEAD 0.866 | | | | 210 | 330 | 90 | $W_1$=Negative value | $W_2$=0 | $W_3$=Positive value | | | | | | | | | | | | | | |
| | 1.000 | | | | 240 | 0 | 120 | $W_1$=Negative value | $W_2$=Negative value | $W_3$=Positive value | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 270 | 30 | 150 | $W_1$=0 | $W_2$=Negative value | $W_3$=Positive value | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 285 | 45 | 165 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Positive value | | | | | | | | | | | | | | |
| 13 | LEAD 0.707 | 0 | 240 | 120 | 315 | 75 | 195 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Positive value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P3 | P2 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | Reverse connection between terminals P2 and P3  |
| | LEAD 0.866 | | | | 330 | 90 | 210 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=0 | | | | | | | | | | | | | | |
| | 1.000 | | | | 0 | 120 | 240 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 30 | 150 | 270 | $W_1$=Positive value | $W_2$=0 | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 165 | 285 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| 14 | LEAD 0.707 | 0 | 240 | 120 | 75 | 195 | 315 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Negative value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and P3  |
| | LEAD 0.866 | | | | 90 | 210 | 330 | $W_1$=0 | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | 1.000 | | | | 120 | 240 | 0 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 150 | 270 | 30 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=0 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 165 | 285 | 45 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Positive value | | | | | | | | | | | | | | |
| 15 | LEAD 0.707 | 0 | 330 | 30 | 135 | 255 | 15 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Positive value | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and PN  |
| | LEAD 0.866 | | | | 150 | 270 | 30 | | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 180 | 300 | 60 | | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 210 | 330 | 90 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 345 | 105 | | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

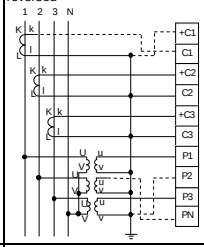
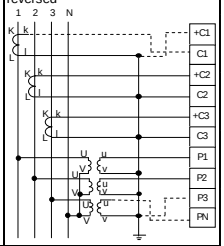
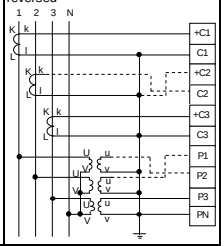
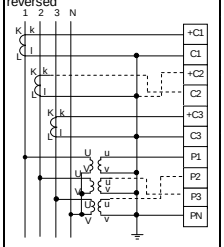
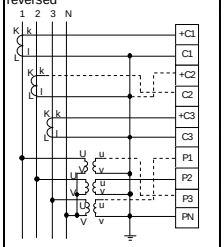
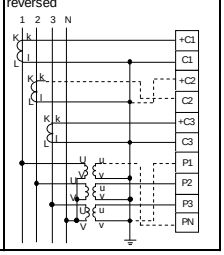
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 16 | LEAD 0.707 | 0 | 330 | 300 | 345 | 105 | 225 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | Reverse connection between terminals P2 and PN  |
| | LEAD 0.866 | | | | 0 | 120 | 240 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 30 | 150 | 270 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 60 | 180 | 300 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 75 | 195 | 315 | | | | | | | | | | | | | | | | |
| 17 | LEAD 0.707 | 0 | 60 | 30 | 285 | 45 | 165 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Normal | Reverse connection between terminals P3 and PN  |
| | LEAD 0.866 | | | | 300 | 60 | 180 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 330 | 90 | 210 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 0 | 120 | 240 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 15 | 135 | 255 | | | | | | | | | | | | | | | | |
| 18 | LEAD 0.707 | 0 | 240 | 120 | 15 | 315 | 75 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | PN | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | P1 and P2 terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 30 | 330 | 90 | $W_1$=Positive value<br>$W_2$=0<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 60 | 0 | 120 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 90 | 30 | 150 | $W_1$=0<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 105 | 45 | 165 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| 19 | LEAD 0.707 | 0 | 240 | 120 | 135 | 75 | 195 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P3 | P2 | PN | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | P2 and P3 terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 150 | 90 | 210 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=0 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 180 | 120 | 240 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 210 | 150 | 270 | $W_1$=Negative value<br>$W_2$=0<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 165 | 285 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| 20 | LEAD 0.707 | 0 | 240 | 120 | 255 | 195 | 315 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | PN | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | P1 and P3 terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 270 | 210 | 330 | $W_1$=0<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 300 | 240 | 0 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 330 | 270 | 30 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=0 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 345 | 285 | 45 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| 21 | LEAD 0.707 | 0 | 330 | 30 | 315 | 255 | 15 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | P1 and PN terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 330 | 270 | 30 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 0 | 300 | 60 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 30 | 330 | 90 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 345 | 105 | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

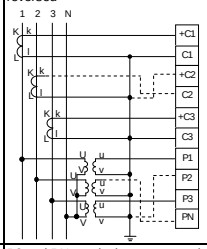
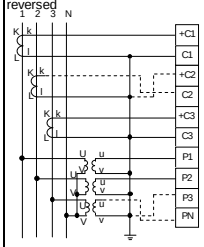
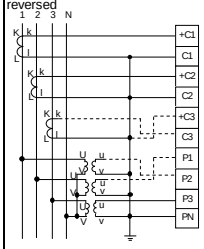
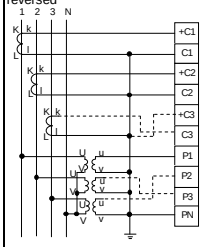
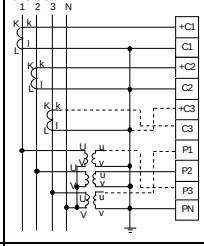
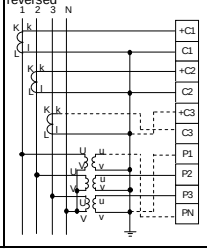
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 22 | LEAD 0.707 | 0 | 330 | 300 | 165 | 105 | 225 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | P2 and PN terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 180 | 120 | 240 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 210 | 150 | 270 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 240 | 180 | 300 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 255 | 195 | 315 | | | | | | | | | | | | | | | | |
| 23 | LEAD 0.707 | 0 | 60 | 30 | 105 | 45 | 165 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C1-C1 Reverse | +C2-C2 Normal | +C3-C3 Normal | P3 and PN terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 120 | 60 | 180 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 150 | 90 | 210 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 180 | 120 | 240 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 195 | 135 | 255 | | | | | | | | | | | | | | | | |
| 24 | LEAD 0.707 | 0 | 240 | 120 | 195 | 135 | 75 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | PN | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | P1 and P2 terminals are reversed and the connection 2 side CT reversed  |
| | LEAD 0.866 | | | | 210 | 150 | 90 | $W_1$=Negative value<br>$W_2$=0<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | 1.000 | | | | 240 | 180 | 120 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 270 | 210 | 150 | $W_1$=0<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 285 | 225 | 165 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| 25 | LEAD 0.707 | 0 | 240 | 120 | 315 | 255 | 195 | W1=Positive value<br>W2=Positive value<br>W3=Positive value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P3 | P2 | PN | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | P1 and P2 terminals are reversed and the connection 1 side CT reversed  |
| | LEAD 0.866 | | | | 330 | 270 | 210 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=0 | | | | | | | | | | | | | | | |
| | 1.000 | | | | 0 | 300 | 240 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 30 | 330 | 270 | $W_1$=Positive value<br>$W_2$=0<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 345 | 285 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| 26 | LEAD 0.707 | 0 | 240 | 120 | 75 | 15 | 315 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | PN | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | P1 and P3 terminals are reversed and the connection 2 side CT reversed  |
| | LEAD 0.866 | | | | 90 | 30 | 330 | $W_1$=0<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | 1.000 | | | | 120 | 60 | 0 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 150 | 90 | 30 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=0 | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 165 | 105 | 45 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| 27 | LEAD 0.707 | 0 | 330 | 30 | 135 | 75 | 15 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | P1 and PN terminals are reversed and the connection 2 side CT reversed  |
| | LEAD 0.866 | | | | 150 | 90 | 30 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 180 | 120 | 60 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 210 | 150 | 90 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 165 | 105 | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

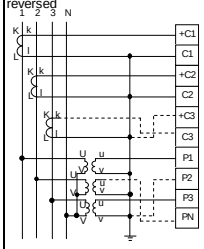
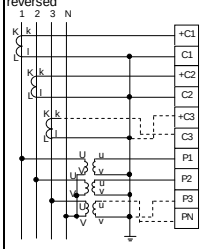
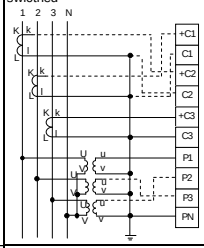
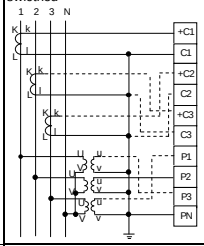
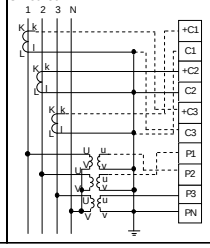
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 28 | LEAD 0.707 | | | | 345 | 285 | 225 | | | | | | | | | | | | | | | | | P2 and PN terminals are reversed and the connection 2 side CT reversed  |
| | LEAD 0.866 | | | | 0 | 300 | 240 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 300 | 30 | 330 | 270 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Positive value | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | |
| | LAG 0.866 | | | | 60 | 0 | 300 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 75 | 15 | 315 | | | | | | | | | | | | | | | | | |
| 29 | LEAD 0.707 | | | | 285 | 225 | 165 | | | | | | | | | | | | | | | | | P3 and PN terminals are reversed and the connection 2 side CT reversed  |
| | LEAD 0.866 | | | | 300 | 240 | 180 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 60 | 30 | 330 | 270 | 210 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Negative value | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C1-C1 Normal | +C2-C2 Reverse | +C3-C3 Normal | |
| | LAG 0.866 | | | | 0 | 300 | 240 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 15 | 315 | 255 | | | | | | | | | | | | | | | | | |
| 30 | LEAD 0.707 | | | | 195 | 315 | 255 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | P1 and P2 terminals are reversed and the connection 3 side CT reversed  |
| | LEAD 0.866 | | | | 210 | 330 | 270 | $W_1$=Negative value | $W_2$=0 | $W_3$=Negative value | | | | | | | | | | | | | | |
| | 1.000 | 0 | 240 | 120 | 240 | 0 | 300 | $W_1$=Negative value | $W_2$=Negative value | $W_3$=Negative value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 270 | 30 | 330 | $W_1$=0 | $W_2$=Negative value | $W_3$=Negative value | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 285 | 45 | 345 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Negative value | | | | | | | | | | | | | | |
| 31 | LEAD 0.707 | | | | 315 | 75 | 15 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Negative value | | | | | | | | | | | | | | P2 and P3 terminals are reversed and the connection 3 side CT reversed  |
| | LEAD 0.866 | | | | 330 | 90 | 30 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=0 | | | | | | | | | | | | | | |
| | 1.000 | 0 | 240 | 120 | 0 | 120 | 60 | $W_1$=Positive value | $W_2$=Negative value | $W_3$=Positive value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P3 | P2 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 30 | 150 | 90 | $W_1$=Positive value | $W_2$=0 | $W_3$=Positive value | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 45 | 165 | 105 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Positive value | | | | | | | | | | | | | | |
| 32 | LEAD 0.707 | | | | 75 | 195 | 135 | $W_1$=Positive value | $W_2$=Positive value | $W_3$=Positive value | | | | | | | | | | | | | | P1 and P3 terminals are reversed and the connection 3 side CT reversed  |
| | LEAD 0.866 | | | | 90 | 210 | 150 | $W_1$=0 | $W_2$=Positive value | $W_3$=Positive value | | | | | | | | | | | | | | |
| | 1.000 | 0 | 240 | 120 | 120 | 240 | 180 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Positive value | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | PN | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 150 | 270 | 210 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=0 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 165 | 285 | 225 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Negative value | | | | | | | | | | | | | | |
| 33 | LEAD 0.707 | | | | 135 | 255 | 195 | | | | | | | | | | | | | | | | | P1 and PN terminals are reversed and the connection 3 side CT reversed  |
| | LEAD 0.866 | | | | 150 | 270 | 210 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 30 | 180 | 300 | 240 | $W_1$=Negative value | $W_2$=Positive value | $W_3$=Negative value | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | |
| | LAG 0.866 | | | | 210 | 330 | 270 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 345 | 285 | | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

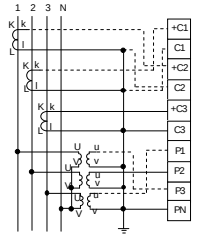
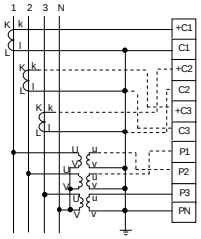
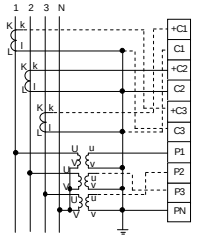
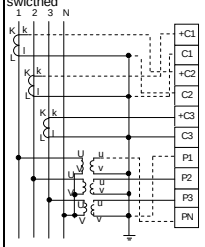
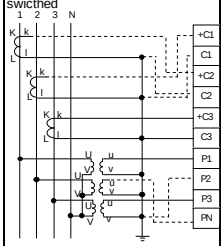
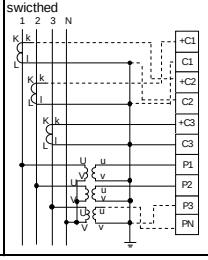
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 34 | LEAD 0.707 | 0 | 330 | 300 | 345 | 105 | 45 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | P2 and PN terminals are reversed and the connection 3 side CT reversed  |
| | LEAD 0.866 | | | | 0 | 120 | 60 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 30 | 150 | 90 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 60 | 180 | 120 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 75 | 195 | 135 | | | | | | | | | | | | | | | | |
| 35 | LEAD 0.707 | 0 | 60 | 30 | 285 | 45 | 345 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C1-C1 Normal | +C2-C2 Normal | +C3-C3 Reverse | P3 and PN terminals are reversed and the connection 3 side CT reversed  |
| | LEAD 0.866 | | | | 300 | 60 | 0 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 330 | 90 | 30 | | | | | | | | | | | | | | | | |
| | LAG 0.866 | | | | 0 | 120 | 60 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 15 | 135 | 75 | | | | | | | | | | | | | | | | |
| 36 | LEAD 0.707 | 0 | 240 | 120 | 75 | 315 | 195 | $W_1=W_2=W_3$ | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P3 | P2 | PN | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | P2 and P3 terminals are reversed and 1 side CT and 2 side CT are swicthed  |
| | LEAD 0.866 | | | | 90 | 330 | 210 | | | | | | | | | | | | | | | | |
| | 1.000 | | | | 120 | 0 | 240 | | | | | | | | | | P3 | P2 | P1 | PN | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | P1 and P3 terminals are reversed and 2 side CT and 3 side CT are swicthed  |
| | LAG 0.866 | | | | 150 | 30 | 270 | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 165 | 45 | 285 | | | | | | | | | | P2 | P1 | P3 | PN | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | P1 and P2 terminals are reversed and 1 side CT and 3 side CT are swicthed  |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

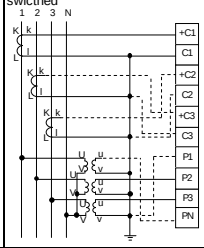
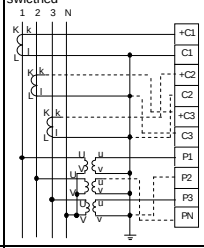
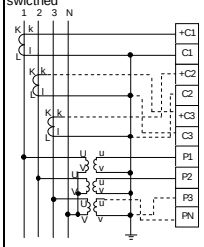
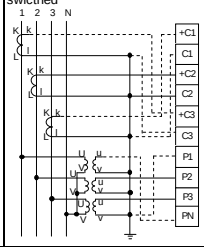
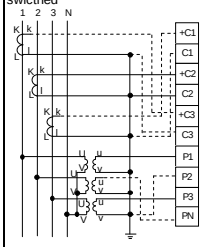
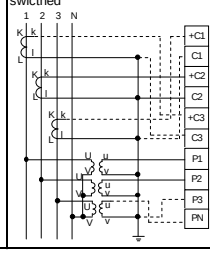
### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 37 | LEAD 0.707 | | | | 195 | 75 | 315 | | | | | | | | | | P3 | P2 | P1 | PN | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | P1 and P3 terminals are reversed and 1 side CT and 2 side CT are swicthed  |
| | LEAD 0.866 | | | | 210 | 90 | 330 | | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 240 | 120 | 240 | 120 | 0 | $W_1=W_2=W_3$ | | | $V_{1N}=V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | PN | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | P1 and P2 terminals are reversed and 2 side CT and 3 side CT are swicthed  |
| | LAG 0.866 | | | | 270 | 150 | 30 | | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 285 | 165 | 45 | | | | | | | | | | P1 | P3 | P2 | PN | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | P2 and P3 terminals are reversed and 1 side CT and 3 side CT are swicthed  |
| 38 | LEAD 0.707 | | | | 255 | 135 | 15 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | LEAD 0.866 | | | | 270 | 150 | 30 | $W_1$=0<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 30 | 300 | 180 | 60 | | | | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | P1 and PN terminals are reversed and 1 side CT and 2 side CT are swicthed  |
| | LAG 0.866 | | | | 330 | 210 | 90 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 345 | 225 | 105 | | | | | | | | | | | | | | | | | |
| 39 | LEAD 0.707 | | | | 105 | 345 | 225 | | | | | | | | | | | | | | | | | |
| | LEAD 0.866 | | | | 120 | 0 | 240 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 300 | 150 | 30 | 270 | | | | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | P2 and PN terminals are reversed and 1 side CT and 2 side CT are swicthed  |
| | LAG 0.866 | | | | 180 | 60 | 300 | $W_1$=Negative value<br>$W_2$=0<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 195 | 75 | 315 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | | |
| 40 | LEAD 0.707 | | | | 45 | 285 | 165 | | | | | | | | | | | | | | | | | |
| | LEAD 0.866 | | | | 60 | 300 | 180 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 60 | 30 | 90 | 330 | 210 | | | | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C2-C2 Normal | +C1-C1 Normal | +C3-C3 Normal | P3 and PN terminals are reversed and 1 side CT and 2 side CT are swicthed  |
| | LAG 0.866 | | | | 120 | 0 | 240 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 135 | 15 | 255 | | | | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

### 9.2.1. 3-phase 4-wire System

| No. | Power Factor (Input) | Phase Angle Display | | | | | | At balanced load ($V_{1N}=V_{2N}=V_{3N}$, $I_1=I_2=I_3$) | | | | | | | Connection (Note 1) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Active Power Display | | | Voltage Display | | | Current Display | | | Voltage | | | | Current | | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{2N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_2$ | $\angle I_3$ | $W_1$ | $W_2$ | $W_3$ | $V_{1N}$ | $V_{2N}$ | $V_{3N}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | N | 1 side CT | 2 side CT | 3 side CT | |
| 41 | LEAD 0.707 | | | | 135 | 15 | 255 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | P1 and PN terminals are reversed and 2 side CT and 3 side CT are swicthed  |
| | LEAD 0.866 | | | | 150 | 30 | 270 | | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 30 | 180 | 60 | 300 | $W_1$=Negative value<br>$W_2$=0<br>$W_3$=0 | | | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | |
| | LAG 0.866 | | | | 210 | 90 | 330 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 225 | 105 | 345 | | | | | | | | | | | | | | | | |
| 42 | LEAD 0.707 | | | | 345 | 225 | 105 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | P2 and PN terminals are reversed and 2 side CT and 3 side CT are swicthed  |
| | LEAD 0.866 | | | | 0 | 240 | 120 | $W_1$=Positive value<br>$W_2$=0<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 300 | 30 | 270 | 150 | | | | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | |
| | LAG 0.866 | | | | 60 | 300 | 180 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 75 | 315 | 195 | | | | | | | | | | | | | | | | |
| 43 | LEAD 0.707 | | | | 285 | 165 | 45 | | | | | | | | | | | | | | | | P3 and PN terminals are reversed and 2 side CT and 3 side CT are swicthed  |
| | LEAD 0.866 | | | | 300 | 180 | 60 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 60 | 30 | 330 | 210 | 90 | | | | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C1-C1 Normal | +C3-C3 Normal | +C2-C2 Normal | |
| | LAG 0.866 | | | | 0 | 240 | 120 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=0 | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 15 | 255 | 135 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| 44 | LEAD 0.707 | | | | 15 | 255 | 135 | | | | | | | | | | | | | | | | P1 and PN terminals are reversed and 1 side CT and 3 side CT are swicthed  |
| | LEAD 0.866 | | | | 30 | 270 | 150 | $W_1$=Positive value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 30 | 60 | 300 | 180 | | | | $V_{1N}<V_{2N}=V_{3N}$ | | | $I_1=I_2=I_3$ | | | PN | P2 | P3 | P1 | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | |
| | LAG 0.866 | | | | 90 | 330 | 210 | $W_1$=0<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 105 | 345 | 225 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| 45 | LEAD 0.707 | | | | 225 | 105 | 345 | | | | | | | | | | | | | | | | P2 and PN terminals are reversed and 1 side CT and 3 side CT are swicthed  |
| | LEAD 0.866 | | | | 240 | 120 | 0 | $W_1$=Negative value<br>$W_2$=Negative value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 330 | 300 | 270 | 150 | 30 | | | | $V_{1N}=V_{3N}>V_{2N}$ | | | $I_1=I_2=I_3$ | | | P1 | PN | P3 | P2 | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | |
| | LAG 0.866 | | | | 300 | 180 | 60 | $W_1$=0<br>$W_2$=Negative value<br>$W_3$=0 | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 315 | 195 | 75 | $W_1$=Positive value<br>$W_2$=Negative value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| 46 | LEAD 0.707 | | | | 165 | 45 | 285 | | | | | | | | | | | | | | | | P3 and PN terminals are reversed and 1 side CT and 3 side CT are swicthed  |
| | LEAD 0.866 | | | | 180 | 60 | 300 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | | | |
| | 1.000 | 0 | 60 | 30 | 210 | 90 | 330 | | | | $V_{1N}=V_{2N}>V_{3N}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | PN | P3 | +C3-C3 Normal | +C2-C2 Normal | +C1-C1 Normal | |
| | LAG 0.866 | | | | 240 | 120 | 0 | $W_1$=Negative value<br>$W_2$=Positive value<br>$W_3$=Positive value | | | | | | | | | | | | | | | |
| | LAG 0.707 | | | | 255 | 135 | 15 | | | | | | | | | | | | | | | | |

Note1: The above examples for incorrect wiring are typical. Extreme cases are excluded such as burnout or destruction of the instrument, VT, or CT caused by voltage application to a current circuit or current application to a voltage circuit.

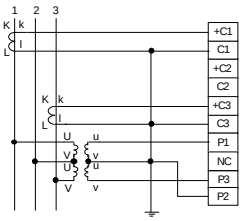
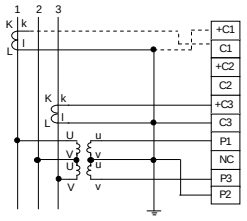
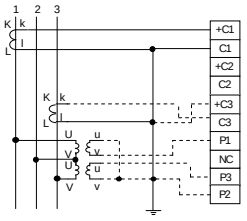
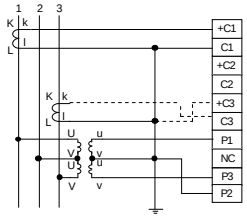
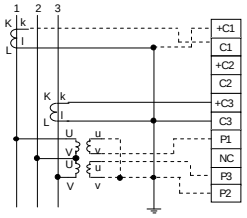
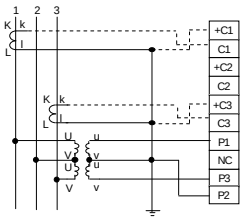
Note : The active power polarity may be displayed in reverse depending on the load status (low power factor, unbalanced load) even if the connection is correct.

# 9. Appendix

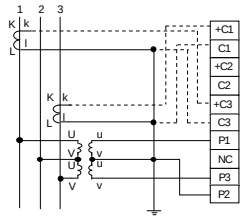
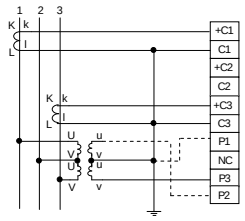
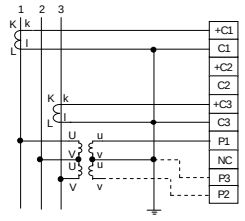
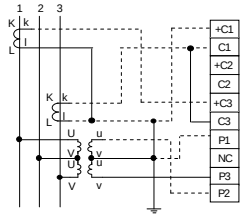
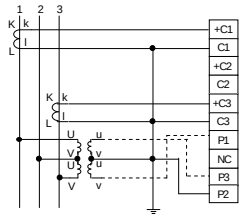
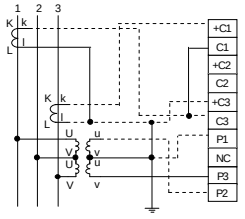
## 9.2. A List of Examples for Incorrect Wiring Display

### 9.2.2. 3-phase 3-wire System

*The shaded parts indicate influential parts caused by incorrect wiring.
The dashed lines show incorrect wiring parts.

| No. | Power Factor (Input) | At balanced load ($V_{12}=V_{23}$, $I_1=I_3$) | | | | | | | | | | | | Connection (Note 7) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{12}$ | $\angle V_{32}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | 1 side CT | 3 side CT | |
| 1 | LEAD 0.707 | 0 | 300 | 345 | 225 | $W_1>W_3$ | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | +C1-C1 Normal | +C3-C3 Normal | Normal  |
| | LEAD 0.866 | | | 0 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 270 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 300 | $W_1<W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 75 | 315 | | | | | | | | | | | | | | |
| 2 | LEAD 0.707 | 0 | 300 | 165 | 225 | $W_1$=Negative value $W_3$=Positive value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P1 | P2 | P3 | +C1-C1 Reverse | +C3-C3 Normal | Reverse connection of 1 side CT  |
| | LEAD 0.866 | | | 180 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 210 | 270 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 240 | 300 | | | | | | | | | Revverse connection for each of 1 side VT and 3 side VT *Refer to the right diagram. | | | +C1-C1 Normal | +C3-C3 Reverse | 1 side VT and 3 side VT are reversed and 3 side CT reversed  |
| | LAG 0.707 | | | 255 | 315 | | | | | | | | | | | | | | |
| 3 | LEAD 0.707 | 0 | 300 | 345 | 45 | $W_1$=Positive value $W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P1 | P2 | P3 | +C1-C1 Normal | +C3-C3 Reverse | Reverse connection of 3 side CT  |
| | LEAD 0.866 | | | 0 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 90 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 120 | | | | | | | | | Revverse connection for each of 1 side VT and 3 side VT *Refer to the right diagram. | | | +C1-C1 Reverse | +C3-C3 Normal | 1 side VT and 3 side VT are reversed and 1 side CT reversed  |
| | LAG 0.707 | | | 75 | 135 | | | | | | | | | | | | | | |
| 4 | LEAD 0.707 | 0 | 300 | 165 | 45 | $W_1$=Negative value $W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | +C1-C1 Reverse | +C3-C3 Reverse | Reverse connection of 1 side VT and 3 side VT  |
| | LEAD 0.866 | | | 180 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 210 | 90 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 240 | 120 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 255 | 135 | | | | | | | | | | | | | | |

## 9.2.2. 3-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{12}=V_{23}$, $I_1=I_3$) | | | | | | | | | | | | Connection (Note 7) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{12}$ | $\angle V_{32}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | 1 side CT | 3 side CT | |
| 5 | LEAD 0.707 | 0 | 300 | 225 | 345 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | +C3-C3 Normal | +C1-C1 Normal | Switch between 1 side CT and 3 side CT  |
| | LEAD 0.866 | | | 240 | 0 | | | | | | | | | | | | | | |
| | 1.000 | | | 270 | 30 | $W_1=W_3=0$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 300 | 60 | $W_1$=Positive value<br>$W_3$=Negative value | | | | | | | | | | | | | |
| | LAG 0.707 | | | 315 | 75 | | | | | | | | | | | | | | |
| 6 | LEAD 0.707 | 0 | 60 | 165 | 45 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | +C1-C1 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and P2  |
| | LEAD 0.866 | | | 180 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 210 | 90 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 240 | 120 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 255 | 135 | | | | | | | | | | | | | | |
| 7 | LEAD 0.707 | 0 | 60 | 285 | 165 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P1 | P3 | P2 | +C1-C1 Normal | +C3-C3 Normal | Reverse connection between terminals P2 and P3  |
| | LEAD 0.866 | | | 300 | 180 | | | | | | | | | | | | | | |
| | 1.000 | | | 330 | 210 | | | | | | | | | P2 | P1 | P3 | Refer to the right figure | | P1 and P2 terminals are reversed and 3 wire connection(Note 1)  |
| | LAG 0.866 | | | 0 | 240 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 15 | 255 | | | | | | | | | | | | | | |
| 8 | LEAD 0.707 | 0 | 60 | 45 | 285 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | +C1-C1 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and P3  |
| | LEAD 0.866 | | | 60 | 300 | | | | | | | | | | | | | | |
| | 1.000 | | | 90 | 330 | $W_1=W_3=0$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 120 | 0 | $W_1$=Negative value<br>$W_3$=Positive value | | | | | | | | P2 | P1 | P3 | Refer to the right figure | | P1 and P2 terminals are reversed and 3 wire connection(Note 2)  |
| | LAG 0.707 | | | 135 | 15 | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

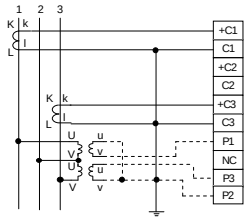
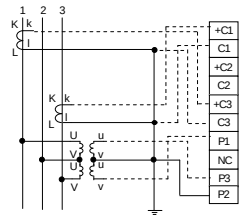
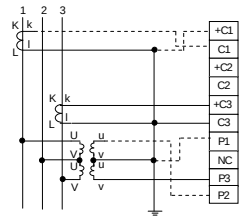
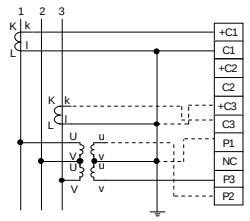
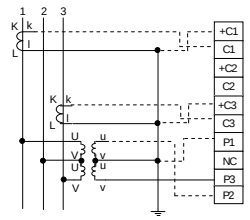
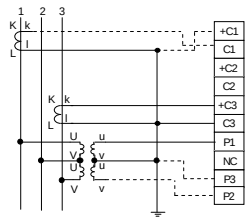
### 9.2.2. 3-phase 3-wire System

<table>
<tr><th rowspan="3">No.</th><th rowspan="3">Power Factor (Input)</th><th colspan="10">At balanced load ($V_{12}=V_{23}$, $I_1=I_3$)</th><th colspan="5">Connection (Note 7)</th></tr>
<tr><th colspan="4">Phase Angle Display</th><th colspan="2">Active Power Display</th><th colspan="3">Voltage Display</th><th colspan="3">Current Display</th><th colspan="3">Voltage</th><th colspan="2">Current</th><th rowspan="2">Connection</th></tr>
<tr><th>$\angle V_{12}$</th><th>$\angle V_{32}$</th><th>$\angle I_1$</th><th>$\angle I_3$</th><th>$W_1$</th><th>$W_3$</th><th>$V_{12}$</th><th>$V_{23}$</th><th>$V_{31}$</th><th>$I_1$</th><th>$I_2$</th><th>$I_3$</th><th>1</th><th>2</th><th>3</th><th>1 side CT</th><th>3 side CT</th></tr>
<tr><td rowspan="5">9</td><td>LEAD 0.707</td><td rowspan="5">0</td><td rowspan="5">300</td><td>225</td><td>105</td><td rowspan="2">$W_1$=Negative value<br>$W_3$=Negative value</td><td rowspan="5">$V_{12}=V_{23}=V_{31}$</td><td rowspan="5">$I_1=I_2=I_3$</td><td rowspan="3">P3</td><td rowspan="3">P1</td><td rowspan="3">P2</td><td rowspan="3">+C1-C1<br>Normal</td><td rowspan="3">+C3-C3<br>Normal</td><td>P3, P1, and P2 terminals of VT are connected toP1, P2, and P3 terminals of the instrument in that order</td></tr>
<tr><td>LEAD 0.866</td><td>240</td><td>120</td></tr>
<tr><td>1.000</td><td>270</td><td>150</td><td>$W_1$=0<br>$W_3$=Negative value</td><td rowspan="3">3 wire connection(Note 2)</td></tr>
<tr><td>LAG 0.866</td><td>300</td><td>180</td><td rowspan="2">$W_1$=Positive value<br>$W_3$=Negative value</td><td rowspan="2">P1</td><td rowspan="2">P2</td><td rowspan="2">P3</td><td rowspan="2">Refer to the right figure</td></tr>
<tr><td>LAG 0.707</td><td>315</td><td>195</td></tr>
<tr><td rowspan="5">10</td><td>LEAD 0.707</td><td rowspan="5">0</td><td rowspan="5">300</td><td>105</td><td>345</td><td rowspan="2">$W_1$=Negative value<br>$W_3$=Positive value</td><td rowspan="5">$V_{12}=V_{23}=V_{31}$</td><td rowspan="5">$I_1=I_2=I_3$</td><td rowspan="3">P2</td><td rowspan="3">P3</td><td rowspan="3">P1</td><td rowspan="3">+C1-C1<br>Normal</td><td rowspan="3">+C3-C3<br>Normal</td><td>P2, P3, and P1 terminals of VT are connected toP1, P2, and P3 terminals of the instrument in that order</td></tr>
<tr><td>LEAD 0.866</td><td>120</td><td>0</td></tr>
<tr><td>1.000</td><td>150</td><td>30</td><td>$W_1$=Negative value<br>$W_3$=0</td><td rowspan="3">3 wire connection(Note 1)</td></tr>
<tr><td>LAG 0.866</td><td>180</td><td>60</td><td rowspan="2">$W_1$=Negative value<br>$W_3$=Negative value</td><td rowspan="2">P1</td><td rowspan="2">P2</td><td rowspan="2">P3</td><td rowspan="2">Refer to the right figure</td></tr>
<tr><td>LAG 0.707</td><td>195</td><td>75</td></tr>
<tr><td rowspan="5">11</td><td>LEAD 0.707</td><td rowspan="5">0</td><td rowspan="5">120</td><td>165</td><td>45</td><td rowspan="5">$W_1$=Negative value<br>$W_3$=Positive value</td><td rowspan="5">$V_{12}=V_{23}<V_{31}$</td><td rowspan="5">$I_1=I_2=I_3$</td><td rowspan="5" colspan="3">Reverse connection of 1 side VT<br>*Refer to the right diagram.</td><td rowspan="5">+C1-C1<br>Normal</td><td rowspan="5">+C3-C3<br>Normal</td><td>Reverse connection of 1 side VT</td></tr>
<tr><td>LEAD 0.866</td><td>180</td><td>60</td></tr>
<tr><td>1.000</td><td>210</td><td>90</td></tr>
<tr><td>LAG 0.866</td><td>240</td><td>120</td></tr>
<tr><td>LAG 0.707</td><td>255</td><td>135</td></tr>
<tr><td rowspan="5">12</td><td>LEAD 0.707</td><td rowspan="5">0</td><td rowspan="5">120</td><td>345</td><td>225</td><td rowspan="5">$W_1$=Positive value<br>$W_3$=Negative value</td><td rowspan="5">$V_{12}=V_{23}<V_{31}$</td><td rowspan="5">$I_1=I_2=I_3$</td><td rowspan="5" colspan="3">Reverse connection of 3 side VT<br>*Refer to the right diagram.</td><td rowspan="5">+C1-C1<br>Normal</td><td rowspan="5">+C3-C3<br>Normal</td><td>Reverse connection of 3 side VT</td></tr>
<tr><td>LEAD 0.866</td><td>0</td><td>240</td></tr>
<tr><td>1.000</td><td>30</td><td>270</td></tr>
<tr><td>LAG 0.866</td><td>60</td><td>300</td></tr>
<tr><td>LAG 0.707</td><td>75</td><td>315</td></tr>
</table>

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

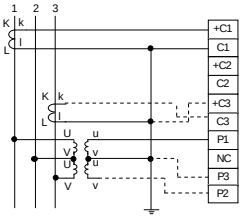
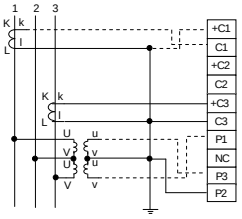
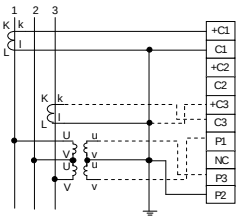
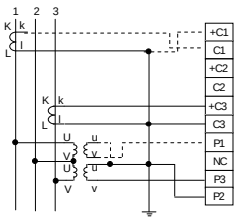
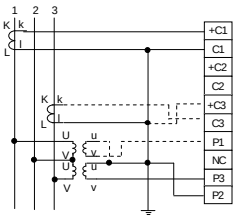
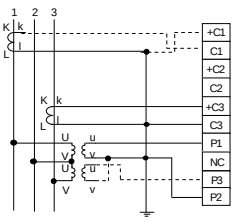
### 9.2.2. 3-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{12}=V_{23}$, $I_1=I_3$) | | | | | | | | | | | | Connection (Note 7) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{12}$ | $\angle V_{32}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | 1 side CT | 3 side CT | |
| 13 | LEAD 0.707 | 0 | 300 | 165 | 45 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | Each of 1 side VT terminal and 3 side VT terminal is reversed.<br>*Refer to the right diagram. | | | +C1-C1 Normal | +C3-C3 Normal | Reverse connection of 1 side VT and 3 side VT<br>  |
| | LEAD 0.866 | | | 180 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 210 | 90 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 240 | 120 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 255 | 135 | | | | | | | | | | | | | | |
| 14 | LEAD 0.707 | 0 | 60 | 285 | 45 | $W_1<W_3$ | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P3 | P2 | P1 | +C3-C3 Normal | +C1-C1 Normal | Reversed phase sequence<br>  |
| | LEAD 0.866 | | | 300 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 330 | 90 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 0 | 120 | $W_1>W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 15 | 135 | | | | | | | | | | | | | | |
| 15 | LEAD 0.707 | 0 | 60 | 345 | 45 | $W_1=W_3$ | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P2 | P1 | P3 | +C1-C1 Reverse | +C3-C3 Normal | P1 and P2 terminals are reversed and 1 side CT reversed<br>  |
| | LEAD 0.866 | | | 0 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 90 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 120 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 75 | 135 | | | | | | | | | | | | | | |
| 16 | LEAD 0.707 | 0 | 60 | 165 | 225 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P2 | P1 | P3 | +C1-C1 Normal | +C3-C3 Reverse | P1 and P2 terminals are reversed and 3 side CT reversed<br>  |
| | LEAD 0.866 | | | 180 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 210 | 270 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 240 | 300 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 255 | 315 | | | | | | | | | | | | | | |
| 17 | LEAD 0.707 | 0 | 60 | 345 | 225 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P2 | P1 | P3 | +C1-C1 Reverse | +C3-C3 Reverse | P1 and P2 terminals are reversed and 1 side CT and 3 side CT are reversed<br>  |
| | LEAD 0.866 | | | 0 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 270 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 300 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 75 | 315 | | | | | | | | | | | | | | |
| 18 | LEAD 0.707 | 0 | 60 | 105 | 165 | $W_1=W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P1 | P3 | P2 | +C1-C1 Reverse | +C3-C3 Normal | P2 and P3 terminals are reversed and 1 side CT reversed<br>  |
| | LEAD 0.866 | | | 120 | 180 | | | | | | | | | | | | | | |
| | 1.000 | | | 150 | 210 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 180 | 240 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 195 | 255 | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

### 9.2.2. 3-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{12}=V_{23}$, $I_1=I_3$) | | | | | | | | | | | | Connection (Note 7) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{12}$ | $\angle V_{32}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | 1 side CT | 3 side CT | |
| 19 | LEAD 0.707 | 0 | 60 | 285 | 345 | $W_1>W_3$ | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P1 | P3 | P2 | +C1-C1 Normal | +C3-C3 Reverse | P2 and P3 terminals are reversed and 3 side CT reversed  |
| | LEAD 0.866 | | | 300 | 0 | | | | | | | | | | | | | | |
| | 1.000 | | | 330 | 30 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 0 | 60 | $W_1<W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 15 | 75 | | | | | | | | | | | | | | |
| 20 | LEAD 0.707 | 0 | 60 | 225 | 285 | $W_1=W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P3 | P2 | P1 | +C1-C1 Reverse | +C3-C3 Normal | P1 and P3 terminals are reversed and 1 side CT reversed  |
| | LEAD 0.866 | | | 240 | 300 | | | | | | | | | | | | | | |
| | 1.000 | | | 270 | 330 | $W_1=W_3=0$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 300 | 0 | $W_1=W_3$=Positive value | | | | | | | | | | | | | |
| | LAG 0.707 | | | 315 | 15 | | | | | | | | | | | | | | |
| 21 | LEAD 0.707 | 0 | 60 | 45 | 105 | $W_1=W_3$=Positive value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P3 | P2 | P1 | +C1-C1 Normal | +C3-C3 Reverse | P1 and P3 terminals are reversed and 3 side CT reversed  |
| | LEAD 0.866 | | | 60 | 120 | | | | | | | | | | | | | | |
| | 1.000 | | | 90 | 150 | $W_1=W_3=0$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 120 | 180 | $W_1=W_3$=Negative value | | | | | | | | | | | | | |
| | LAG 0.707 | | | 135 | 195 | | | | | | | | | | | | | | |
| 22 | LEAD 0.707 | 0 | 120 | 345 | 45 | $W_1>W_3$ | | $V_{12}=V_{23}<V_{31}$ | | | $I_1=I_3<I_2$ | | | Revverse connection of 1 side VT *Refer to the right diagram. | | | +C1-C1 Reverse | +C3-C3 Normal | 1 side VT reversed and 1 side CT reversed  |
| | LEAD 0.866 | | | 0 | 60 | | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 90 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 120 | $W_1<W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 75 | 135 | | | | | | | | | | | | | | |
| 23 | LEAD 0.707 | 0 | 120 | 165 | 225 | $W_1$=Negative value $W_3$=Negative value | | $V_{12}=V_{23}<V_{31}$ | | | $I_1=I_3<I_2$ | | | Revverse connection of 1 side VT *Refer to the right diagram. | | | +C1-C1 Normal | +C3-C3 Reverse | 1 side VT reversed and 3 side CT reversed  |
| | LEAD 0.866 | | | 180 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 210 | 270 | | | | | | | | | Revverse connection of 3 side VT *Refer to the right diagram. | | | +C1-C1 Reverse | +C3-C3 Normal | 3 side VT reversed and 1 side CT reversed  |
| | LAG 0.866 | | | 240 | 300 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 255 | 315 | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

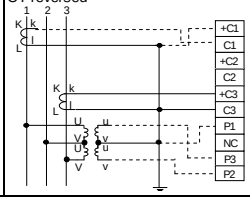
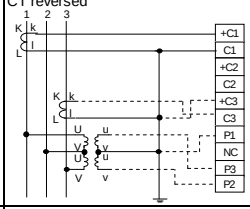
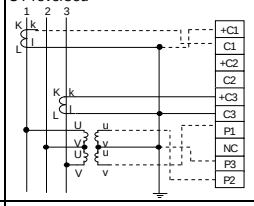
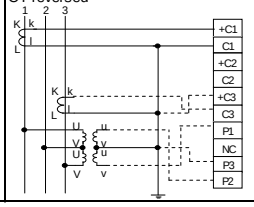
### 9.2.2. 3-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{12}=V_{23}$, $I_1=I_3$) | | | | | | | | | | | | Connection (Note 7) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{12}$ | $\angle V_{32}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | 1 side CT | 3 side CT | |
| 24 | LEAD 0.707 | 0 | 120 | 285 | 165 | $W_1<W_3$ | | $V_{12}=V_{23}<V_{31}$ | | | $I_1=I_2=I_3$ | | | Revverse connection of 1 side VT *Refer to the right diagram. | | | Refer to the right figure | | 1 side VT reversed and 3 wire connection(Note1) |
| | LEAD 0.866 | | | 300 | 180 | $W_1=W_3$ | | | | | | | | | | | | | |
| | 1.000 | | | 330 | 210 | $W_1>W_3=0$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 0 | 240 | $W_1$=Positive value $W_3$=Negative value | | | | | | | | | | | | | |
| | LAG 0.707 | | | 15 | 255 | | | | | | | | | | | | | | |
| 25 | LEAD 0.707 | 0 | 120 | 105 | 345 | $W_1$=Negative value $W_3$=Negative value | | $V_{12}=V_{23}<V_{31}$ | | | $I_1=I_2=I_3$ | | | Revverse connection of 3 side VT *Refer to the right diagram. | | | Refer to the right figure | | 3 side VT reversed and 3 wire connection(Note1) |
| | LEAD 0.866 | | | 120 | 0 | | | | | | | | | | | | | | |
| | 1.000 | | | 150 | 30 | $W_1$=Negative value $W_3=0$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 180 | 60 | $W_1$=Negative value $W_3$=Positive value | | | | | | | | | | | | | |
| | LAG 0.707 | | | 195 | 75 | | | | | | | | | | | | | | |
| 26 | LEAD 0.707 | 0 | 300 | 105 | 225 | $W_1$=Negative value $W_3$=Positive value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | Refer to the right figure | | 3 wire connection(Note3) |
| | LEAD 0.866 | | | 120 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 150 | 270 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 180 | 300 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 195 | 315 | | | | | | | | | | | | | | |
| 27 | LEAD 0.707 | 0 | 300 | 345 | 105 | $W_1$=Positive value $W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2=I_3$ | | | P1 | P2 | P3 | Refer to the right figure | | 3 wire connection(Note4) |
| | LEAD 0.866 | | | 0 | 120 | | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 150 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 180 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 75 | 195 | | | | | | | | | | | | | | |
| 28 | LEAD 0.707 | 0 | 300 | 15 | 225 | $W_1>W_3$ | | $V_{12}=V_{23}=V_{31}$ | | | $I_2=I_3<I_1$ | | | P1 | P2 | P3 | Refer to the right figure | | 3 wire connection(Note5) |
| | LEAD 0.866 | | | 30 | 240 | | | | | | | | | | | | | | |
| | 1.000 | | | 60 | 270 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 90 | 300 | $W_1$ (=0)<$W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 105 | 315 | $W_1$=Negative value $W_3$=Positive value | | | | | | | | | | | | | |
| 29 | LEAD 0.707 | 0 | 300 | 345 | 195 | $W_1$=Positive value $W_3$=Negative value | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_2<I_3$ | | | P1 | P2 | P3 | Refer to the right figure | | 3 wire connection(Note6) |
| | LEAD 0.866 | | | 0 | 210 | $W_1>W_3=0$ | | | | | | | | | | | | | |
| | 1.000 | | | 30 | 240 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.866 | | | 60 | 270 | $W_1<W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 75 | 285 | | | | | | | | | | | | | | |

# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

### 9.2.2. 3-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{12}=V_{23}$, $I_1=I_3$) | | | | | | | | | | | | Connection (Note 7) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{12}$ | $\angle V_{32}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | 1 | 2 | 3 | 1 side CT | 3 side CT | |
| 30 | LEAD 0.707 | 0 | 300 | 45 | 105 | $W_1$=Positive value | $W_3$=Negative value | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P3 | P1 | P2 | +C1-C1 Reverse | +C3-C3 Normal | P3, P1, and P2 terminals of VT are connected to P1, P2, and P3 terminals of the instrument in that order and 1 side CT reversed  |
| | LEAD 0.866 | | | 60 | 120 | | | | | | | | | | | | | | |
| | 1.000 | | | 90 | 150 | $W_1$=0 | $W_3$=Negative value | | | | | | | | | | | | |
| | LAG 0.866 | | | 120 | 180 | $W_1$=Negative value | $W_3$=Negative value | | | | | | | | | | | | |
| | LAG 0.707 | | | 135 | 195 | | | | | | | | | | | | | | |
| 31 | LEAD 0.707 | 0 | 300 | 225 | 285 | $W_1$=Negative value | $W_3$=Positive value | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P3 | P1 | P2 | +C1-C1 Normal | +C3-C3 Reverse | P3, P1, and P2 terminals of VT are connected to P1, P2, and P3 terminals of the instrument in that order and 3 side CT reversed  |
| | LEAD 0.866 | | | 240 | 300 | | | | | | | | | | | | | | |
| | 1.000 | | | 270 | 330 | $W_1$=0 | $W_3$=Positive value | | | | | | | | | | | | |
| | LAG 0.866 | | | 300 | 0 | $W_1=W_3$ | | | | | | | | | | | | | |
| | LAG 0.707 | | | 315 | 15 | $W_1>W_3$ | | | | | | | | | | | | | |
| 32 | LEAD 0.707 | 0 | 300 | 285 | 345 | $W_1<W_3$ | | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P2 | P3 | P1 | +C1-C1 Reverse | +C3-C3 Normal | P2, P3, and P1 terminals of VT are connected to P1, P2, and P3 terminals of the instrument in that order and 1 side CT reversed  |
| | LEAD 0.866 | | | 300 | 0 | $W_1=W_3$ | | | | | | | | | | | | | |
| | 1.000 | | | 330 | 30 | $W_1$=Positive value | $W_3$=0 | | | | | | | | | | | | |
| | LAG 0.866 | | | 0 | 60 | $W_1$=Positive value | $W_3$=Negative value | | | | | | | | | | | | |
| | LAG 0.707 | | | 15 | 75 | | | | | | | | | | | | | | |
| 33 | LEAD 0.707 | 0 | 300 | 105 | 165 | $W_1$=Negative value | $W_3$=Negative value | $V_{12}=V_{23}=V_{31}$ | | | $I_1=I_3<I_2$ | | | P2 | P3 | P1 | +C1-C1 Normal | +C3-C3 Reverse | P2, P3, and P1 terminals of VT are connected to P1, P2, and P3 terminals of the instrument in that order and 3 side CT reversed  |
| | LEAD 0.866 | | | 120 | 180 | | | | | | | | | | | | | | |
| | 1.000 | | | 150 | 210 | $W_1$=Negative value | $W_3$=0 | | | | | | | | | | | | |
| | LAG 0.866 | | | 180 | 240 | $W_1$=Negative value | $W_3$=Positive value | | | | | | | | | | | | |
| | LAG 0.707 | | | 195 | 255 | | | | | | | | | | | | | | |

Note1: When 1 side CT and 3 side CT switch to each other, and in addition, the terminals ‘C3’ and ‘+C3’ of CT are connected to the terminals ‘+C1’ and ‘C1’ of the instrument in that order.

Note2: When 1 side CT and 3 side CT switch to each other, and in addition, the terminals ‘C1’ and ‘+C1’ of CT are connected to the terminals ‘+C3’ and ‘C3’ of the instrument in that order.

Note3: When the terminals ‘C1’ and ‘+C1’ of CT are connected to the terminals ‘+C1’ and ‘C1’ of the instrument in that order.

Note4: When the terminals ‘C3’ and ‘+C3’ of CT are connected to the terminals ‘+C3’ and ‘C3’ of the instrument in that order.

Note5: When ‘+C1’ and ‘C3’of CT are connected and it is connected to the ‘+C1’ terminal of the instrument.

Note6: When ‘C1’ and ‘+C3’of CT are connected and it is connected to the ‘+C3’ terminal of the instrument.

Note7: The above examples for incorrect wiring are typical. Extreme cases are excluded such as burnout or destruction of the instrument, VT, or CT caused by voltage application to a current circuit or current application to a voltage circuit.

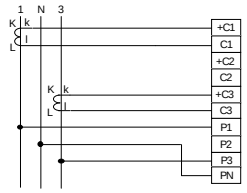
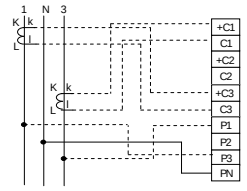
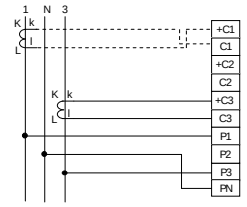
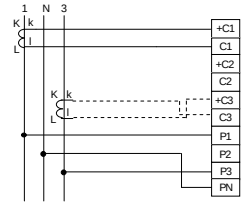
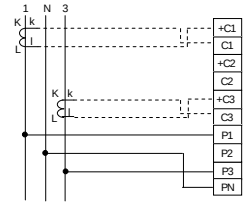
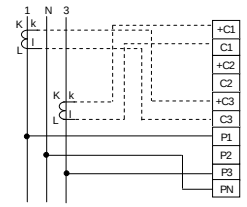
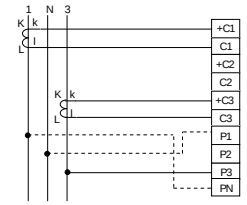
Note : The active power polarity may be displayed in reverse depending on the load status (low power factor, unbalanced load) even if the connection is correct.

Note : The above table shows incorrect wiring display examples of 3-phase 3-wire system (2CT). Those of 3-phase 3-wire system (3CT) are also the same. However, it is not possible to detect the incorrect wiring of the CT secondary side.

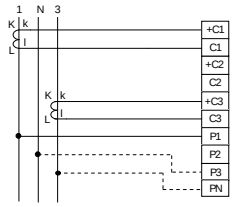
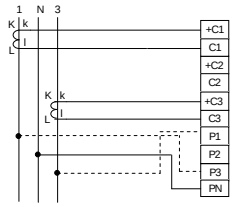
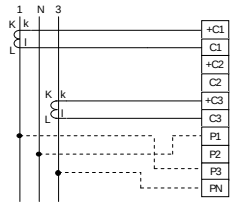
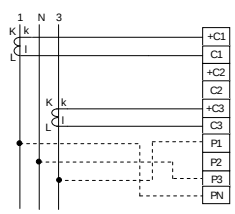
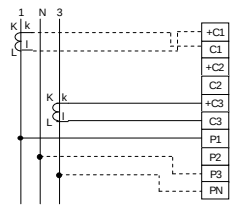
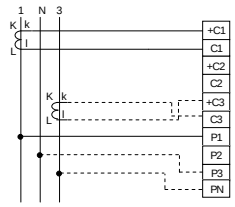
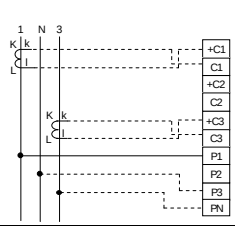
## 9.2. A List of Examples for Incorrect Wiring Display

### 9.2.3. 1-phase 3-wire System

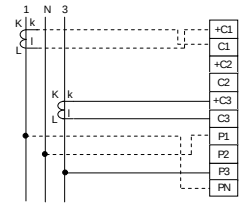
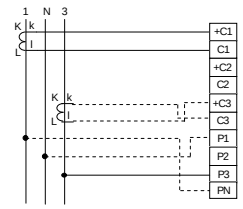
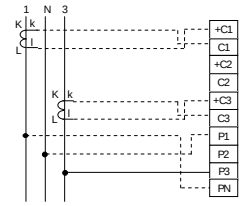
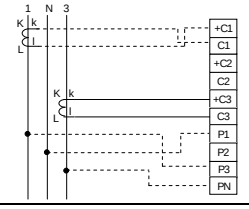
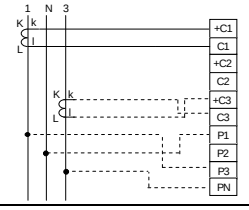
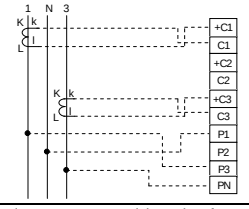
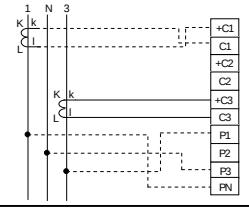
*The shaded parts indicate influential parts caused by incorrect wiring.
The dashed lines show incorrect wiring parts.

| No. | Power Factor (Input) | At balanced load ($V_{1N}=V_{3N}$ (or $V_{2N}$), $I_1=I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 1 | LEAD 0.707 | 0 | 180 | 315 | 135 | $W_1=W_3$ | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | P1 | PN | P3 | +C1-C1 Normal | +C3-C3 Normal | Normal  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | P3 | PN | P1 | +C3-C3 Normal | +C1-C1 Normal | Reversed phase sequence  |
| 2 | LEAD 0.707 | 0 | 180 | 135 | 135 | $W_1$=Negative value $W_3$=Positive value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P1 | PN | P3 | +C1-C1 Reverse | +C3-C3 Normal | Reverse connection of 1 side CT  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 3 | LEAD 0.707 | 0 | 180 | 315 | 315 | $W_1$=Positive value $W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P1 | PN | P3 | +C1-C1 Normal | +C3-C3 Reverse | Reverse connection of 3 side CT  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 4 | LEAD 0.707 | 0 | 180 | 135 | 315 | $W_1$=Negative value $W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | P1 | PN | P3 | +C1-C1 Reverse | +C3-C3 Reverse | Reverse connection of 1 side CT and 3 side CT  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 5 | LEAD 0.707 | 0 | 180 | 135 | 315 | $W_1$=Negative value $W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | P1 | PN | P3 | +C3-C3 Normal | +C1-C1 Normal | Switch between 1 side CT and 3 side CT  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 6 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value $W_3$=Positive value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3$ $I_N=0$ | | | PN | P1 | P3 | +C1-C1 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and PN  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |

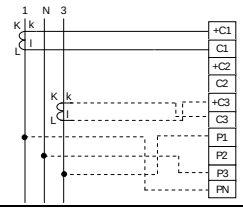
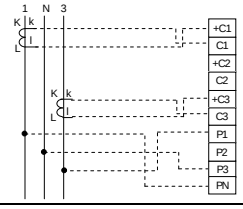
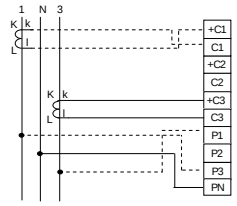
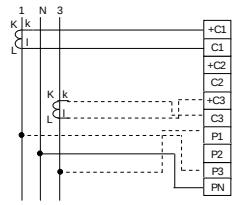
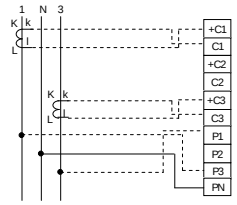
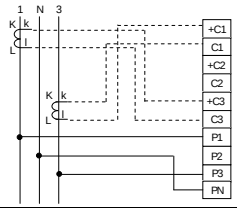
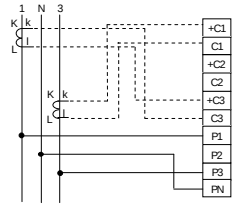
## 9.2.3. 1-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{1N}$=$V_{3N}$ (or $V_{2N}$), $I_1$=$I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 7 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}$>$V_{3N}$=$V_{13}$ | | | $I_1$=$I_3$<br>$I_N$=0 | | | P1 | P3 | PN | +C1-C1 Normal | +C3-C3 Normal | Reverse connection between terminals P3 and PN  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 8 | LEAD 0.707 | 0 | 180 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}$=$V_{3N}$<$V_{13}$ | | | $I_1$=$I_3$<br>$I_N$=0 | | | P3 | PN | P1 | +C1-C1 Normal | +C3-C3 Normal | Reverse connection between terminals P1 and P3  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 9 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}$=$V_{13}$<$V_{3N}$ | | | $I_1$=$I_3$<br>$I_N$=0 | | | P3 | P1 | PN | +C1-C1 Normal | +C3-C3 Normal | Voltage are connected the order of P3, P1, and PN terminals  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 10 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}$>$V_{3N}$=$V_{13}$ | | | $I_1$=$I_3$<br>$I_N$=0 | | | PN | P3 | P1 | +C1-C1 Normal | +C3-C3 Normal | Voltage are connected the order of PN, P3, and P1 terminals  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 11 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}$>$V_{3N}$=$V_{13}$ | | | $I_1$=$I_3$<$I_N$ | | | P1 | P3 | PN | +C1-C1 Reverse | +C3-C3 Normal | P3 and PN terminals are reversed and 1 side CT is reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 12 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1$>$W_3$ | | $V_{1N}$>$V_{3N}$=$V_{13}$ | | | $I_1$=$I_3$<$I_N$ | | | P1 | P3 | PN | +C1-C1 Normal | +C3-C3 Reverse | P3 and PN terminals are reversed and 3 side CT is reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 13 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}$>$V_{3N}$=$V_{13}$ | | | $I_1$=$I_3$<br>$I_N$=0 | | | P1 | P3 | PN | +C1-C1 Reverse | +C3-C3 Reverse | P3 and PN terminals are reversed, and both of CTs are reversed.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |

## 9.2.3. 1-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{1N}=V_{3N}$ (or $V_{2N}$), $I_1=I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 14 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1<W_3$ | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | PN | P1 | P3 | +C1-C1 Reverse | +C3-C3 Normal | P1 and PN terminals are reversed and 1 side CT is reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 15 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | PN | P1 | P3 | +C1-C1 Normal | +C3-C3 Reverse | P1 and PN terminals are reversed and 3 side CT is reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 16 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3$<br>$I_N=0$ | | | PN | P1 | P3 | +C1-C1 Reverse | +C3-C3 Reverse | P1 and PN terminals are reversed and both of CTs reversed.  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 17 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | P3 | P1 | PN | +C1-C1 Reverse | +C3-C3 Normal | Voltage are connected the order of P3, P1, and PN terminals, and 1 side CT is reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 18 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1<W_3$ | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | P3 | P1 | PN | +C1-C1 Normal | +C3-C3 Reverse | Voltage are connected the order of P3, P1, and PN terminals, and 3 side CT is reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 19 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3$<br>$I_N=0$ | | | P3 | P1 | PN | +C1-C1 Reverse | +C3-C3 Reverse | Voltage are connected the order of P3, P1, and PN terminals, and Both of CTs are reversed.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 20 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1>W_3$ | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3<I_N$ | | | PN | P3 | P1 | +C1-C1 Reverse | +C3-C3 Normal | Voltage are connected the order of PN, P3, and P1 terminals, and 1 side CT is reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |

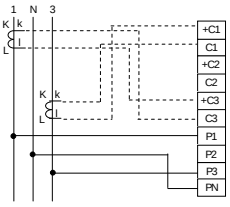
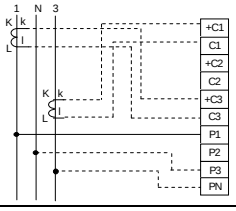
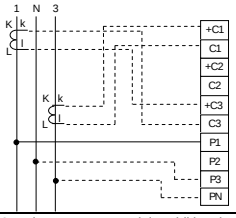
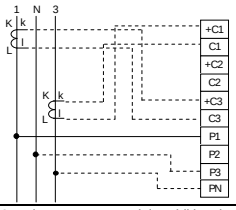
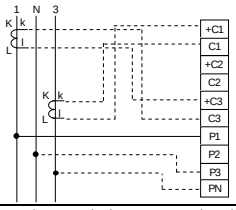
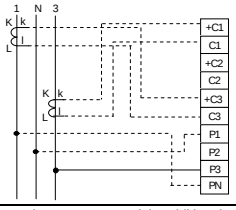
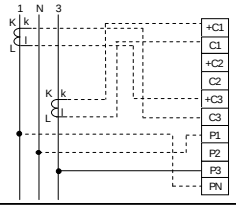
## 9.2.3. 1-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{1N}=V_{3N}$ (or $V_{2N}$), $I_1=I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 21 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3<I_N$ | | | PN | P3 | P1 | +C1-C1<br>Normal | +C3-C3<br>Reverse | Voltage are connected the order of PN, P3, and P1 terminals, and 3 side CT is reversed.<br>  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 22 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3$<br>$I_N=0$ | | | PN | P3 | P1 | +C1-C1<br>Reverse | +C3-C3<br>Reverse | Voltage are connected the order of PN, P3, and P1 terminals, and both of CTs are reversed.<br>  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 23 | LEAD 0.707 | 0 | 180 | 315 | 315 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P3 | PN | P1 | +C1-C1<br>Reverse | +C3-C3<br>Normal | P1 and P3 terminals are reversed and 1 side CT is reversed.<br>  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 24 | LEAD 0.707 | 0 | 180 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P3 | PN | P1 | +C1-C1<br>Normal | +C3-C3<br>Reverse | P1 and P3 terminals are reversed and 3 side CT is reversed.<br>  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 25 | LEAD 0.707 | 0 | 180 | 315 | 135 | $W_1=W_3$ | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$<br>$I_N=0$ | | | P3 | PN | P1 | +C1-C1<br>Reverse | +C3-C3<br>Reverse | P1 and P3 terminals are reversed and both of CTs are reversed.<br>  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 26 | LEAD 0.707 | 0 | 180 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P1 | PN | P3 | +C3-C3<br>Normal | +C1-C1<br>Reverse | Both of CTs switch to each other, and the terminals '+C1' and 'C1' are reversed.<br>  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 27 | LEAD 0.707 | 0 | 180 | 315 | 315 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P1 | PN | P3 | +C3-C3<br>Reverse | +C1-C1<br>Normal | Both of CTs switch to each other, and the terminals '+C3' and 'C3' are reversed.<br>  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |

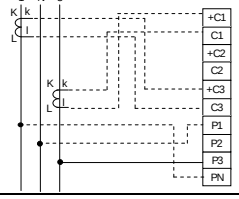
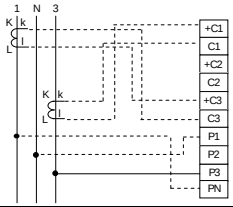
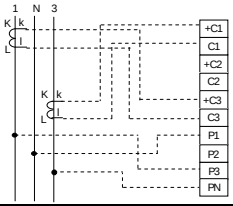
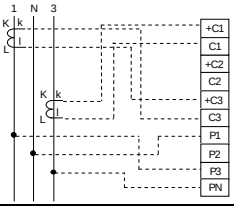
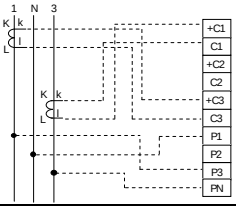
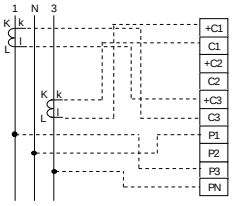
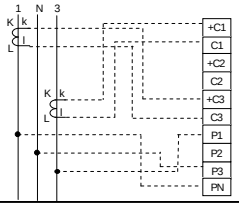
# 9. Appendix

## 9.2. A List of Examples for Incorrect Wiring Display

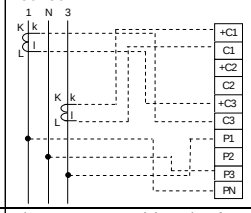
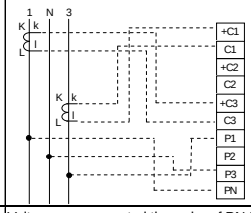
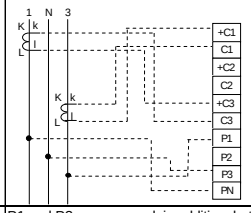
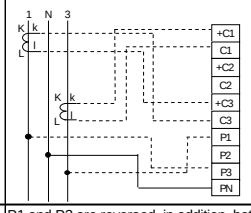
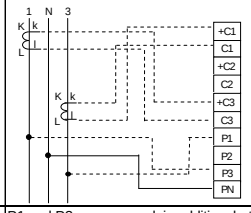
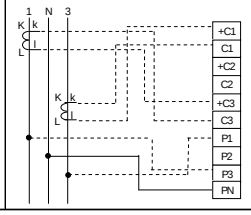
### 9.2.3. 1-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{1N}=V_{3N}$ (or $V_{2N}$), $I_1=I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 28 | LEAD 0.707 | 0 | 180 | 315 | 135 | $W_1=W_3$ | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | P1 | PN | P3 | +C3-C3 Reverse | +C1-C1 Reverse | Both of CTs are switched and reversed each other .  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 29 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value $W_3$=Positive value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | P1 | P3 | PN | +C3-C3 Normal | +C1-C1 Normal | P3 and PN terminals are reversed, and both of CTs are switched to each other.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 30 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value $W_3$=Negative value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3<I_N$ | | | P1 | P3 | PN | +C3-C3 Reverse | +C1-C1 Normal | P3 and PN are reversed, in addition, both of CTs are switched to each other, and the '+C3' and 'C3' are reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 31 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1>W_3$ | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3<I_N$ | | | P1 | P3 | PN | +C3-C3 Normal | +C1-C1 Reverse | P3 and PN are reversed, in addition, both of CTs are switched to each other, and the '+C1' and 'C1' are reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 32 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value $W_3$=Negative value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | P1 | P3 | PN | +C3-C3 Reverse | +C1-C1 Reverse | P3 and PN are reversed, in addition, both of CTs are switched and reversed each other.  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 33 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value $W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$ $I_N=0$ | | | PN | P1 | P3 | +C3-C3 Normal | +C1-C1 Normal | P1 and PN terminals are reversed, and both of CTs are switched to each other.  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 34 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1<W_3$ | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | PN | P1 | P3 | +C3-C3 Reverse | +C1-C1 Normal | P1 and PN are reversed, in addition, both of CTs are switched to each other, and the '+C3' and 'C3' are reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |

## 9.2.3. 1-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{1N}=V_{3N}$ (or $V_{2N}$), $I_1=I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 35 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | PN | P1 | P3 | +C3-C3 Normal | +C1-C1 Reverse | P1 and PN are reversed, in addition, both of CTs are switched to each other, and the '+C1' and 'C1' are reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 36 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3$<br>$I_N=0$ | | | PN | P1 | P3 | +C3-C3 Reverse | +C1-C1 Reverse | P1 and PN are reversed, in addition, both of CTs are switched and reversed each other.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 37 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3$<br>$I_N=0$ | | | P3 | P1 | PN | +C3-C3 Normal | +C1-C1 Normal | Voltage are connected the order of P3- P1- PN, and both of CTs are switched to each other.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 38 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | P3 | P1 | PN | +C3-C3 Reverse | +C1-C1 Normal | Voltage are connected the order of P3- P1- PN, both of CTs switch to each other, and '+C3' and 'C3' are reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 39 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1<W_3$ | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3<I_N$ | | | P3 | P1 | PN | +C3-C3 Normal | +C1-C1 Reverse | Voltage are connected the order of P3- P1- PN, both of CTs switch to each other, and '+C3' and 'C3' are reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 40 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}=V_{13}<V_{3N}$ | | | $I_1=I_3$<br>$I_N=0$ | | | P3 | P1 | PN | +C3-C3 Reverse | +C1-C1 Reverse | Voltage are connected the order of P3- P1- PN, both of CTs are switched and reversed each other.  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |
| 41 | LEAD 0.707 | 0 | 0 | 315 | 135 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3$<br>$I_N=0$ | | | PN | P3 | P1 | +C3-C3 Normal | +C1-C1 Normal | Voltage are connected the order of PN-P3- P1, and both of CTs are switched to each other.  |
| | LEAD 0.866 | | | 330 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 225 | | | | | | | | | | | | | | |

## 9.2.3. 1-phase 3-wire System

| No. | Power Factor (Input) | At balanced load ($V_{1N}=V_{3N}$ (or $V_{2N}$), $I_1=I_3$ (or $I_2$)) | | | | | | | | | | | | Connection (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Phase Angle Display | | | | Active Power Display | | Voltage Display | | | Current Display | | | Voltage | | | Current | | Connection |
| | | $\angle V_{1N}$ | $\angle V_{3N}$ | $\angle I_1$ | $\angle I_3$ | $W_1$ | $W_3$ | $V_{1N}$ | $V_{3N}$ | $V_{13}$ | $I_1$ | $I_N$ | $I_3$ | 1 | N | 3 | 1 side CT | 3 side CT | |
| 42 | LEAD 0.707 | 0 | 0 | 315 | 315 | $W_1>W_3$ | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3<I_N$ | | | PN | P3 | P1 | +C3-C3 Reverse | +C1-C1 Normal | Voltage are connected the order of PN-P3-P1, both of CTs switch to each other, and '+C3' 'C3' are reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 43 | LEAD 0.707 | 0 | 0 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3<I_N$ | | | PN | P3 | P1 | +C3-C3 Normal | +C1-C1 Reverse | Voltage are connected the order of PN-P3-P1, both of CTs switch to each other, and '+C1' 'C1' are reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 44 | LEAD 0.707 | 0 | 0 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}>V_{3N}=V_{13}$ | | | $I_1=I_3$<br>$I_N=0$ | | | PN | P3 | P1 | +C3-C3 Reverse | +C1-C1 Reverse | Voltage are connected the order of PN-P3-P1, both of CTs are switched and reversed each other.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |
| 45 | LEAD 0.707 | 0 | 180 | 315 | 315 | $W_1$=Positive value<br>$W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P3 | PN | P1 | +C3-C3 Reverse | +C1-C1 Normal | P1 and P3 are reversed, in addition, both of CTs are switched to each other, and the '+C3' and 'C3' are reversed.  |
| | LEAD 0.866 | | | 330 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 0 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 30 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 45 | 45 | | | | | | | | | | | | | | |
| 46 | LEAD 0.707 | 0 | 180 | 135 | 135 | $W_1$=Negative value<br>$W_3$=Positive value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3<I_N$ | | | P3 | PN | P1 | +C3-C3 Normal | +C1-C1 Reverse | P1 and P3 are reversed, in addition, both of CTs are switched to each other, and the '+C1' and 'C1' are reversed.  |
| | LEAD 0.866 | | | 150 | 150 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 180 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 210 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 225 | | | | | | | | | | | | | | |
| 47 | LEAD 0.707 | 0 | 180 | 135 | 315 | $W_1$=Negative value<br>$W_3$=Negative value | | $V_{1N}=V_{3N}<V_{13}$ | | | $I_1=I_3$<br>$I_N=0$ | | | P3 | PN | P1 | +C3-C3 Reverse | +C1-C1 Reverse | P1 and P3 are reversed, in addition, both of CTs are switched and reversed each other.  |
| | LEAD 0.866 | | | 150 | 330 | | | | | | | | | | | | | | |
| | 1.000 | | | 180 | 0 | | | | | | | | | | | | | | |
| | LAG 0.866 | | | 210 | 30 | | | | | | | | | | | | | | |
| | LAG 0.707 | | | 225 | 45 | | | | | | | | | | | | | | |

Note1: The above examples for incorrect wiring are typical. Extreme cases are excluded such as burnout or destruction of the instrument, VT, or CT caused by voltage application to a current circuit or current application to a voltage circuit.

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