Panasonic

# KW4M
# Eco-Power Meter
# User's Manual




**KW4M Eco-Power Meter User's Manual**
ARCT1F413E-2 '08.03

http://www.mew.co.jp/ac/e

Matsushita Electric Works, Ltd.

# Cautions for Your Safety

Read the manual carefully before installing, running and maintenance for proper operation.

Before using, master the knowledge of the equipment, safety information and all of other notes.

This manual uses two safety flags to indicate different levels of danger.

**WARNING** A handling error could cause serious physical injury to an operator and in the worst case could even be fatal.

- If the use is predicted to lead to human injuries and/or grave expanding damage, take the special safety measures such as double interlock.
- Do not use the product in the environment that has inflammable gas. It might lead to an explosion.

**CAUTION** A handling error could cause serious physical injury to an operator or damage to the equipment.

- Tighten the wires firmly with terminal screws. The bad connection might cause abnormal heat and smoke.
- Do not use the unit outside the range of the specifications regarding such as rating, environment conditions etc. It might cause abnormal heat or smoke.
- Do not discompose or modify the unit. It might give you an electric shock or cause smoke.
- Do not touch the terminal while current is running. It might give you an electric shock.

## Introduction

Thank you for indeed for purchasing “KW4M Eco-POWER METER” for this time.
In this manual, we explain the usage of “KW4M Eco-POWER METER” in detail.
Please use it correctly after understanding the content enough.

# Table of Contents

# Cautions before using

## ■ Installation environment

**◇Do not use the Unit in the following environments.**

- ・Where the unit will be exposed to direct sunlight and where the ambient temperature is outside the range of -10 to 50 °C.
- ・Where the ambient humidity is outside the range of 30 to 85 % RH (at 20℃ non-condensing) and where condensation might occur by sudden temperature changes
- ・Where inflammable or corrosive gas might be produced
- ・Where the unit will be exposed to excessive airborne dust or metal particles
- ・Where the unit will be exposed to water, oil or chemicals
- ・Where organic solvents such as benzene, paint thinner, alcohol, or strong alkaline solutions such as ammonia or caustic soda might adhere to the product
- ・Where direct vibration or shock might be transmitted to the product, and where water might wet the product

**◇Please use the Unit according to the specifications described in this manual. Otherwise, it may malfunction or cause fire and an electric shock.**

- ・Connect to the power supply in compliance with the rating.
- ・Refer to the wiring diagram to ensure proper wiring for the power supply, input and output.
- ・Do not perform wiring or installation with a live line. It may also lead to circuit burnout or fire by way of the secondary CT side opening.
- ・Do not add voltage and current to an output terminal from outside.

## ■ Installation

- ・Installation and wiring must be performed by expert personnel for electrical work or electric piping.
- ・The power supply terminal and voltage input terminal of the main unit is common. Therefore if additional noise effects the power supply line, incorrect measurements may result.
- ・Eco-POWER METER is designed to be used in a control panel.
- ・As to measurement
  If there is some distortion by harmonic or waveform, it may not measure correctly.
  Please check with the actual system before adopting it.

## ■ Static electricity

- ・Discharge static electricity touching the grounded metal etc. when you touch the unit.
- ・Excessive static electricity might be generated especially in a dry place.

## ■ Cleaning

- ・Wipe dirt of the main unit with soft cloth etc. When thinner is used, the unit might deform or be discolored.

## ■ Power supply

- ・Connect a breaker to the voltage input part for safety reasons and to protect the device.
  The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.
- ・Do not turn on the power supply or input until all wiring is completed.

## ■ Before power on

Please note the following points when turning on power at the first time.

- ・Confirm there are neither wiring rubbish nor especially an electrical conduction when installed.
- ・Confirm neither the power supply wiring, the I/O wiring nor the power-supply voltage are wrong.
- ・Tighten the installation screw and the terminal screw surely.
- ・Use an electric wire applicable to the rated current.

# Chapter 1 Unit's Features and Structure

## 1-1 Features

■KW4M Eco-POWER METER is a wattmeter in DIN48 size. Electrical energy (voltage, current, etc.) is measured using AC voltage and AC current input via one of the following systems: single-phase two-wire system, single-phase three-wire system, or three-phase three-wire system.
This also works as an hour meter, that is measured power-on or power-off time, and as a counter that is for pulse output equipment like flowmeter.

■**Eco-POWER METER is designed chiefly to manage saving energy. It is neither intended nor can it be legally used for billing.**

## 1-2 Unit's Name and Part Numbers

1-2-1 Main unit

| Phase and Wire system | Power Supply | Measured voltage input | Measured current input | Current transformer | Terminal type | Protocol | Model No |
|---|---|---|---|---|---|---|---|
| ・Single-phase two-wire<br>・Single-phase three-wire<br>・Three-phase three-wire | 100-240V AC | ・100-120 /200-240V AC<br>・100-120V AC<br>・200-240V AC | 5A<br>50A<br>100A<br>250A<br>400A | Dedicated CT type (5A/50A/100A/ 250A/400A) | Screw terminal | MEWTOCOL | AKW5111 |
| | | | | | | MODBUS (RTU) | AKW5112 |
| | | | | | 11-pin | MEWTOCOL | AKW5211 |
| | | | | | | MODBUS (RTU) | AKW5212 |

1-2-2 Dedicated Current Transformer (CT)

| Rated primary current | Model No |
|---|---|
| 5A | AKW4801 |
| 50A | |
| 100A | AKW4802 |
| 250A | AKW4803 |
| 400A | AKW4804 |

1-2-3 Options

| Product name | Contents | Model No |
|---|---|---|
| Mounting frame | Used for mounting in a panel (supplied with a unit) | AT8-DA4 |
| Rubber gasket | Used for mounting in a panel (supplied with a unit) | ATC18002 |
| Protective cover | Used for protecting a front display (common to Timer/Counter) | AQM4803 |
| DIN rail socket | For 11-pin type(surface mounting) | ATC180041 |
| Rear terminal socket | For 11-pin type (embedded mounting) | AT78051 |
| 11P cap | For 11-pin type (connectable directly with soldering) | AT8-DP11 |
| Mounting rail | DIN rail terminal socket fixing rail | AT8-DLA1 |

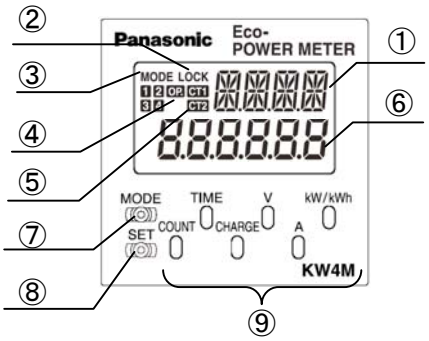
## 1-3 Measurement items

| Item | | Unit | Data range |
|---|---|---|---|
| Instantaneous electric power | | kW | 0.00 to 9999.99 |
| Integrated electrical energy | | kWh<br>MWh | 0.00 to 9999.99kWh to 10.00MWh to 9999.99MWh |
| | | | 9-digit display: 0.00 to 9999999.99 kWh |
| Current | L1（CT1）-phase current | A | 0.0～999.9 (MEWTOCOL type) |
| | | | 0.0～6000.0 (MODBUS (RTU) type) |
| | L2（CT2）-phase current | A | 0.0～999.9 (MEWTOCOL type) |
| | | | 0.0～6000.0 (MODBUS (RTU) type) |
| Voltage | Voltage between 1-2 | V | 0.0 to 9999.9 |
| | Voltage between 2-3 | V | 0.0 to 9999.9 |
| Electricity charge ※ | Yen | JPY | 0 to 999999 |
| | Dollars | $ | 0 to 9999.99 |
| | Euros | EUR | 0 to 9999.99 |
| | Yuan | CNY | 0 to 9999.99 |
| Hour meter | ON-time | h(Hour) | 0.0 to 99999.9 |
| | OFF-time | h(Hour) | 0.0 to 99999.9 |
| Pulse input | | Count | 0 to 999999 |

※Eco-POWER METER is designed chiefly to manage saving energy.
It is neither intended nor can it be legally used for billing.

# Chapter 2 Parts Name and Working

## 2-1 Parts Names




① Mode name display (16-segment)

② Lock indicator — Light is on when locked.

③ Mode indicator — Light is on when the mode is being set.

④ Output indicator — Light is on when pulse is output.

⑤ CT direction notification — Light is on when CT is connected correctly and current flows.

⑥ Display for value selected (7-segment)
Instantaneous electric power,
Integrated electrical energy,
Current, Voltage, Electricity charge, Hour meter and Counter

⑦ MODE key — Use to select mode

⑧ SET key — Use to set each value entered

⑨ Select keys — a) Change which value is displayed.
b) Make settings in a particular mode.

## 2-2 Select Keys' Functions

| | POWER measurement | PULSE measurement |
|---|---|---|
| **<kW/kWh>** | ・Instantaneous electric power → Integrated electrical energy<br>・(Continuous press) Display by 9-digit (Integrated electric power) | --- |
| **< A >** | L1(CT1)-phase current → L2(CT2)-phase current | |
| **< V >** | Voltage between 1 and 2 → Between 2 and 3 | |
| **<CHARGE>** | Electricity charge: JPY→ $ → EUR → CNY | |
| **<TIME>** | ON-time → OFF-time | |
| **<COUNT>** | --- | ・Count value → Preset value<br>・(Continuous press at preset value display) Shift to preset value setting mode |
| **<MODE>+<SET>** | Reset (Integrated electrical energy, ON-time, OFF-time) | Reset (Count value) |
| **<MODE>** | Shift to each setting mode | |
| **<SET>** | ・Set each value entered<br>・(Continuous press) All keys locked. While in LOCK mode, releases LOCK mode | |

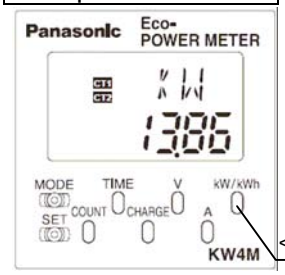
# Chapter 3 Display of each Value

## 3-1 Instantaneous electric power / Integrated Electrical energy

・Press <kW/kWh>key to display the instantaneous electric power and integrated electrical energy.
・Press <kW/kWh>key to change the instantaneous electric power to integrated electrical energy.
*Displayed data is updated at every 1 second.

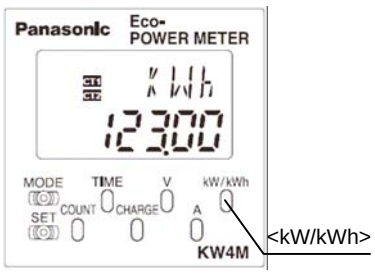
**Instantaneous electric power(kW) → Integrated electrical energy(kWh)**

Sample of 13.86kW




<kW/kWh>

Sample of 123.00kWh




・Integrated electrical energy is measured and displayed from 0.00kWh to 9999.99MWh.
・The decimal point and the unit are changed automatically.

kWh 0.00 → kWh 9999.99 → kWh 10000.0 → kWh 99999.9 → MWh 100.00 → MWh 9999.99 →

(After reaching the full scale (99999.9kWh), the value reverts to 0.00kWh but continues to measure.)

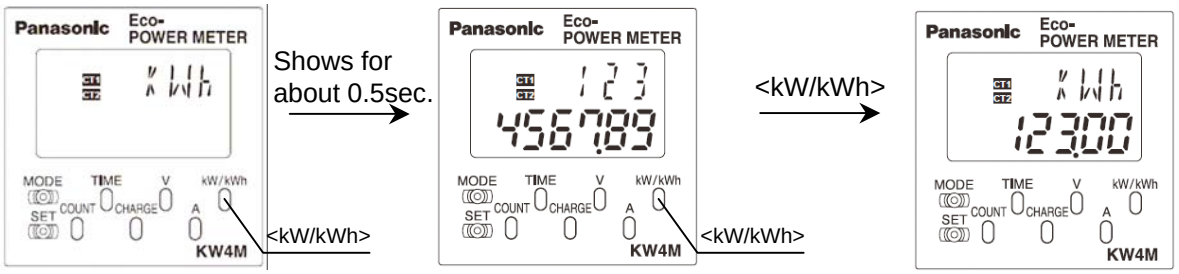
How to display with 9-digit

**Integrated electrical energy can be displayed with 9-digit.**

・Continuous press <kW/kWh> for about 2sec. or more at the instantaneous electric power or integrated electrical energy display, “kWh” shows for about 0.5sec. and integrated electrical energy with 9-digit is displayed.

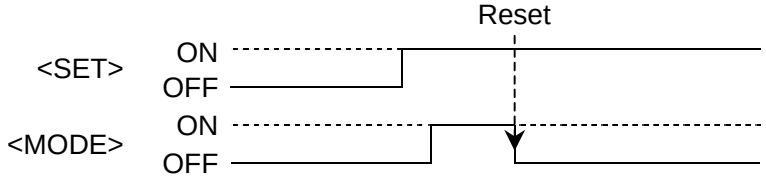
Integrated electrical energy 9-digit (kWh)
Sample of 1234567.89kWh

Instantaneous electric power (kW)
Sample of 13.86kW




How to reset the integrated electrical energy

・Press <MODE>key while pressing <SET>key makes integrated electrical energy clear.



## 3-2 Current

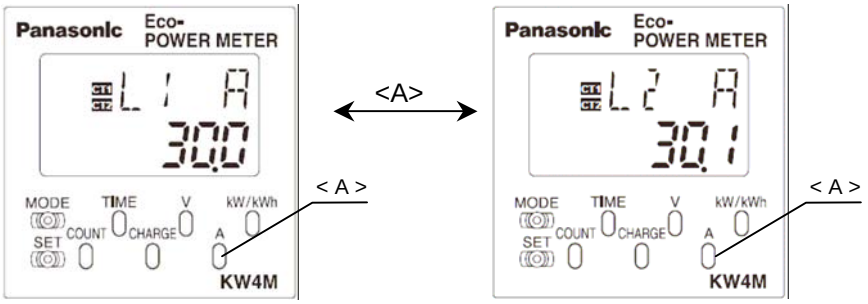
・Press <A>key to display the current value of the load.

・Press <A>key to change L1(CT1)-phase current to L2(CT2)-phase current

*Displayed data is updated at every 1 second.

**L1(CT1)-phase current (A)** → **L2(CT2)-phase current (A)**

Sample of L1(CT1)-phase 30.0A | Sample of L2(CT2)-phase 30.1A




・When input current exceeds 150%F.S. at each range,「－ － － － － －」will be displayed in the lower line.

・Current measurement parts

Eco-POWER METER measures the current as below.

| System \ Display | L1(CT1)A | L2(CT2)A |
|---|---|---|
| Single-phase two-wire | 1(L1)-phase current | - |
| Single-phase three-wire | 1(R)-phase current | 3(T)-phase current |
| Three-phase three-wire | 1(R)-phase current | 3(T)-phase current |

## 3-3 Voltage

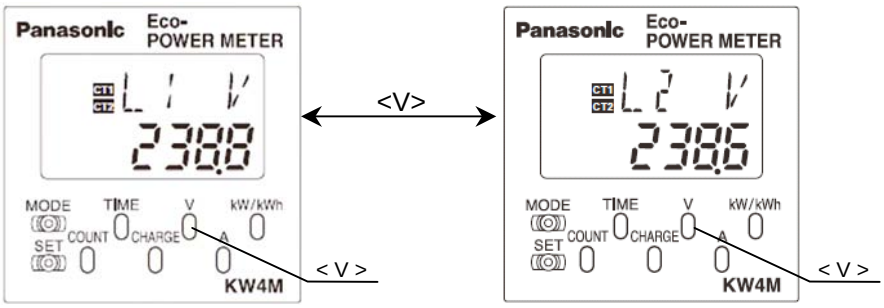
・Press <V>key to display the voltage value of the load.

・Press <V>key to change voltage between 1 and 2(V) to 2 and 3(V).

*Displayed data is updated at every 1 second.

**Voltage between 1 and 2(V)** → **Voltage between 2 and 3(V)**

Sample display of 238.8V | Sample display of 238.6V




・When input voltage exceeds 150%F.S. at each range,「－ － － － － －」will be displayed in the lower line.

・Voltage measurement parts

Eco-POWER METER measures the voltage as below.

| System \ Display | L1V | L2V |
|---|---|---|
| Single-phase two-wire | Voltage between 1 and 2 (R-phase) | － |
| Single-phase three-wire | Voltage between 1 and 2 (R-phase) | Voltage between 2 and 3 (T-phase) |
| Three-phase three-wire | Voltage between 1 and 2 (Between R and S line) | Voltage between 2 and 3 (Between S and T line) |

## 3-4 Electricity Charge

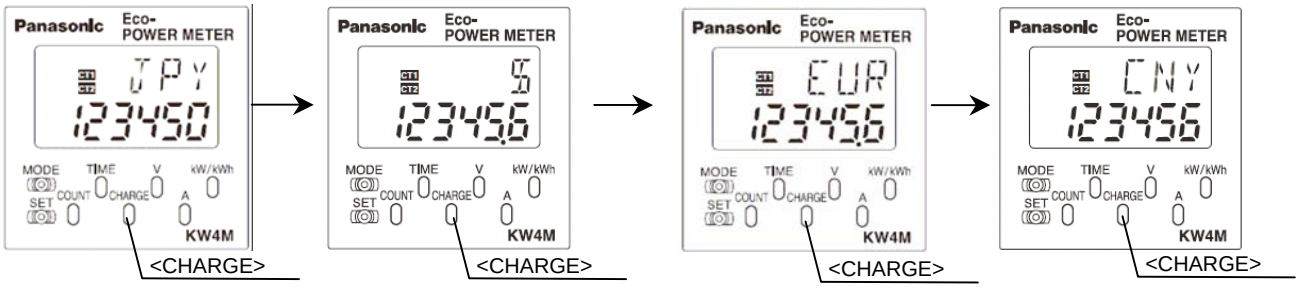
It displays the standard electricity charge for the integrated electrical energy.

・Press <CHARGE>key to display the electricity charge.

・At electricity charge display, press <CHARGE>key to change between JPY, $,EUR and CNY.

**Yen** → **Dollars** → **Euros** → **Yuan**

Sample of 123450 yen | Sample of 12345.6 dollars | Sample of 12345.6 euros | Sample of 123456 yuan



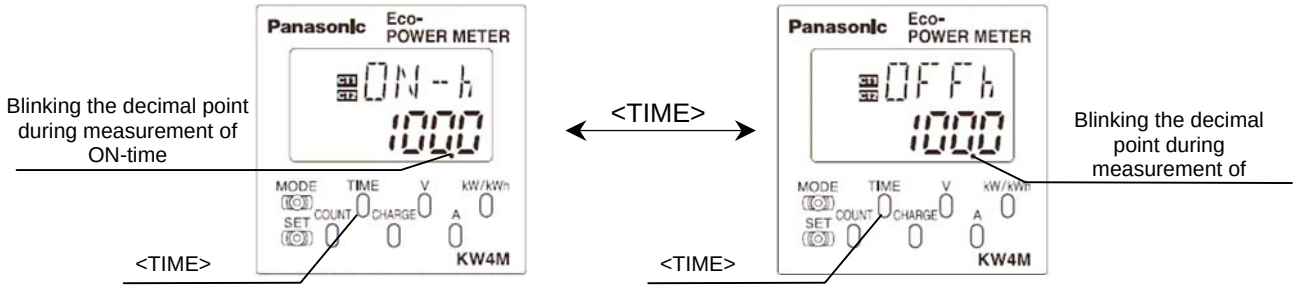

## 3-5 Hour Meter

・Press <TIME> key to display the load ON-time or load OFF-time measured by CT1.

・Press <TIME> key to change the load ON-time to load OFF-time.

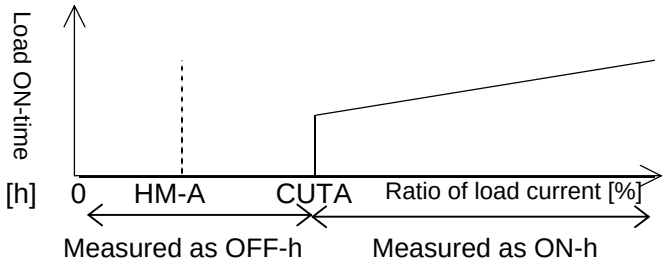
**ON-time (h)** → **OFF-time (h)**

Sample of ON-time 100.0 h | Sample of OFF-time 100.0 h

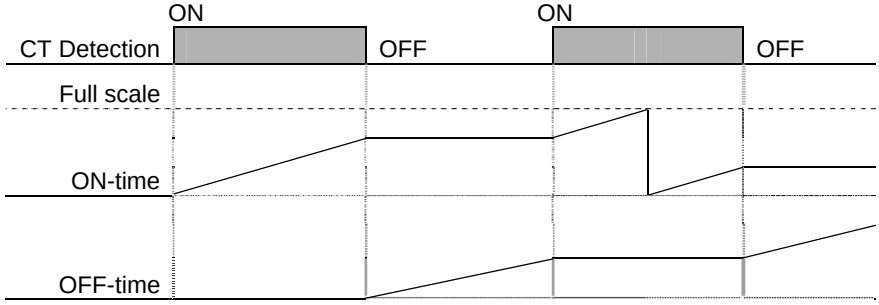



∗ When load current is under the setting current for time measurement（HM-A）, it measures as OFF-time. When load current is exceeded to the setting current for time measurement（HM-A）, it measures as ON-time. Current for time measurement (HM-A) is set to under cutoff current （CUTA）, all current is measured as OFF-time.

∗ Current flow of CT1

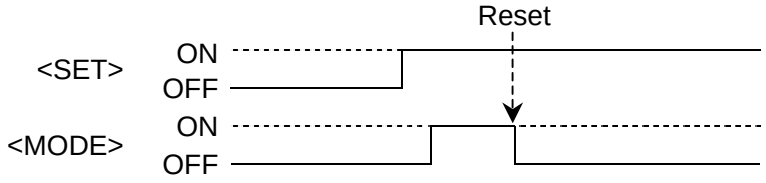



∗ After reaching the full scale (99999.9h）, the value reverts to 0.0h but continues to measure.



How to Reset ON/OFF-time

・Press <MODE>key while pressing <SET>key makes ON / OFF-time clear.




## 3-6 Count Value / Preset Value

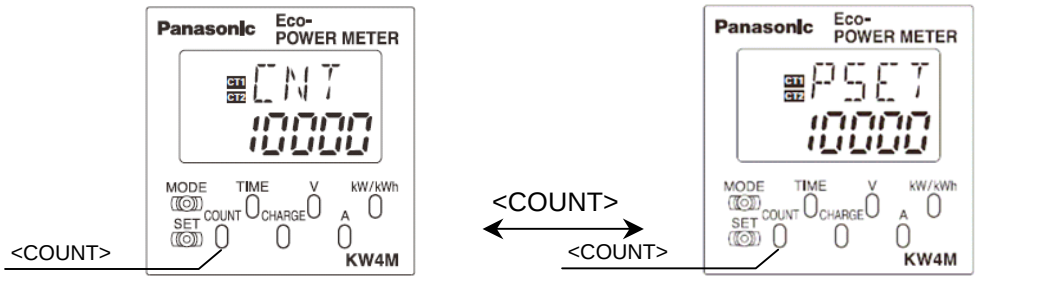
It displays present count value (pulse input value) and preset value.

・Press <COUNT> key to display count value (pulse input value).

・Press <COUNT> key to change count value to preset value.

**Count value(COUNT)** → **Preset value(COUNT)**

Sample of count value:10000 Sample of preset value:10000




How to Enter the Preset Value

・Press <COUNT> continuously for about 3sec. at preset value display, “PSET” is blinking.

・Enter a preset value using <kW/kWh>,< A >, < V >, <CHARGE>, <TIME> and <COUNT>.

・Press <SET> to set the entered value. “PSET” stops blinking.

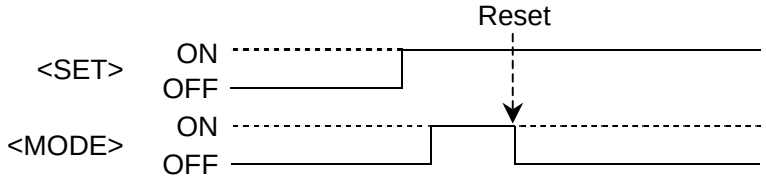
Position of Decimal Point

・The position of decimal point for count value and preset value is decided according to the setting at ‘Pre-scale setting mode’.

Ex) When preset value set to 0.01, the decimal point is fixed the last 2 digit for count value and preset value.

How to Reset Count value

・Press <MODE>key while pressing <SET>key makes count value clear.

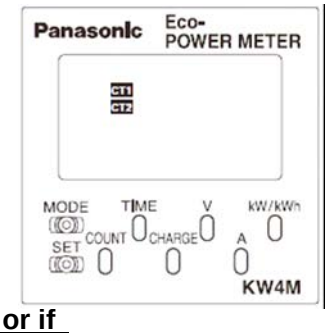


# Chapter 4 Various Functions

## 4-1 LOCK mode


It is the mode makes <MODE>key and Select keys unable.
Use when you want to fix one of the measurement displays (For all displays).
When you press <SET>key continuously for about 3sec., the “LOCK” indicator lights and <MODE>key and Select keys become locked (pressing them will have no effect).
Press <SET>key continuously for about 3sec. again to release Lock mode.
The “LOCK” indicator goes off and the lock mode is released (unlocked)

## 4-2 CT Direction Notification (POWER Measurement)




This shows the connection condition of CT and notices wrong voltage or wrong connection of CT wiring.

- “CT1(CT2)” lights if the input voltage is corresponding to the direction of the current.
- “CT1” lights if the voltage between 1 and 2 is corresponding to the direction of L1-phase current.
- “CT2” lights if the voltage between 2 and 3 is corresponding to the direction of L2-phase current.

**＊It does not light if the load current is under the cutoff current (CUTA) or if there is some distortion by harmonic or waveform.**

## 4-3 Counter function (PULSE measurement)

### 4-3-1 Operation mode

Maintain output hold count HOLD

[Output] OFF → ON

[Counting] ← possible →

| [Addition] | 0 | 1 | 2 | 3 | ・・・ | n-2 | n-1 | n | n+1 | n+2 | n+3 |
|---|---|---|---|---|---|---|---|---|---|---|---|

n: Preset value

(1) Output control is maintained after count-up completion and until reset. However counting is possible despite of count-up completion.
(2) It reverts“0” after counting up full scale, but output control is maintained. However output is OFF if count value or preset value is changed.

### 4-3-2 Change the Preset Value

It is possible to change the preset value even during counting. However note the following points.

◇When the pre-scale value is “1.000”.（PSCL=1.000）

(1) If the preset value is changed to the value less than the count value, counting will continue until it reaches full scale, returns to “0” and then reaches the new preset value.
(2) If the preset value is changed to “0”, it will not count up at start with “0”. It counts up when the counting value comes to “0” again (after reach to full scale). However output is OFF if count value or preset value is changed.
(3) When the count value is fixed, output is changed according to the changing of preset value as below.
①If the preset value is changed to the value less than the count value or same as count value, output is ON.
（Count value ≧ Preset value）
②If the preset value is changed to the value more than the count value, output is OFF.
（Count value ＜ Preset value）

◇When the pre-scale is not “1.000”.（PSCL≠1.000）

Even if the preset value is changed after counting to full scale, output is not changed.

# Chapter 5 Settings

## 5-1 Operation procedure

Each setting is classified as follows. There are the detailed explanations from next pages.

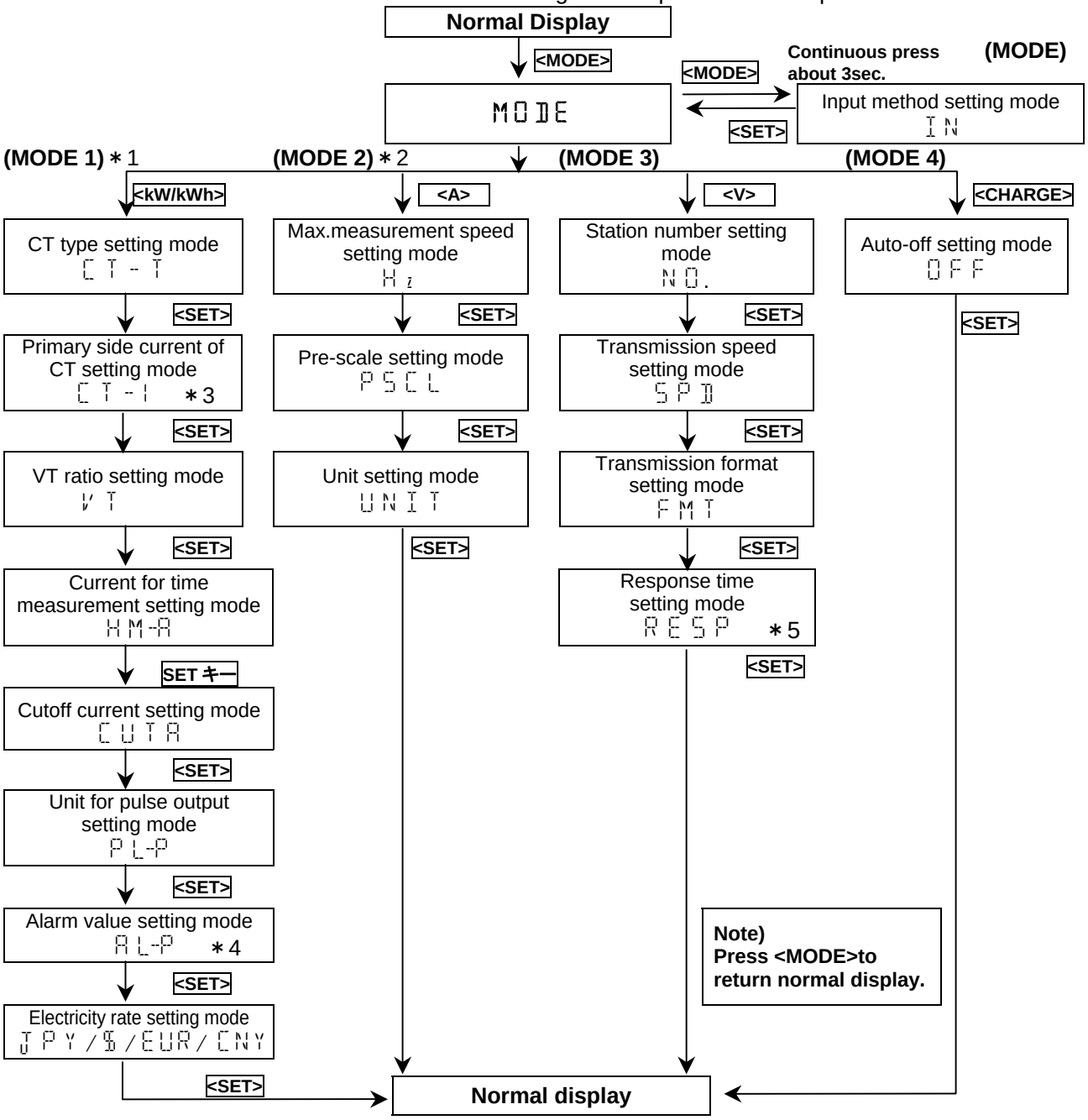
・MODE:<MODE>
　…Mode for selection of Power measurement (Power meter) or Pulse measurement (Pulse counter).

・MODE1: <MODE>+<kW/kWh> … Mode for setting each parameter for power measurement.

・MODE2: <MODE>+<A> … Mode for setting of each parameter for pulse measurement

・MODE3: <MODE>+<V> … Mode for setting of each parameter for serial communication (RS-485)

・MODE4: <MODE>+<CHARGE> … Mode for setting of each parameter for optional function




＊1 MODE1 is only for POWER measurement.

＊2 MODE2 is only for PULSE measurement.

＊3 Primary side current of CT setting mode is only for when ‘5A’ is selected on CT type setting mode.

＊4 Alarm value setting mode is only for when ‘ALARM’ is selected on Unit for pulse output setting mode.

＊5 Response time setting mode is only for MODBUS type.

**NOTE） Power measurement (Power meter) and Pulse measurement (Pulse counter) can not be used at the same time.**

## 5-2 Setting Mode Explanation

■The value with under line is initial setting among each setting value.　　☆Set before measurement.

### 5-2-1 MODE (Select input method)

**＜MODE＞**

**Input method setting mode** IN

**Mode defines input method, power measurement or pulse measurement.**

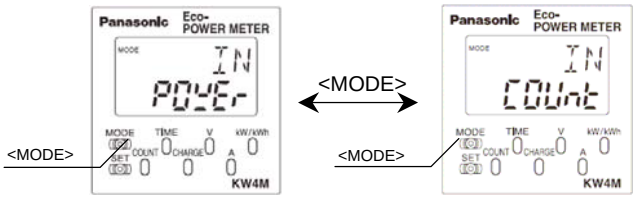
・Select from POWER / COUNT

・"POWER" is selected when using power measurement (Power meter).

・"COUNT" is selected when using pulse measurement (Pulse counter).

**Normal display**

↓ **<MODE>**

| Input method setting mode | Display |
|---|---|
| ・Press <MODE> continuously about 3s. to shift to this mode.<br>・Select POWER (Power measurement) →COUNT (Pulse measurement) using <MODE>. |  |

↓ **<SET>**

**Normal display**

### 5-2-2 MODE1

(Mode for setting each parameter for power measurement.
This mode doesn't show when pulse measurement is selected.)

**＜MODE＞+＜kW/kWh＞**

**CT type setting mode** CT-T

**Mode defines input current type of the dedicated CT.**

・Select from the type of 5A/50A/100A/250A/400A.

・When the secondary current of CT is 5A, select "5A".

**Primary side current of CT setting mode** CT-1

**Mode defines primary current when measuring by combination with existing CT, its secondary current of 5A.**

**It is possible to use as the second step for combination with existing CT by selecting "5A" in the CT type setting mode. In this case, it is necessary to set the primary side current.**

・It can be set the range of 1 to 999.

・When connecting 5ACT directly and measure with 5A range, set to "5".

ex) If measured CT is 400A/5A, set to "400".

※This mode is only when "5A" is selected on CT type setting mode.

**VT ratio setting mode** VT

**Mode defines voltage-input method to the main unit, input voltage directly or uses a voltage transformer (VT) (over 240VAC).**

・It can be set the range of 1.00 to 99.99.

"1.00" should be set when voltage input directly without connecting VT.

"1.01～99.99" should be set when VT is used to input voltage.

ex) If the VT is 440V/110V, set to "4.00".

**Current for time measurement setting mode** HM-A

**Mode defines for time measured current. Unit measures ON-time and OFF-time by setting value.**

・It can be set the range of 1.0% to 100.0%F.S.

ex) When 10.0 is set, the current exceeds 10.0%F.S is measured as ON-time, the current under 10.0%F.S is measured as OFF-time.

※Measured current is the current of L1(CT1)-phase.

**Cutoff current setting mode** CUTA

**Mode defines load current that does not measured (Cutoff current).**
**Use to avoid miss-measurement by wiring or induction noise at no-load.**
**0.00kW is displayed for instantaneous electric power, 0.0A is displayed for current. Integrated electrical energy is not measured.**

・It can be set the range of 1.0% to 50.0%.
ex) When set to 10.0, current under 10.0%F.S is not measured.

**Unit for pulse output setting mode (Power)** PL-P

**Mode defines unit used for pulse output.**

・Select from 0.001/0.01/0.1/1/10/100kWh /Alarm.
When "ALARM" is set, alarm is output at the time when instantaneous electric power is over the setting value.
When one of the "0.001/0.01/0.1/1/10/100"[kWh] is set, one pulse is output at the setting value.

**Alarm value setting mode** AL-P

**Mode defines instantaneous electric power used for alarm output.**

・It is set the range of 0.00 to 9999.99kW.

※This mode is only when "ALARM" is selected on unit for pulse output setting mode.

**Electricity charge setting mode** JPY/$/EUR/CNY

**Mode defines electricity charge ratio used as a standard per 1kWh.**
**The electricity charge ration of 4 kinds of currency (JPY, $ ,EUR,CNY) can be set.**

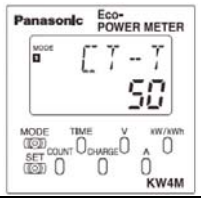
・It can be set the range of 0.0 to 99.9 yen/1kWh. (Initial 10.0)
・It can be set the range of 0.000 to 9.999 dollars/1kWh. (Initial 0.093)
・It can be set the range of 0.000 to 9.999 euros/1kWh. (Initial 0.085)
・It can be set the range of 0.00 to 99.99 yuan/1kWh. (Initial 10.00）

**Normal display**

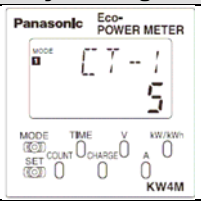
↓ **<MODE>**

**MODE display**

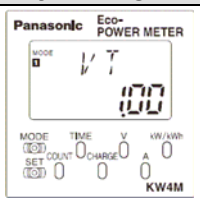
↓ **<kW/kWh>**

| **CT type setting mode** | **Factory setting / Display** |
|---|---|
| ・Press **<kW/kWh>** to change CT type.<br>・CT type is selected from 50→100→250→400→5 |  |

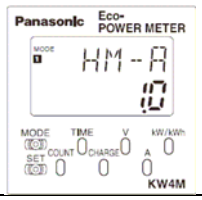
↓ **<SET>**

| **Primary side current of CT setting mode** | **Factory setting / Display** |
|---|---|
| ・Enter primary side current of CT using **<kW/kWh>,< A >, < V >**.<br>・If measured CT is 100A/5A, set to 100.<br>・If 5A is measured, set to 5.<br>It is only when "5A" is selected on CT type setting mode. |  |

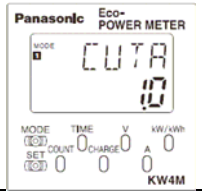
↓ **<SET>**

| **VT ratio setting mode** | **Factory setting / Display** |
|---|---|
| ・Enter VT ratio using**<kW/kWh>,< A >,< V >,<CHARGE>**.<br>・If the VT is 440/110, set to "4.00".<br>（1.00～99.99） |  |

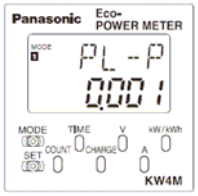
↓ **<SET>**

| Current for time measurement setting mode | Factory setting / Display |
|---|---|
| ・Enter current for time measurement using **<kW/kWh>,< A >,< V >**.<br>・If you measure the current over 50.0%F.S, set to “50.0”.<br>（1.0～100.0） |  |

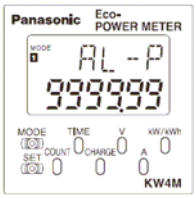
↓ **<SET>**

| Cutoff current setting mode | Factory setting / Display |
|---|---|
| ・Enter cutoff current using **<kW/kWh> ,< A >,< V >**.<br>・If you don’t measure the current under 10.0%F.S, set to “10.0”.<br>（1.0～50.0） |  |

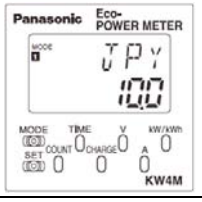
↓ **<SET>**

| Unit for pulse output setting mode | Factory setting / Display |
|---|---|
| ・Press **<kW/kWh>** to change unit for pulse output.<br>・Unit is selected from<br>0.001→0.01→0.1→1→10→100 →ALARM. |  |

↓ **<SET>**

| Alarm value setting mode | Factory setting / Display |
|---|---|
| ・Enter power for alarm using **<kW/kWh>,< A >,< V >,<CHARGE>,<TIME>,<COUNT>**.<br>*It is only when “ALARM” is selected on unit for pulse output setting mode.<br>（0～9999.99kWh） |  |

↓ **<SET>**

| Electricity charge setting mode | Factory setting / Display |
|---|---|
| ・Press <COUNT> to change JPY→＄→EUR→CNY.<br>・Enter the rate per 1kWh using **<kW/kWh>,< A >,< V >,<CHARGE>**. |  |

↓ **<SET>**

**Normal display**

5-2-3 MODE2

(Mode for setting each parameter for pulse measurement.
This mode doesn't show when power measurement is selected.)

**＜MODE＞+＜ A ＞**

**Max. counting speed setting mode** Hz

**Mode defines max. counting speed.**

・Select from 2kHz/30Hz

**Pre-scale setting mode** PSCL

**Mode defines pre-scale value used for change count value.**

・It can be set the range of 0.001 to 100.000. (Initial 1.000)

・The position of decimal point set with this mode is applied to count value and preset value.

ex) When 0.01 (Last 2-digit) is set, the decimal point of count value and preset value has 2 digit under decimal point.

**Unit setting mode** UNIT

**Mode defines unit used for count value display.**

・Select from CNT/l/kl/$m^3$.

| Set | CNT | l | kl | $m^3$ |
|---|---|---|---|---|
| Display | CNT | l | kl | m3 |

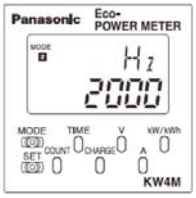
※Count value does not change even if the unit setting is changed during counting.

**Normal display**

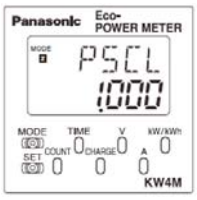
↓ **<MODE>**

**MODE display**

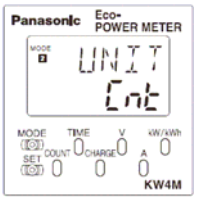
↓ **< A >**

| Max. counting speed setting mode | Factory setting / Display |
|---|---|
| ・Press <kW/kWh> to change max. counting speed.<br>・Max. counting speed is selected from 2000(2kHz) → 30（30Hz）. |  |

↓ **<SET>**

| Pre-scale setting mode | Factory setting / Display |
|---|---|
| ・Enter pre-scale value using **<kW/kWh>,< A >,< V >,<CHARGE>,<TIME>,<COUNT>**.<br>・Pre-scale value can be entered the range of 0.001 to 100.000.<br>・The position of decimal point set with this mode is applied to count value and preset value. |  |

↓ **<SET>**

| Unit setting mode | Factory setting / Display |
|---|---|
| ・Press <kW/kWh> to change unit.<br>・Unit is selected from CNT→ l →kl→m3. |  |

↓ **<SET>**

**Normal display**

5-2-4 MODE3

（Mode for setting of each parameter for serial communication (RS-485)）

**＜MODE＞+＜ V ＞**

**Station number setting mode** NO.

**Mode defines an individual station no. for each unit when two or more units communicate via serial communication (RS-485).**

・It can be set the range of 01 to 99.

**Transmission speed (Baud rate) setting mode** SPD

**Mode defines serial communication (RS-485) transmission speed. Define the transmission speed according to the master's (PLC etc.).**

・Select from 19200/9600/4800/2400【bit/s】.

**Transmission format setting mode** FMT

**Mode defines serial communication (RS-485) transmission format (Data length, Parity). Define the transmission format according to the master's (PLC etc).**

・Select from 8bit-o/7bit-n/7bit-E/7bit-o/8bit-n/8bit-E for MEWTOCOL type.
8bit-o/8bit-n/8bit-E for MODBUS type.
"n(none)" means parity is not available.
"E(Even)" means parity is even number.
"o(odd)" means parity is odd number.

**Response time setting mode** RESP

**<Only MODBUS type>**

**MODE defines serial communication (RS485) response time of main unit.**
**When command is received, it sends response after setting response time passes.**

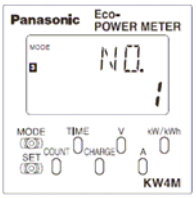
・It can be set the range of 5 to 99ms.

**Normal display**

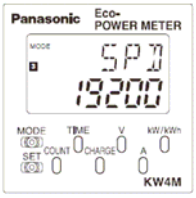
↓ **<MODE>**

**MODE display**

↓ **< V >**

| Station number setting mode | Factory setting / Display |
|---|---|
| ・Enter the station number using <kW/kWh>, < A >.<br>・Station number can be entered the range of 01 to 99. |  |

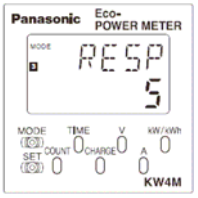
↓ **<SET>**

| Transmission speed setting mode | Factory setting / Display |
|---|---|
| ・Press <kW/kWh> to change transmission speed.<br>・Transmission speed is selected from<br>19200→9600→4800→2400. |  |

↓ **<SET>**

| Transmission format setting mode | Factory setting / Display |
|---|---|
| ・Press <kW/kWh> to change transmission format<br>(Data length / Parity).<br>・Transmission format is selected from<br>8bit-o→7bit-n→7bit-E→7it-o→8bit-n→8bit-E.<br>・n: not available　E: even number　o: odd number |  |

↓ **<SET>**

| Response time setting mode <Only for MODBUS type> | Factory setting / Display |
|---|---|
| ・Enter the response time using <kW/kWh>, < A >.<br>Response time can be entered the range of 05 to 99ms. |  |

↓ **<SET>**

**Normal display**

5-2-5 MODE4

(Mode for setting of each parameter for optional function)

**＜MODE＞+＜CHARGE＞**

**Auto-off setting mode** OFF

**Backlight LED turns off automatically when there is no key operation for a long time.**

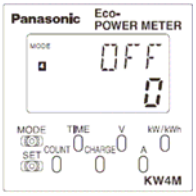
・Off time can be set the range of 0 to 99min.
"0" should be set if you want to turn always light on.
"1~99" should be set if you want to turn light off at setting time.
・After turns off the backlight, any key operation makes it turns on.

**Normal display**

↓ **<MODE>**

**MODE display**

↓ **<CHARGE>**

| Auto-off setting mode | Factory setting / Display |
|---|---|
| ・Enter auto-off time by minute using **<kW/kWh>,< A >**.<br>・Auto-off time can be entered the range of 0 to 99.<br>・"0" should be set to turn always light on.<br>・"1~99" should be set to turn light off at setting time (minute).<br>・While light off, press any key to light on. |  |

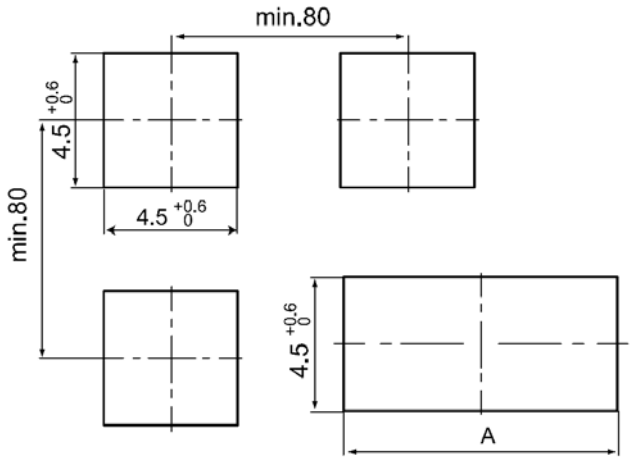
↓ **<SET>**

**Normal display**

# Chapter 6 Installation and Wiring

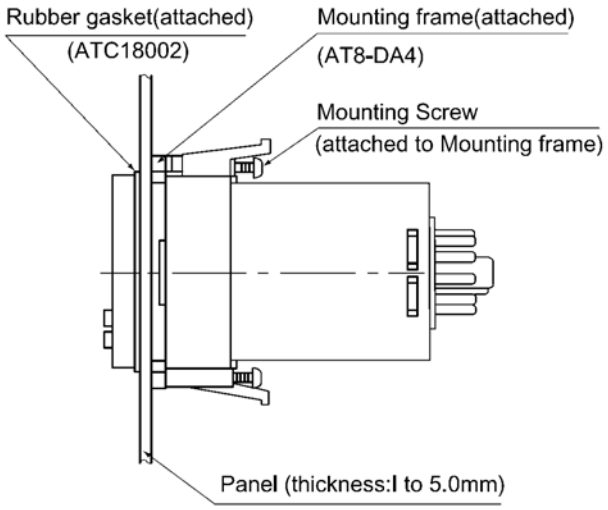
## 6-1 Panel Cut-out dimensions

(Unit: mm)




Dimension A when 'u' products are mounted in a row: $A=(48 * n-2.5)^{+0.6}_{0}$
If the products are mounted in a row, they lose their waterproofing properties.

## 6-2 Panel mounting diagram




How to mount

From the panel front, pass the main unit through the square holes. Insert the mounting frame from the rear and push it in so that the gap between the mounting frame and the panel surface is minimized. Tighten the screws (2 places) equally tight and check that there is no rattling. If the screws are overly tightened, the frame may come off. In that case, loosen the screws and tighten them again pushing the frame in.

## 6-3 Wiring

6-3-1 Terminal arrangement

| Functions | | Terminal No. | |
|---|---|---|---|
| | | Pin type | Screw terminal type |
| 1, R, R | | ① | ⑧ |
| 2, N, S | | ② | ⑨ |
| 3, T, T | | ③ | ⑩ |
| RS-485 | (+) | ④ | ⑪ |
| | (−) | ⑤ | ① |
| Pulse output | (+) | ⑥ | ⑥ |
| | (−) | ⑦ | ⑦ |
| CT1(k) / IN | | ⑧ | ② |
| CT1(l), CT2(l) | | ⑨ | ③ |
| CT2(k) | | ⑩ | ④ |
| 0V | | ⑪ | ⑤ |

(1) Be sure to wire correctly according to the terminal arrangement and wiring diagrams.
(2) A DIN rail socket (ATC180041) should be used for Pin type Eco-POWER METER.

⚠ **The input (applied) voltage to each pin (terminal) is as follows.**

| Phase and wire | Type | Pin (Terminal) | Input (Applied) voltage |
|---|---|---|---|
| Single-phase two-wire | Pin type | ①-② | 100-120/200-240VAC (100-120/200-240V〜) |
| | Screw terminal type | ⑧-⑨ | |
| Single-phase three-wire | Pin type | ①-②-③ | 100-120VAC (100-120V〜:3W) |
| | Screw terminal type | ⑧-⑨-⑩ | |
| Three-phase three-wire | Pin type | ①-②-③ | 200-240VAC (200-240V 3〜) |
| | Screw terminal type | ⑧-⑨-⑩ | |

6-3-2 Power measurement

◇Main unit wiring diagrams

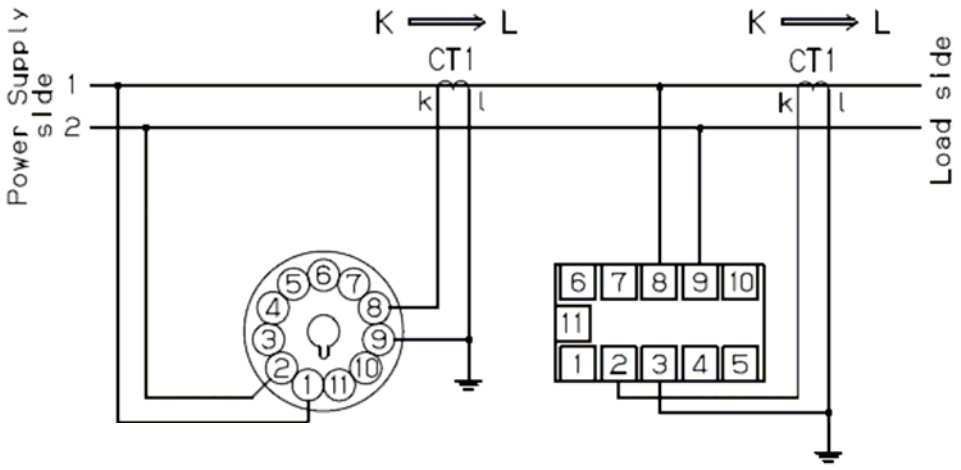
***Please connect a breaker to the voltage input part for safety reasons and to protect the device.**

*Grounding CT's secondary side (l line) is recommended for the unit protection when CT breaks down.

1) When measuring load with 100-200V system

① Single-phase 2 wire system

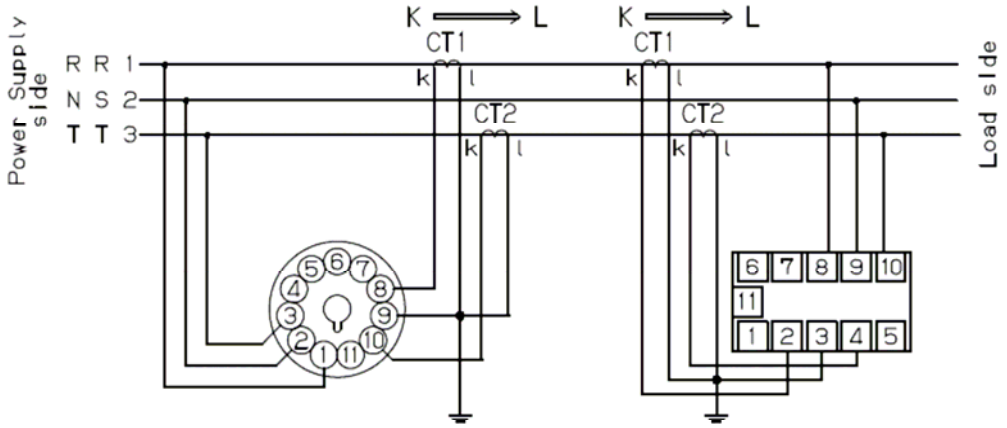
*One CT is required to measure single-phase 2 wire system.




＜ Pin type ＞　　＜Screw terminal type＞

②Single-phase 3 wire system / Three-phase 3 wire system

*Two CTs are required to measure Single-phase 3-wire / Three-phase 3 wire system.




＜ Pin type ＞　　＜Screw terminal type＞

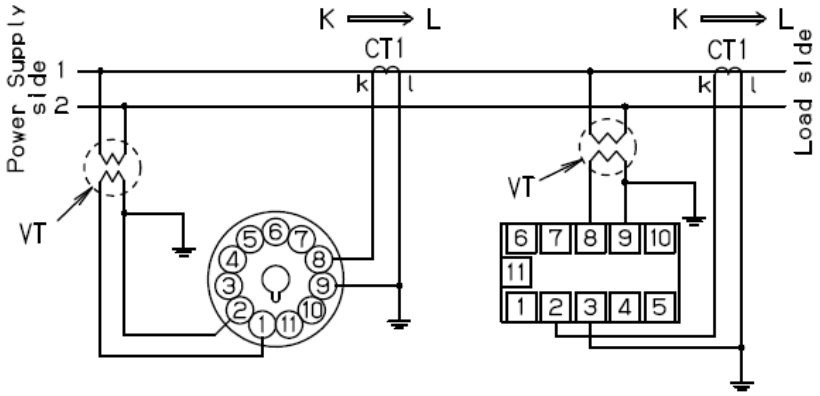
2) When measuring load with 200V or more system

VT (Voltage transformer) is needed when you measure a load with voltage over 200V system.

Use commercial VT, those secondary rating is 110V.

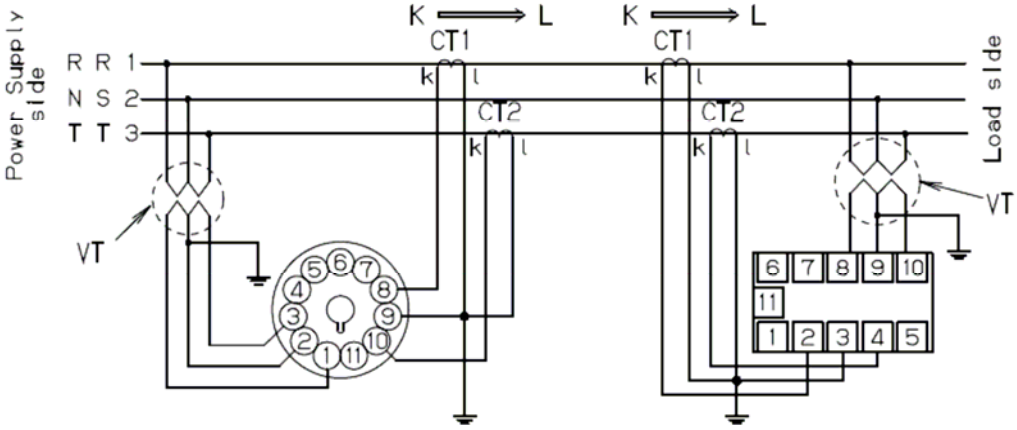
*Grounding CT's secondary side (l line) and VT's neutral line is recommended for the unit protection when CT or VT breaks down.

① Single-phase 2 wire system




＜ Pin type ＞　　＜Screw terminal type＞

②Single-phase 3 wire system / Three-phase 3 wire system




＜ Pin type ＞　　＜Screw terminal type＞

◇To connect CT with secondary current 5A

How to connect the unit to measure by combination with existing commercial CT

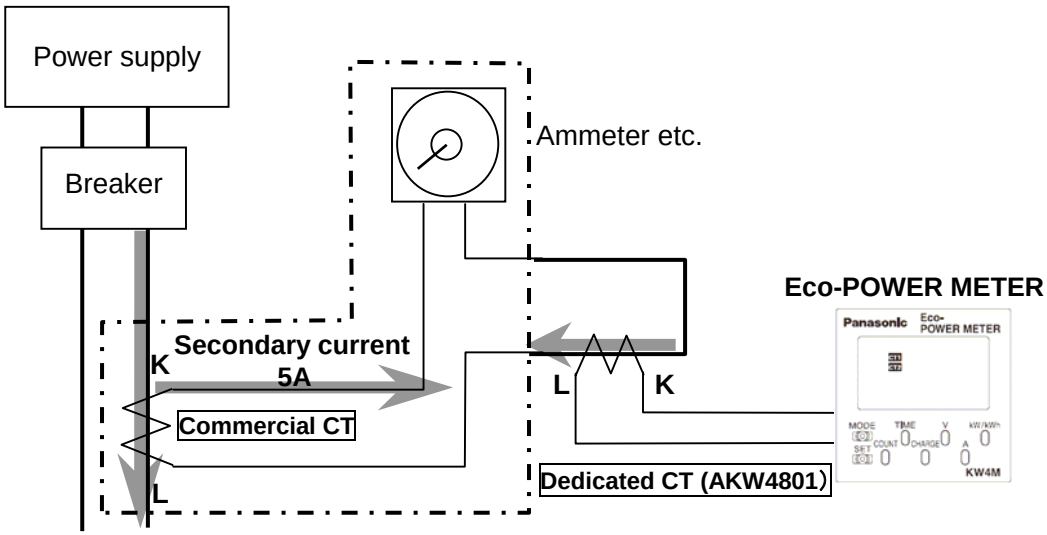
(1) Select 5A at CT type setting mode (CT-T).

(2) Set the primary current of measured commercial CT (secondary current 5A) at primary side current of CT setting mode (CT-1).

< ex > If the measured CT is 400A/5A, set to ”400”.

(3) Clamp the dedicated CT for 5A (AKW4801), which is connected to the main unit first, to secondary side of the commercial CT. CT direction (K→L) should be set for the commercial CT direction.

(Connection example)




◇How to attach the Current Transformer (CT)

・One current transformer (CT) is required to measure a single-phase, two-wire system. Two CTs are required to measure a single-phase, three-wire system or three-phase, three-wire system. Using 2 CTs should be the same.

・When connecting CT, connect the secondary side to the terminal of the main unit first, and after that wire the primary side to a load electric wire.

・The CT has polarity. Wire correctly according to the K and L marks.

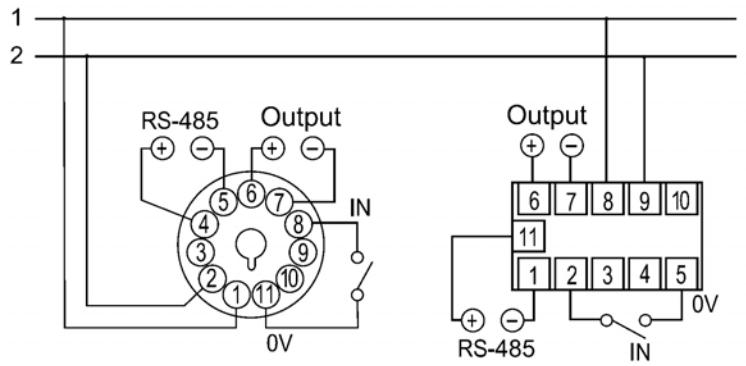
・For the dedicated CT (AKW4801,4802,4803,4804), ‘k’ is the white wire and ‘ l ’ is the black wire.

・Check beforehand that the thickness of the electric wire is smaller than the through-hole of the CT. If you use a CT that separates at the bottom, make sure it is closed securely once the wire is in place; if not an error in measurement will occur.

・When CT’s cable is extended, it is possible to extend up to about 10m with the cable of 0.75mm$^2$ or more cross section under the environment without noise at all. Please use the thick cable as much as possible.

6-3-3 Pulse measurement

◇Main unit wiring diagrams




＜ Pin type ＞　　＜Screw terminal type＞

◇Input connection

・Contact input

Use highly reliable metal plated contacts. Since the contact's bounce time leads directly to error in the count value, use contacts with as short a bounce time as possible. In general, select 30Hz for max. counting speed.

・Non-contact input (Transistor input)

Connect with an open collector. Use the transistor with the following specifications.

$V_{CEO}$=20V min. $I_C$=20mA min. $I_{CBO}$=6 $\mu$ A max

Use transistors with a residual voltage of less than 1.5V when the transistor is ON.

※Short-circuit impedance should be less than 1kΩ.

(When the impedance is 0Ω, drain current is approx. 5mA.)

The open-circuit impedance should be more than 100kΩ.

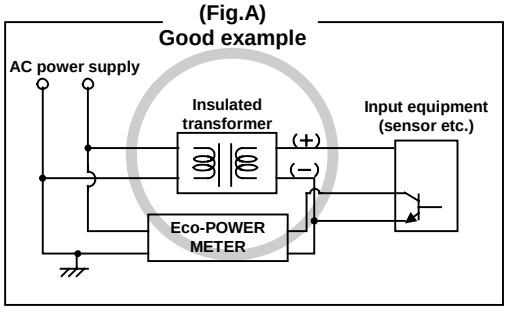
・Input wiring

Please wire as short as possible by using a shielded wire or a metallic electric wire tube individually.

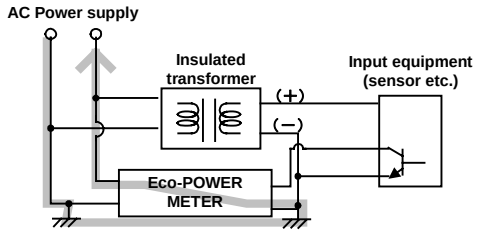
## (Caution)

The AC power supply input part is not insulated to pulse input parts. So the input equipment must have the power supply transformer in which the secondary side is not grounded with the primary and secondary sides insulated, in order to prevent interference of the power supply circuit when connecting the external input circuit. Be sure not to use an auto-transformer.

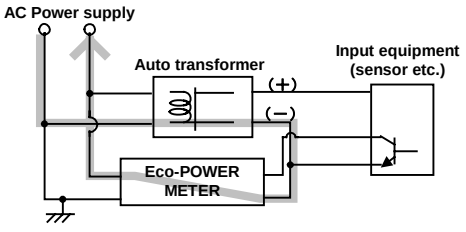
**(Fig.A)**
**Good example**




**(Fig.B) No Good example**



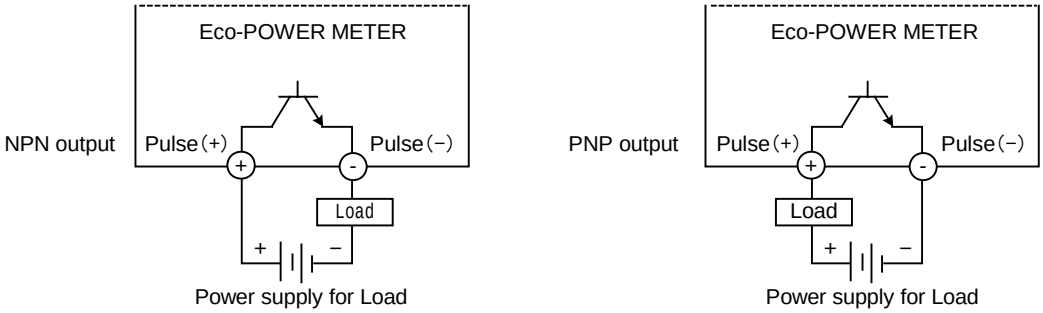

Do not ground the secondary side.




Do not use an auto-transformer.

## 6-3-4 For Output connection

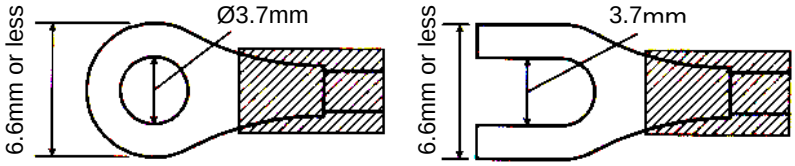
Since the transistor output is insulated from the internal circuit by a photo-coupler, it can be used both as a NPN output and PNP (equal value) output.




## 6-3-5 For Wiring terminal

・When using a crimp terminal, it should be with insulation sleeve applicable to M3.5 screw as shown below.

・Tightening torque: under 0.8N・m



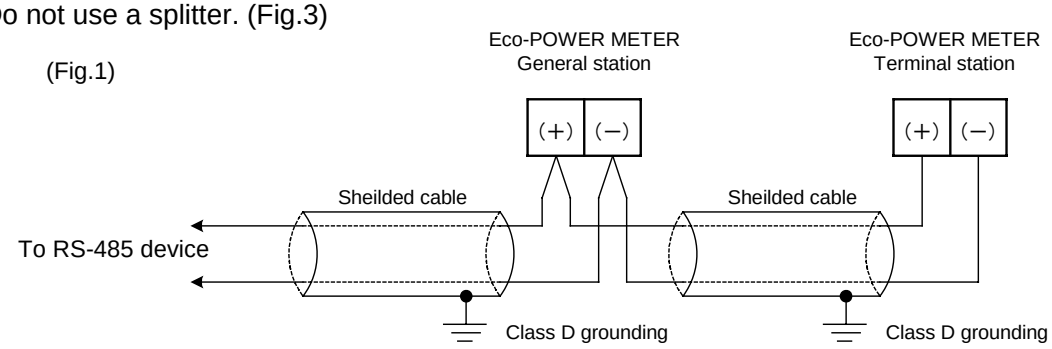

## 6-3-6 RS-485 communication

・When using shielded cable for the RS-485 transmission line, ground one end. Use a class D (class 3) dedicated earth for grounding. Do not share a ground with other earth lines. (Fig.1)

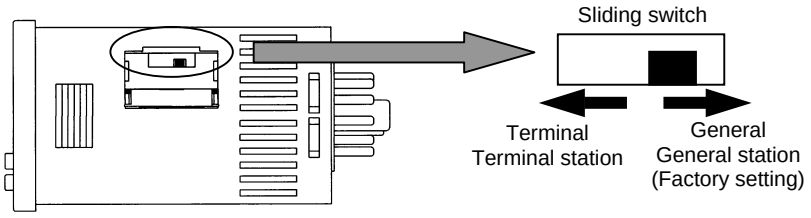
・Change the slide switch on the side of main unit as a terminal station. (Fig.2)

・Be sure to connect with daisy chain the RS-485 transmission line between each unit. Do not use a splitter. (Fig.3)

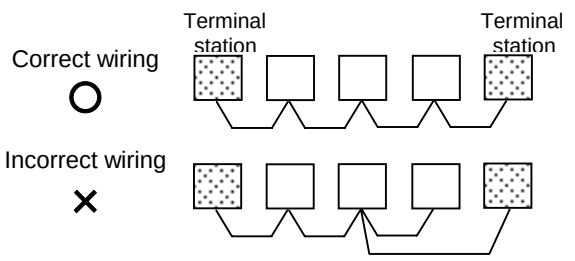
(Fig.1)




(Fig.2)



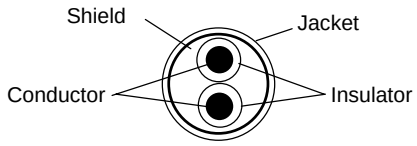
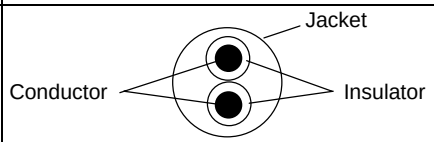

(Fig.3)



Recommended Cable

Use the transmission cables shown below for Eco-POWER METER RS485 communication system.

| Cable | Conductor | | Insulator | | Cable diameter | Applicable cable |
|---|---|---|---|---|---|---|
| | Size | Resistance (at 20℃) | Material | Thickness | | |
| Twisted-pair with shield | 1.25 $mm^2$ (AWG16) or more | Max.16.8Ω/km | Polyetheline | Max. 0.5 mm | Approx. 8.5 mm | HITACHI KPEV-S 1.25 $mm^2$ × 1P Belden Inc. 9860 |
| | 0.5 $mm^2$ (AWG20) or more | Max.33.4Ω/km | Polyetheline | Max. 0.5 mm | Approx. 7.8 mm | HITACHI KPEV-S 0.5 $mm^2$ × 1P Belden Inc. 9207 |
| VCTF | 0.75 $mm^2$ (AWG18) or more | Max.25.1Ω/km | PVC | Max. 0.6 mm | Approx. 6.6 mm | VCTF 0.75 $mm^2$ × 2C (JIS) |

| Cable | Section |
|---|---|
| Twisted-pair with shield |   |
| VCTF |   |

Notes

1) Use shielded type twist cables.
2) Use only one type of the transmission cables.
   Do not mix different types of the cables.
3) Use twist pair cables under a bad noise environment.

6-3-7 Low Voltage Directive

When using in the application confirming to EN61010-1/IEC61010-1, make sure to satisfy the following conditions.

(1) Pulse output part secure only basic insulation. In order to secure reinforced (double) insulation demanded by EN 61010-1/ IEC61010-1, secure basic insulation or more with load side and reinforced (double) insulation with communication system side.
(2) Provide the voltage input part with an EN60947-1 or EN60947-3 compliant circuit breaker.
   The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.
(3) Use a wire with basic insulation or more for a wire cramped (or connected) CT.

【Environmental conditions】

- Overvoltage category Ⅱ, Pollution degree 2
- Indoor use
- An ambient temperature of –10 to 50℃
- An ambient non-condensing humidity of 35 to 85%RH (at 20℃)
- Altitude of 2000m or less

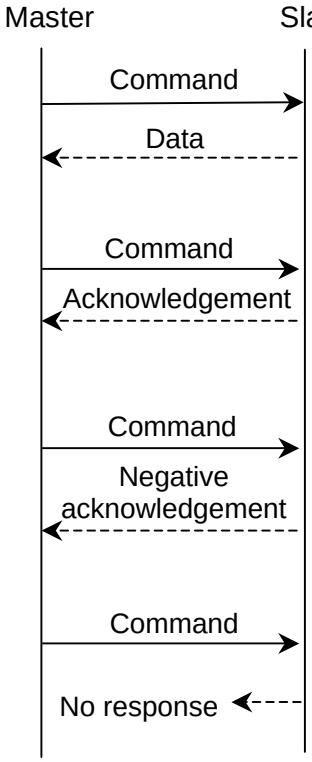
【Mount the product in a place with】

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gasses
- Few mechanical vibrations or shocks
- No exposure to direct sunlight
- No large capacity electromagnetic switches or cables through which large current is flowing

# Chapter 7 Communications

## 7-1 Communication Procedures

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of Eco-POWER METER (hereafter Slave).




• Response with data
When master sends reading command, slave responds with the corresponding set value or current status.

• Acknowledgement
When master sends setting command, slave responds by sending the acknowledgement.

• Negative acknowledgement
When master sends a non-existent command or value out of the setting range, the slave returns negative acknowledgement.

• No response
Slave will not respond to master in the following cases.
- Global address “FF” (MEWTOCOL) is set.
- Broadcast address “00H” (Modbus protocol) is set.
- Communication error (framing error, parity error)
- CRC-16 discrepancy (Modbus RTU mode)

## 7-2 Communication timing

◆The minimum access time from the master is 1 sec. (Minimum time for update the data)
Eco-POWER METER may not response due to noise and so on, be sure to check that it receives the response from Eco-POWER METER.

◆In order to improve the communication quality, we recommend to send the transmission again.

Communication timing of RS-485

◇Eco-POWER METER (Slave) side

When Eco-POWER METER (Slave) starts transmission to RS-485 communication line, it is arranged so as to provide an idle status transmission period of the below before sending the response to ensure the synchronization on the receiving side.

- MEWTOCOL type: about 3ms (transmission speed: 19200bps, 9600 bps)
  about 10ms (transmission speed: 4800bps, 2400bps)
- MODBUS type: about 5 to 99ms (setting available)

And after sending the response, transmitter is cut within transmission period of about 20ms.

◇Master side (Cautions of setting a program)

At communication, keep the following conditions.

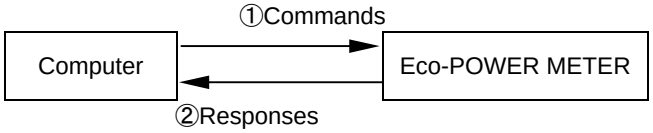
1) Set the program so that the master can disconnect the transmitter from the communication line within the transmission period of about 3ms after sending the command in preparation for reception of the response from Eco-POWER METER (Slave).
2) To avoid collision of transmissions between the master and Eco-POWER METER (Slave), send a next command after checking that the master received the response.

## 7-3 MEWTOCOL communication

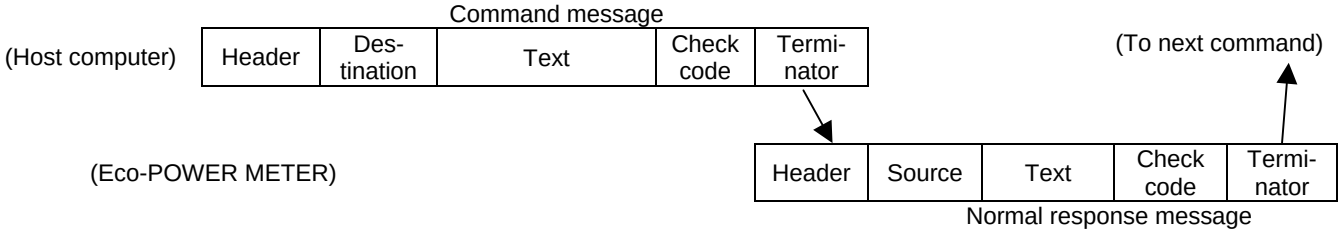
7-3-1 Overview of MEWTOCOL-COM (RS-485)

◆Command and response functions

The computer sends commands (instructions) to Eco-POWER METER, and receives responses in return. This enables the computer and Eco-POWER METER to converse with each other, so that various kinds of information can be obtained and provided.




◆Command and response formats




◇Control codes

| Name | Character | ASCII code | Explanation |
|---|---|---|---|
| Header | % | 25H | Indicates the beginning of a message. |
| Command | # | 23H | Indicates that the data comprises a command message. |
| Normal response | $ | 24H | Indicates that the data comprises a normal response message. |
| Error response | ! | 21H | Indicates that the data comprises a response message when an error occurs. |
| Terminator | CR | 0DH | Indicates the end of a message. |

◇Destination and source AD (H), (L)

Two-digit decimal 01 to 99 (ASCII codes)

Command messages contain a station number for Eco-POWER METER that receives the message.

When FF (ASCII code table) is used, however, the transmission is a global transmission (sent to all stations at once).

Note) When a global transmission is sent, no response to the command message is returned.

◇Block check code Bcc (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

These are codes (horizontal parity) that are used to detect errors in the transmitted data.

If "**" is entered instead of "Bcc", however, messages can be transmitted without the Bcc. In this case, the Bcc is included with the response

◇Error code Err (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

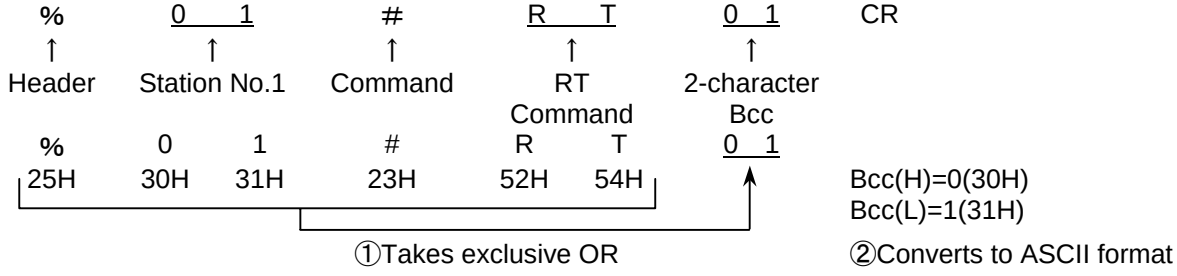
These indicate the contents if an error occurs.

◆Bcc（Block Check Code）

-The Bcc is a code that carries out an error check using horizontal parity, to improve the reliability of the data being sent.

-The Bcc uses an exclusive OR from the header (%) to the final character of the text, and converts the 8- bit data into a 2-character ASCII code.

Example)



7-3-2 Data Register List

| Data register | Name | Unit | Kind of data | Range | R/W |
|---|---|---|---|---|---|
| DT00050 | Rate ￥(JPY) | 0.1¥ | Sign-less 16bit | 0 to 99.9 | R/W |
| DT00051 | Rate $ | 0.001$ | Sign-less 16bit | 0.000 to 9.999 | R/W |
| DT00052 | Rate €（EUR） | 0.001€ | Sign-less 16bit | 0.000 to 9.999 | R/W |
| DT00053 | Rate yuan (CNY) | 0.01 yuan | Sign-less 16bit | 0.00 to 99.99 | R/W |
| DT00100<br>DT00101 | Integrated electric power | 0.01kWh | Sign-less 32bit | 0 to 9999999.99 | R/W |
| DT00107 | L1(CT1)-phase current | 0.1A | Sign-less 16bit | 0.0 to 999.9 | R |
| DT00109 | L2(CT2)-phase current | 0.1A | Sign-less 16bit | 0.0 to 999.9 | R |
| DT00060 | CT type | Rated A ( rms ) | Sign-less 16bit | 5 types: 5,50,100,250,400 | R/W |
| DT00061<br>DT00062 | Unit for Pulse output | — | Sign-less 32bit | 1(0.001),10(0.01),100(0.1),<br>1000(1),10000(10),100000(100)<br>999(Instantaneous electrical energy: Values of DT00064 and 00065 are applied) | R/W |
| DT00063 | Primary side current value when CT 5A | A | Sign-less 16bit | 1 to 999 | R/W |
| DT00064<br>DT00065 | Alarm value (Instantaneous electric power) | 0.01kW | Sign-less 32bit | 0 to 9999.99 | R/W |
| DT00066 | VT ratio | 0.01 | Sign-less 16bit | 1.00 to 99.99 | R/W |
| DT00067 | Threshold value current for time measurement | 0.1% | Sign-less 16bit | 1.0 to 100.0 | R/W |
| DT00068 | Cutoff current | 0.1% | Sign-less 16bit | 1.0 to 50.0 | R/W |
| DT00150<br>DT00151 | Load ON-time | 0.1h | Sign-less 32bit | 0 to 99999.9 | R/W |
| DT00152<br>DT00153 | Load OFF-time | 0.1h | Sign-less 32bit | 0 to 99999.9 | R/W |
| DT00154<br>DT00155 | Pulse count value | — | Sign-less 32bit | 0 to 999999 | R/W |
| DT00158<br>DT00159 | Preset value | — | Sign-less 32bit | 0 to 999999 | R/W |
| DT00160<br>DT00161 | Pre-scale value | 0.001 | Sign-less 32bit | 1 to 100000 (0.001 to 100.000)<br>＊Decimal point fixed | R/W |
| DT00162 | Max.counting speed | Hz | Sign-less 16bit | 30 or 2000 | R/W |
| DT00163 | Auto-off time | min | Sign-less 16bit | 0 to 99（0 means always light on） | R/W |
| DT00164 | Display unit | — | Sign-less 16bit | 0:CNT, 1: l, 2: kl, 3: m3 | R/W |
| DT00170<br>DT00171 | Voltage between 1 and 2 | 0.1V | Sign-less 32bit | 0 to 9999.9 | R |
| DT00172<br>DT00173 | Voltage between 2 and 3 | 0.1V | Sign-less 32bit | 0 to 9999.9 | R |
| DT00176<br>DT00177 | Instantaneous electric power | 0.01kW | Sign-less 32bit | 0 to 9999.99 | R |

Note1) R: Read W: Write

2) Data register except specified is 0.

3) DT00061,00062 (Unit for pulse output) and DT00160,00161 (Pre-scale value) is numerical value (in the range of data register).

4) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM's life short. Avoid to usage like this.

5) Write a data within the range when you write it.

## 7-3-3 Error Codes

◇Basic procedure errors

| Error code | Error name | Explanation |
|---|---|---|
| 40H | Bcc error | ・A Bcc error occurred in the command data. |
| 41H | Format error | ・A command message was sent that does not fit the transmission format. |
| 42H | No support error | ・A command was sent that is not supported. |
| 43H | Procedure error | ・Delimiter with multiple frames was sent.<br>・The response shall be multiple frames. |

◇Application error

| Error code | Error name | Explanation |
|---|---|---|
| 60H | Parameter error | ・The data code is not “D”. |
| 61H | Data error | ・Word No. was specified without decimal.（0000F etc.）<br>・The starting word No. is bigger than the ending word No.<br>・Writing data has a code that is not hexadecimal. |
| 62H | Registration error | ・Too many registrations have been entered (more than 17).<br>・“MD” command was sent when some registration has been exist.<br>・“MG” command was sent when registration has not been entered. |

◇Self-diagnostic error

| Error code | Error name | Explanation |
|---|---|---|
| 45H | Operation error | ・At “WD” command, writing data is exceeded the range of data register. |

## 7-3-4 Command

Eco-POWER METER has 5 kinds of commands.

| Command name | Code | Explanation |
|---|---|---|
| Read data area | RD | Reads the contents of data area. |
| Write data to data area | WD | Writes data to a data area. |
| Resister or Reset data monitored | MD | Resisters the data to be monitored. |
| Monitoring start | MG | Monitors a registered data. |
| Read status | RT | Reads the specifications of Eco-POWER METER and error code if an error occurs. |

**◆[RD]: Read data area (Reads the contents of data area.)**

◇Command

| % | Destination ×10¹ ×10⁰ | # | R | D | D | Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ | Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ | Bcc ×16¹ ×16⁰ | CR |
|---|---|---|---|---|---|---|---|---|---|

◇Normal response (Read successful)

| % | Source ×10¹ ×10⁰ | $ | R | D | First register contents 4 characters ×16¹ ×16⁰ ×16³ ×16² | Last register contents 4 characters ×16¹ ×16⁰ ×16³ ×16² | Bcc ×16¹ ×16⁰ | CR |
|---|---|---|---|---|---|---|---|---|

(lower word) (higher word) (lower word) (higher word)

◇Error response

| % | Source ×10¹ ×10⁰ | ! | Error code ×16¹ ×16⁰ | Bcc ×16¹ ×16⁰ | CR |
|---|---|---|---|---|---|

(Common to each command)

**◆[WD]: Write data area (Writes date to a data area.)**

◇Command

| % | Destination ×10¹ ×10⁰ | # | W | D | D | Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ | Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ | First writing data 4 characters ×16¹ ×16⁰ ×16³ ×16² | ⇒ |
|---|---|---|---|---|---|---|---|---|---|

(lower word) (higher word)

◇Normal response (Write successful)

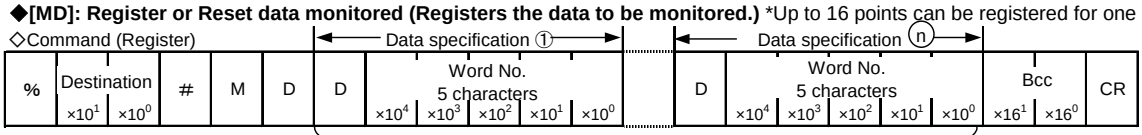
| % | Source ×10¹ ×10⁰ | $ | W | D | Bcc ×16¹ ×16⁰ | CR |
|---|---|---|---|---|---|---|

| ⇒ | Last writing data 4 characters ×16¹ ×16⁰ ×16³ ×16² | Bcc ×16¹ ×16⁰ | CR |
|---|---|---|---|

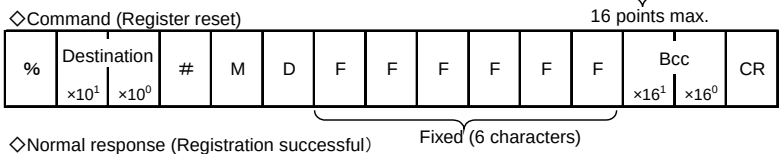
(lower word) (higher word)

**◆[MD]: Register or Reset data monitored (Registers the data to be monitored.)** *Up to 16 points can be registered for one unit.

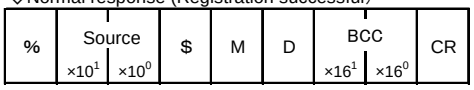
◇Command (Register)




◇Command (Register reset)

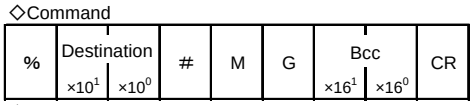



◇Normal response (Registration successful)

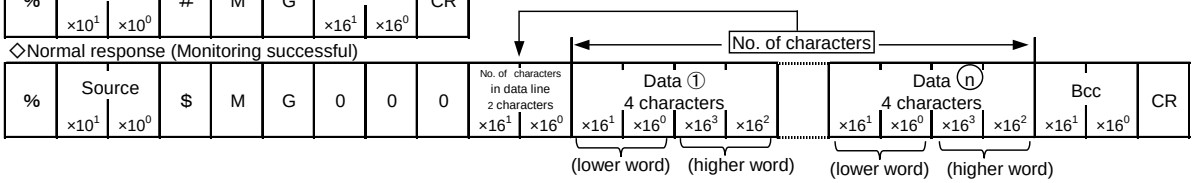



**◆[MG]: Monitoring start (Monitors a registered data.)**

◇Command




◇Normal response (Monitoring successful)

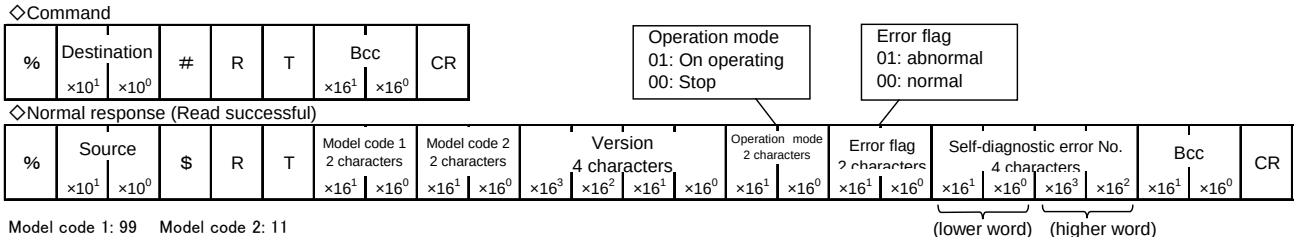



**◆[RT]: Read the status of Eco-POWER METER (Reads the specifications of Eco-POWER METER and error codes if an error occurs.)**

◇Command




◇Normal response (Read successful)




Model code 1: 99 Model code 2: 11

## 7-5 MODBUS (RTU) Communication

7-5-1 Overview of MODBUS (RTU)

◆8-bit binary data in command is transmitted as it is.

| | | |
|---|---|---|
| Data format | Start bit | : 1 bit |
| | Data bit | : 8 bits ※7bits is not available. |
| | Parity | : No parity, Even parity, Odd parity Selectable |
| | Stop bit | : 1 bit (Fixed) |
| | Error detection | : CRC-16 (Cyclic Redundancy Check) |
| | Data interval | : 3.5 character transmission time or less |

◆Message configuration

RTU mode is configured to start after idle time processing of more than 3.5 character transmissions and end after idle time processing of more than 3.5 character transmissions.

| 3.5 idle characters | Slave address | Function code | Data | Error check CRC-16 | 3.5 idle characters |
|---|---|---|---|---|---|
| | 8-bit | 8-bit | ∗∗bits | 16-bit | |

Master judges the transmission complete after no command for 4-characters idle time and process the command.

*Transmission speed and judgment time to complete transmission

| Transmission speed (bps) | Judgment time to complete (ms) |
|---|---|
| 19200 | about 2.00 |
| 9600 | about 4.00 |
| 4800 | about 8.00 |
| 2400 | about 16.00 |

◇Slave address:

Slave address is an individual instrument number on the slave side and is set within the range 1 to 99 (01H to 63H). Master identifies slaves by the slave address of the requested message.

Slave informs master which slave is responding to master by placing its own address in the response message. Slave address 0 (00H, broadcast address) can identify all slaves connected. However slaves do not respond.

◇Function code: Function code is command code for the slave to undertake the following action types.

| Function code | Contents |
|---|---|
| 03(03H) | DT Read |
| 06(06H) | DT1 word write |
| 16(10H) | DT several data write |

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when slave returns response message to master.

When acknowledgement is returned, slave simply returns original function code. When negative acknowledgement is returned, MSB of original function code is set as 1 for response.

For example, when the master sends request message setting 00H to function code by mistake, slave returns 80H by setting MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to data of response message and returned to master in order to inform it of what kind of error has occurred.

| Exception code | Contents |
|---|---|
| 1(01H) | Illegal Function (Non-existent function) |
| 3(03H) | Illegal data value (Value out of the devise numbers) |

note1) Even if it commands to write (06H.10H) to non-existent data address, slave response with acknowledgement. However, it doesn't write.

note2) Even if it commands to write the value out of the setting range, slave response with acknowledgement. However, it doesn't write.

note3) The maximum number of reading slaves is 26 (57-bite), the maximum number of writing slaves is 23 (55-bite).

◇Data: Data depends on the function code.
A request message from the master side is composed of data item, number of data and setting data.
A response message from the slave side is composed of number of bytes, data and exception code in negative acknowledgement.

◇Error check: 16-bit data to detect communication errors. Refer to the next.

◇Acknowledgement response
When command is to write 1 point, same massage of command is responded.
When command is to write several points, part of command message (6-bite) is responded.

◆Error check
After calculating CRC-16 (Cyclic Redundancy Check) from slave address to the end of data, the calculated 16-bit data is appended to the end of message in sequence from low order to high order.
<How to calculate CRC>
In CRC system, the information is divided by the polynomial series. The remainder is added to the end of the information and transmitted. The generation of polynomial series is as follows.
(Generation of polynomial series: $X^{16} + X^{15} + X^{2} + 1$)

① Initialize the CRC-16 data (assumed as X) (FFFFH).
② Calculate exclusive OR (XOR) with the 1st data and X. This is assumed as X.
③ Shift X one bit to the right. This is assumed as X.
④ When a carry is generated as a result of the shift, XOR is calculated by X of ③ and the fixed value (A001H). This is assumed as X. If a carry is not generated, go to step ⑤.
⑤ Repeat steps ③ and ④ until shifting 8 times.
⑥ XOR is calculated with the next data and X. This is assumed as X.
⑦ Repeat steps ③ to ⑤.
⑧ Repeat steps ③ to ⑤ up to the last data.
⑨ Set X as CRC-16 to the end of message in sequence from low order to high order.

◆Message example
① Reading electricity rate (0032H) of address 1
・Command

| 3.5 idle characters | Slave address (01H) | Function code (03H) | Data item (0032H) | Number of data (0001H) | Error check CRC-16 (25C5H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | ←character number |

・Response message from slave in normal status (When Rate=1000(10.00) [03E8H])

| 3.5 idle characters | Slave address (01H) | Function code (03H) | Number of response byte (02H) | Number of data (03E8H) | Error check CRC-16 (B8FAH) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 1 | 2 | 2 | ←character number |

② Setting electricity rate (0032H) of address 1 (When rate is set to 20.00(2000) [07D0H])
・Command

| 3.5 idle characters | Slave address (01H) | Function code (06H) | Data item (0032H) | Number of data (07D0H) | Error check CRC-16 (2BA9H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | ←character number |

・Response message from slave in normal status

| 3.5 idle characters | Slave address (01H) | Function code (06H) | Data item (0032H) | Number of data (07D0H) | Error check CRC-16 (2BA9H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | ←character number |

③ Reset integrated electric power (0064H, 0065H:2-word) of address 1

(When setting to 0 [0000, 0000H])

・Command

| 3.5 idle characters | Slave address (01H) | Function code (10H) | Data item (0064H) | Number of data item to write (0002H) | Number of data (04H) | ⇒ |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 1 | ←character number |

| ⇒ | Date 1 (0000H) | Date 2 (0000H) | Error check CRC-16 (F474H) | 3.5 idle characters |
|---|---|---|---|---|
| | 2 | 2 | 2 | ←character number |

・Response message from slave in normal status

| 3.5 idle characters | Slave address (01H) | Function code (10H) | Data item (0064H) | Number of data item to write (0002H) | Error check CRC-16 (0017H) | 3.5 idle characters |
|---|---|---|---|---|---|---|
| | 1 | 1 | 2 | 2 | 2 | ←character number |

・A response message from the slave in exception (error) status

(When number of data has been mistaken.)

Function code MSB is set to 1 for the response message in exception (error) status (90H).
The exception code 03H (Value out of the device numbers) is returned as contents of error.

<Mistaken message example (Command)>

| 3.5 idle characters | Slave address (01H) | Function code (10H) | Number of data item to write (0002H) | Number of data ***(06H)*** | ⇒ |
|---|---|---|---|---|---|

↑ **Mistake**

| ⇒ | Data 1 (0000H) | Data 2 (0000H) | Error check CRC-16 (8DB4) | 3.5 idle characters |
|---|---|---|---|---|

<Response message from slave to mistaken command
(Response message in exception (error) status)>

| 3.5 idle characters | Slave address (01H) | Function code (90H) | Exception code (03H) | Error check CRC-16 (0C01H) | 3.5 idle characters |
|---|---|---|---|---|---|

7-4-2 Data Register List

| MODBUS Function code | Data item (MEWTOCOL) | Name | Unit | Kind of date | Range: Hexadecimal (Range: Decimal) |
|---|---|---|---|---|---|
| 03H/06H/10H | 0032H (DT00050) | Rate ￥(JPY) | 0.01 | Sign-less 16bit | 0H～270FH (0～9999) |
| 03H/06H/10H | 0033H (DT00051) | Rate $ | 0.001$ | Sign-less 16bit | 0H～270FH (0～9999) |
| 03H/06H/10H | 0034H (DT00052) | Rate €(EUR) | 0.001€ | Sign-less 16bit | 0H～270FH (0～9999) |
| 03H/06H/10H | 0035H (DT00053) | Rate yuan (CNY) | 0.01CNY | Sign-less 16bit | 0H～270FH (0～9999) |
| 03H/06H/10H | 0064H (DT00100)<br>0065H (DT00101) | Integrated active power | 0.01kWh | Sign-less 32bit | 0H～3B9AC9FFH (0～999999999) |
| 03H | 006BH (DT00107) | Current L1A (CT1) | 0.1A | Sign-less 16bit | 0H～270FH (0～9999) |
| 03H | 006CH (DT00108) | Current L2A (CT2) | 0.1A | Sign-less 16bit | 0H～270FH (0～9999) |
| 03H/06H/10H | 003CH (DT00060) | CT type | Rated A (rms) | Sign-less 16bit | 5 types:<br>5H(5), 32H(50), 64H(100), FAH(250), 190H(400) |
| 03H/06H/10H | 003DH (DT00061)<br>003EH (DT00062) | Unit for Pulse output | — | Sign-less 32bit | 1H(1)<0.001>, AH(10)<0.01>, 64H(100)<0.1>, 3E8H(1000)<1>, 2710H(10000)<10>, 186A0H(100000)<100>, 3E7H(999)<br><Instantaneous electric power: Values of 0040H, 0041H> |
| 03H/06H/10H | 003FH (DT00063) | Primary side current value when CT 5A | 1A | Sign-less 16bit | 1H～3E7H (1～999) |
| 03H/06H/10H | 0040H (DT00064)<br>0041H (DT00065) | Alarm value (Instantaneous active power) | 0.01kW | Sign-less 32bit | 0H～F423FH (1～999999) |
| 03H/06H/10H | 0042H (DT00066) | VT ratio | 0.01 | Sign-less 16bit | 64H～270FH (100～9999) |
| 03H/06H/10H | 0043H (CT00067) | Current threshold for time measurement | 0.1% | Sign-less 16bit | AH～3E8H (10～1000) |
| 03H/06H/10H | 0044H (DT00068) | Cutoff current | 0.1% | Sign-less 16bit | AH～1F4H (10～500) |
| 03H/06H/10H | 0096H (DT00150)<br>0097H (DT00151) | Load ON-time | 0.1h | Sign-less 32bit | 0H～F423FH (0～999999) |
| 03H/06H/10H | 0098H (DT00152)<br>0099H (DT00153) | Load OFF-time | 0.1h | Sign-less 32bit | 0H～F423FH (0～999999) |
| 03H/06H/10H | 009AH (DT00154)<br>009BH (DT00155) | Pulse count value | — | Sign-less 32bit | 0H～F423FH (0～999999) |

| | | | | | |
|---|---|---|---|---|---|
| 03H/06H/10H | 009EH (DT00158)<br>009FH (DT00159) | Preset value | — | Sign-less 32bit | 0H～F423FH (0～999999) |
| 03H/06H/10H | 00A0H (DT00160)<br>00A1H (DT00161) | Pre-scale value | 0.001 | Sign-less 32bit | 1H～186A0H (1～100000)<br>＊Decimal point is fixed. |
| 03H/06H/10H | 00A2H (DT00162) | Max. counting speed | Hz | Sign-less 16bit | 1EH (30), 7D0H (2000) |
| 03H/06H/10H | 00A3H (DT00163) | Auto-off time | min | Sign-less 16bit | 0H～63H (0～99) |
| 03H/06H/10H | 00A4H (DT00164) | Display unit | — | Sign-less 16bit | 0H(0):CNT, 1H(1): l , 2H(2): kl , 3H(3): m3 |
| 03H | 00AAH (DT00170)<br>00ABH (DT00171) | Voltage L1V (Between 1 and 2) | 0.1V | Sign-less 32bit | 0H～1869FH (0～99999) |
| 03H | 00ACH (DT00172)<br>00ADH (DT00173) | Voltage L2V (Between 2 and 3) | 0.1V | Sign-less 32bit | 0H～1869FH (0～99999) |
| 03H | 00B0H (DT00176)<br>00B1H (DT00177) | Instantaneous power | 0.01kW | Sign-less 32bit | 0H～F423FH (0～999999) |

note 1) 03H: Read 06H/10H: Write
note 2) Data register except specified is “0”.
note 3) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM’s life short. Avoid to usage like this.
note 4) Write a data within the range when you write it.

# Chapter 8 Specifications

## 8-1 Main unit

<table>
<tr><td>Rated operating voltage</td><td colspan="2">100-120/200-240V AC</td></tr>
<tr><td>Rated frequency</td><td colspan="2">50/60Hz common</td></tr>
<tr><td>Rated power consumption</td><td colspan="2">8VA</td></tr>
<tr><td>Allowable operating voltage range</td><td colspan="2">85-132/170-264V AC（85%～110% of rated operating voltage）</td></tr>
<tr><td>Allowable momentary power-off time</td><td colspan="2">10ms</td></tr>
<tr><td>Ambient temperature</td><td colspan="2">-10～+50℃（-25℃ to +70℃ at storage）</td></tr>
<tr><td>Ambient humidity</td><td colspan="2">30～85%RH（at 20℃ non-condensing）</td></tr>
<tr><td>Breakdown voltage (initial)</td><td>Between the isolated circuits:<br>2000V for 1min<br>note) Cut-off current: 10mA<br>However protective varistor excluded.</td><td rowspan="2">【Use as a Power meter】<br>・Insulated circuit<br>（Between ①－②, ②－③, ①－③）<br>①Power terminal<br>(1(R),2(N,S),3(T)),<br>CT input terminal<br>(CT1(+),CT2(+),CT1,2(-))<br>②RS-485 terminal(+,-)<br>③Pulse output terminal(+,-)<br>・Outer edge (case)－all terminals<br>【Use ad a Pulse counter】<br>・Insulated circuit<br>(Between ①－②, ②－③, ①－③)<br>①Power terminal (1(R),2(N)),<br>Pulse input terminal (CT1 (+), 0V)<br>②RS-485 terminal (+,-)<br>③Pulse output terminal (+,-)<br>・Outer edge (case)－all terminals</td></tr>
<tr><td>Insulation resistance (initial)</td><td>Between the isolated circuits:<br>100MΩor more<br>(measured with 500V DC)</td></tr>
<tr><td>Vibration resistance</td><td colspan="2">10 to 55Hz (1cycle/min) single amplitude: 0.75mm(1h on 3 axes)</td></tr>
<tr><td>Shock resistance</td><td colspan="2">Min. 294m/s$^2$ (5 times on 3 axes)</td></tr>
<tr><td>Display method</td><td colspan="2">6-digit, 7-segment LCD with backlight (Setting value)<br>4-digit, 16-segment (Mode) LCD<br>Upper section: Green, Lower section: Amber</td></tr>
<tr><td>Power failure memory method</td><td colspan="2">EEP-ROM (more than 100,000 overwrite)</td></tr>
<tr><td>Protection</td><td colspan="2">IEC Standard IP66 (only front panel with rubber gasket)<br>Note) Mounted in a row, waterproofing property will be lost.</td></tr>
<tr><td>Weight</td><td colspan="2">approx.130g (11-pin type), approx.140g (Screw terminal type)</td></tr>
</table>

## 8-2 Input Specifications

8-2-1 Power Input

| | | |
|---|---|---|
| Measuring item | Power | Instantaneous electric power **(kW)** |
| | | Integrated electrical energy **(kWh, MWh)** |
| | Voltage | Each phase Voltage (Between 1 and 2, 2 and 3) **(V)** |
| | Current | Each phase Current<br>(L1(CT1)-phase current, L2(CT2)-phase current) **(A)** |
| | Electricity charge | Integrated electricity charge **(JPY, $ ,EUR,CNY)** |
| | Power-on time | Hour Meter (Load ON-time, Load OFF-time) **(hour)** |
| Phase and wire system | | Single-phase two-wire system<br>Single-phase three-wire system<br>Three-phase three-wire system |
| Input voltage | Rating | Single-phase two-wire : 100-120/200-240V AC（common）<br>Single-phase three-wire : 100-120V AC<br>Three-phase three-wire : 200-240V AC |
| | Allowance | 85% to 110% of rated input voltage |
| | Allowable measurement voltage | Single-phase two-wire : 85-132/170-264V AC（common）<br>Single-phase three-wire : 85-132V AC<br>Three-phase three-wire : 170-264V AC |
| | VT ratio | 1.00～99.99 (Set with setting mode)<br>**※Voltage transformer (VT) is required when you measure a load with voltage over 200V system.**<br>**※Secondary current rating of commercial VT is 110V.** |
| | Max. measured voltage | 9999.9V |
| Input current | Primary side rating | <In case using dedicated CT><br>・5A/50A/100A/250A/400A (Select with setting mode)<br><In case using 5A CT with secondary rating 5A><br>・1～999.9A (Set with setting mode) (MEWTOCOL type)<br>・1～4000A (Set with setting mode) (MODBUS type)<br>**※Use a commercial CT with secondary side current of 5A when measuring 400A or more.**<br>**※Accuracy coverage：10～100% of rated current of CT** |
| | CT ratio | ・1～999 (Set with setting mode) (MEWTOCOL type)<br>・1～4000 (Set with setting mode) (MODBUS type)<br>**※In case measuring CT of secondary rated current 5A.** |
| | Max. measured current | ・ 999.9A (MEWTOCOL type)<br>・6000.0A (MODBUS type) |
| Special functions | Cut-off current | 1.0～50.0%F.S |
| | Hour meter threshold current | 1.0～100.0%F.S |
| Allowable measured instantaneous electric power | | 0.00～9999.99kW |
| Allowable measured integrated electrical energy | | ・Display with 6-digit: 0.00kWh～9999.99MWh<br>・Display with 9-digit: 0.00kWh～9999999.99kWh |
| Allowable measured time (Power ON/OFF time) | | 0.0～99999.9h |
| Allowable measured electricity charge | | Yen (JPY) : 0~999999<br>Dollars ($) : 0~9999.99<br>Euros (EUR) : 0~9999.99<br>Yuan (CNY) : 0~9999.99 |

| | | |
|---|---|---|
| Accuracy (without error in CT and VT) | Basic accuracy | Instantaneous electric power, Integrated electrical energy<br>Voltage, Current, Electricity charge<br>±2.5% F.S. ±1digit<br>(at 20℃, rated input, rated frequency, power-factor 1)<br>**※Accuracy coverage：10～100% of rated current of CT** |
| | | Hour Meter<br>±0.01%±1digit (at 20℃)<br>(In case power on start or current energizing,±0.01%+1s±1 digit) |
| | Temperature characteristics | ±1.5% F.S. /10℃ ±1digit<br>(Range of –10 to 50℃ based on 20℃ for rated input power-factor 1) |
| | Frequency characteristics | ±1.5% F.S.±1 digit<br>(Frequency change±5% based on rated frequency, for rated input power-factor 1) |

8-2-2 Pulse input specifications

| | | |
|---|---|---|
| Input mode | | Addition (Fixed) |
| Max. counting speed | | 2kHz /30Hz (Select with setting mode) |
| Pulse input | | Min. input signal width:<br>0.25ms (When selected 2kHz) /16.7ms (When selected 30Hz)<br>ON:OFF ratio = 1 : 1 |
| Input signal | | Contact / No contact (open collector)<br>・Impedance when shorted: 1kΩ<br>・Residual voltage when shorted: Max. 2V<br>・Impedance when open: 100kΩ |
| Output mode | | HOLD (Over count) |
| Number of Digit | | 6-digit (0 to 999999)（Selectable with setting mode） |
| Pre-scale setting | Decimal point | Set to 3rd decimal places (Auto-setting) |
| | Range | 0.001～100.000 (Selectable with setting mode) |
| | Unit | 「CNT」/「I」/「kI」/「m3」(Selectable with setting mode)<br>（Count value does not change even if the unit setting is changed during counting.） |

## 8-3 Pulse output (Transistor output) Specifications

| | | |
|---|---|---|
| Number of output point | | 1 point |
| Insulation method | | Optical coupler |
| Output type | | Open collector |
| Output capacity | | 100mA 30V DC |
| Pulse width | | approx. 10ms * |
| ON state voltage drop | | 1.5V or less |
| OFF state leakage current | | 100μA or less |
| Pulse output unit | Power measurement | 0.001/0.01/0.1/1/10/100kWh/Alarm (Selectable with setting mode) |
| | Pulse measurement | HOLD (Over count) |

* We recommend the setting of minimum unit for pulse output for measurement shown as below.
Output pulse: 4 pulse or less per 1sec.
How to calculate
(Unit for pulse output：PL-P)＞(Max. measurement power [kW])／(3600[s]×4 [pulse/s])

**Caution** (1) Improper unit setting may cause miss counting.
(2) If the OFF time is too short, there is a possibility of counting errors.

## 8-4 Communication Specifications

| | | |
|---|---|---|
| Interface | | Conforming to RS-485 |
| Protocol | | MEWTOCOL/MODBUS (RTU) (different model) |
| Isolation status | | Isolated with the internal circuit |
| Number of connected units | | 99 (max.) ※1 ※2 |
| Transmission distance | | 1200m |
| Transmission speed | | 19200/9600/4800/2400bps (selectable with setting mode) |
| Transmission Format | Data length | 8bit/7bit (selectable with setting mode) (MEWTOCOL type)<br>7bit (fixed) (MODBUS type) |
| | Parity | Not available/Odd number/Even number<br>(selectable with setting mode) |
| | Stop bit | 1bit（fixed） |
| Communication method | | Half-duplex |
| Synchronous system | | Synchronous communication method |
| Ending resistance | | approx. 120Ω（built-in）※3 |

◆Factory settings

| Transmission speed (Baud rate) | Data length | Parity | Stop bit | Station no. |
|---|---|---|---|---|
| 19200 bps | 8 bit | Odd number | 1 bit (fixed) | 1 |

※1 For RS-485 converter on the computer side, we recommend SI-35 (from LINE EYE Co.,Ltd.).

※2 When using SI-35, SI-35USB or PLC from Matsushita Electric Works, Ltd. (which can be connected up to 99 units), up to 99 Eco-POWER METER can be connected.
In case using this system with the other devices, up to 31 Eco-POWER METER can be connected.

※3 Change the sliding switch of main unit as a terminal station. (Factory setting; General side)

## 8-5 Dedicated Current Transformer Specifications

| Model No. | | AKW4801 | AKW4802 | AKW4803 | AKW4804 |
|---|---|---|---|---|---|
| Primary side rated current | | 5A / 50A | 100A | 250A | 400A |
| Rated secondary side current | | 1.67mA / 16.7mA | 33.3mA | 125mA | 200mA |
| Winding (Turn) | | 3000 | 3000 | 2000 | 2000 |
| Ratio error | | ±1.0% F.S. | | | |
| Hole Dia (mm) | | φ10 | φ16 | φ24 | φ36 |
| Breakdown voltage (initial) | | AC1000V/1min<br>（Between through hole and output lead wire） | AC2000V/1min<br>（Between through hole and output lead wire） | | |
| Insulation resistance (initial) | | Min. 100MΩ (at DC500V)（Between through hole and output lead wire） | | | |
| Vibration resistance | Functional | 10～55Hz (1 cycle/ minute) single amplitude of 0.375mm<br>(1 hrs. on X, Y and Z axes) | | | |
| | Destructive | 10～55Hz (1 cycle/ minute) single amplitude of 0.15mm<br>(10 min. on X, Y and Z axes) | | | |
| Shock resistance | Functional | Min. 98m/s$^2$ (4 times on X, Y and Z axes) | | | |
| | Destructive | Min. 294m/ s$^2$ (5 times on X, Y and Z axes) | | | |
| Output protection level | | ±7.5V with clamp element | | ±3.0V with clamp element | |
| Permissible clamping frequency | | Approx. 100 times | | | |
| Ambient temperature | | -10 to +50℃ (without frost and non-condensing) | | | |
| Storage temperature | | -20 to +60℃ (without frost and non-condensing) | | | |
| Ambient humidity | | 35～80%RH（at 20℃ non-condensing） | | | |
| Weight | | Approx. 50g<br>(Trunk cable included) | Approx. 80g<br>(Trunk cable included) | Approx. 200g<br>(without trunk cable) | Approx. 300g<br>(without trunk cable) |

**Note) Dedicated current transformers (CT), AKW4801, 4802,4803,4804, are dedicated for low voltage under 440V. They can not be used for high voltage circuit. In case measuring high voltage circuit, make a 2-step construction by combination of a commercial CT of secondary side current 5A for high voltage and the dedicated CT for 5A (AKW4801).**

### 8-6 Self-diagnostic function

If an error occurs, the following indication will be given.

| Indicator | Meaning | Output status | To recover |
|---|---|---|---|
| Err-00 | CPU error | OFF | Turn the power off and then on again. |
| Err-01 | Memory error* | | EEP-ROM life ended. Replace the unit. |

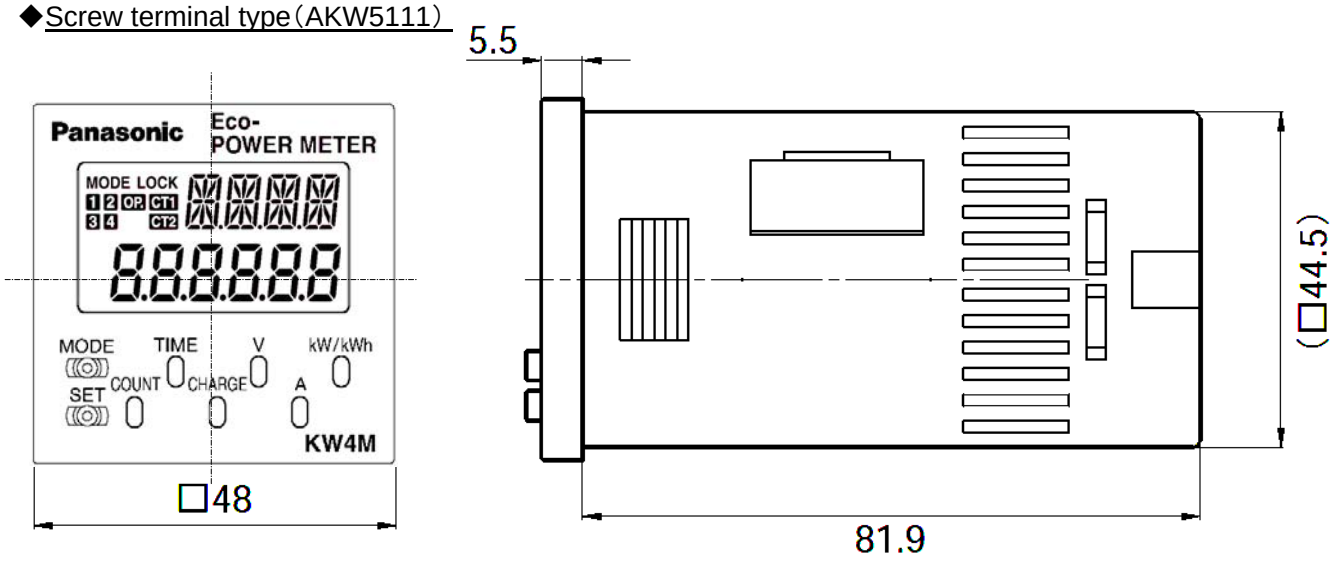
*Includes the possibility that the EEP-ROM's life has expired.

## Chapter 9 Dimensions

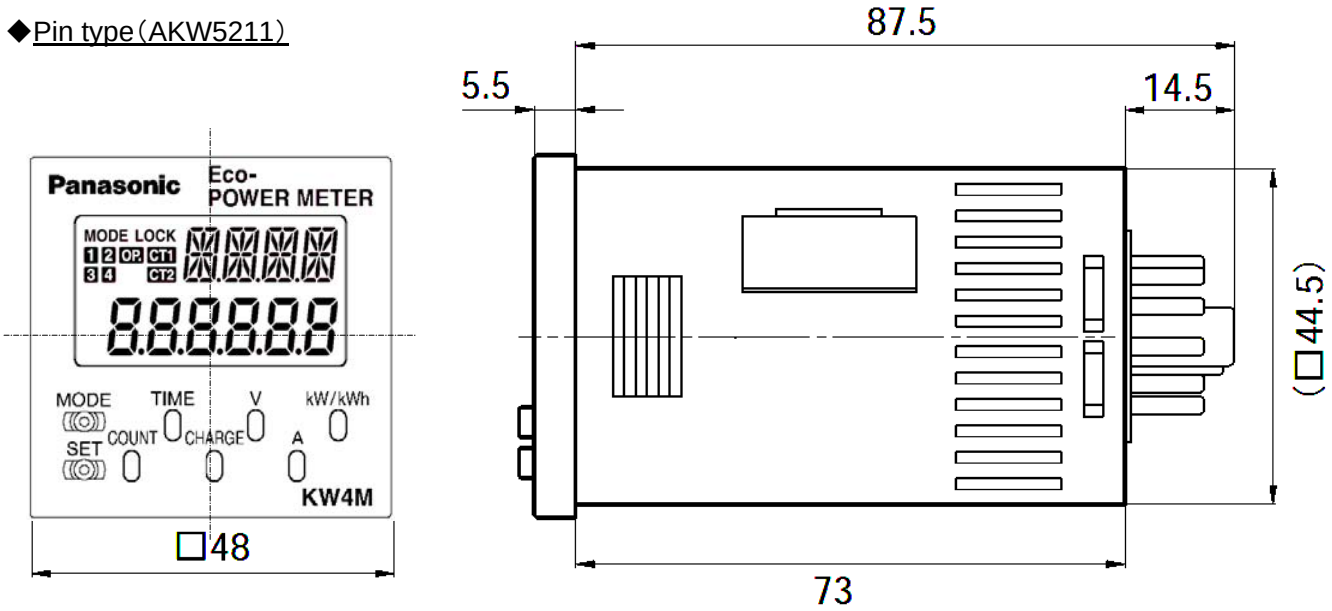
### 9-1 Main unit

(Unit: mm)
(Clearance: ±1.0)

◆Screw terminal type（AKW5111）



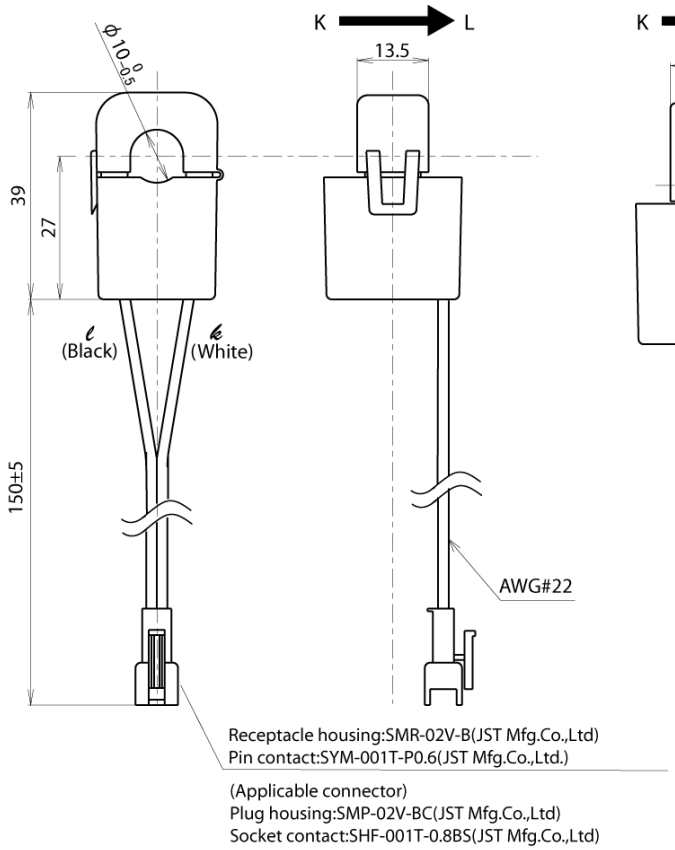

◆Pin type（AKW5211）



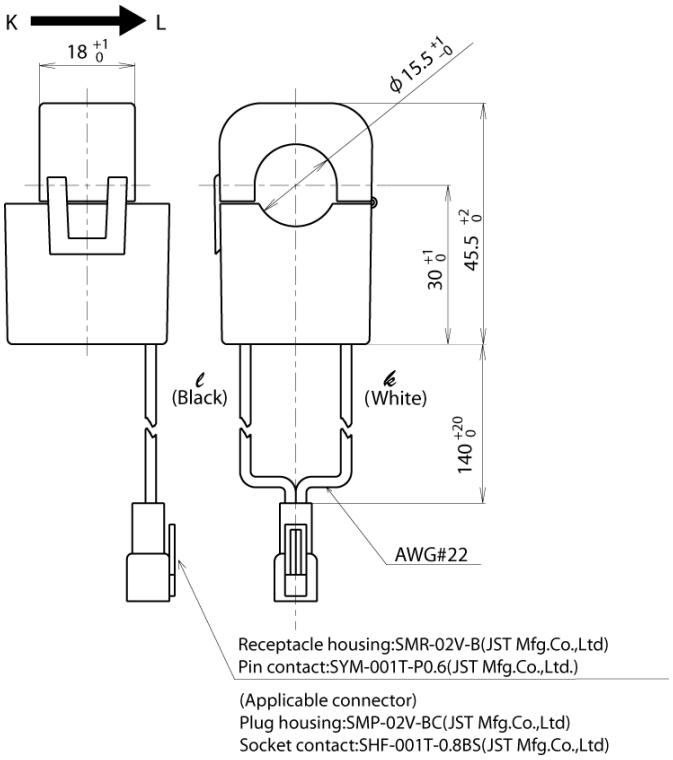
## 9-2 Dedicated CT

(Unit: mm)
(Clearance: ±1.0)

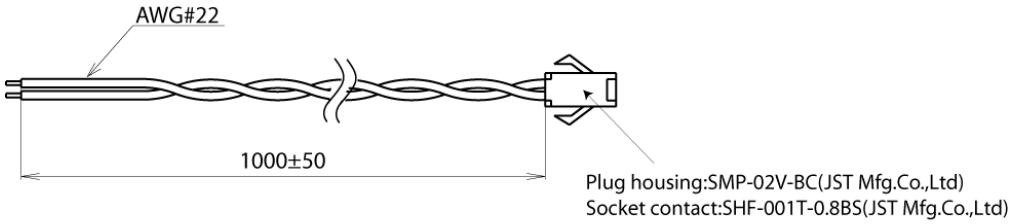
◆For 5A/50A(AKW4801)



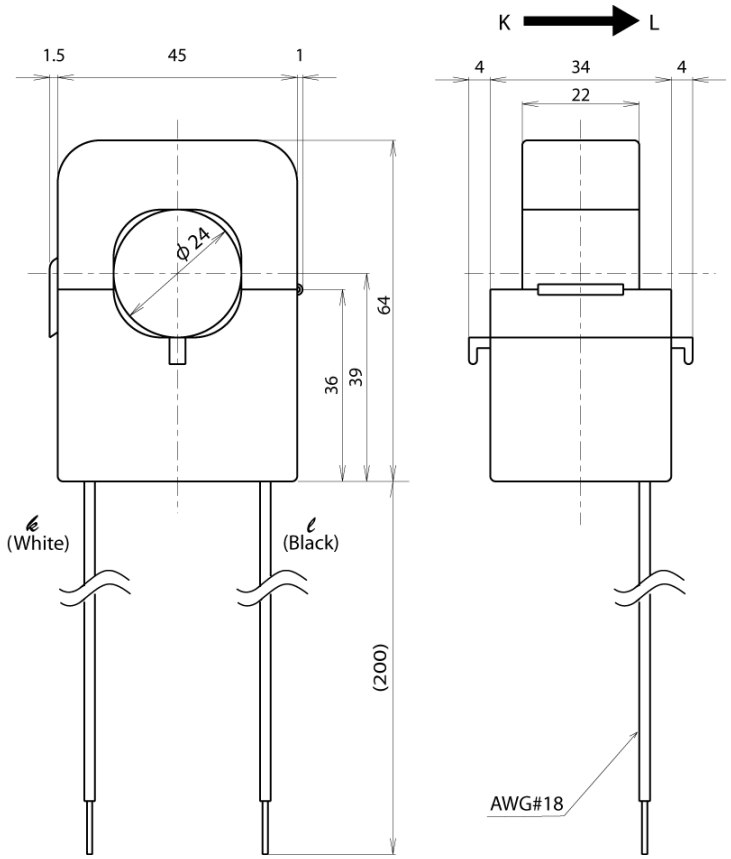

◆For 100A（AKW4802）



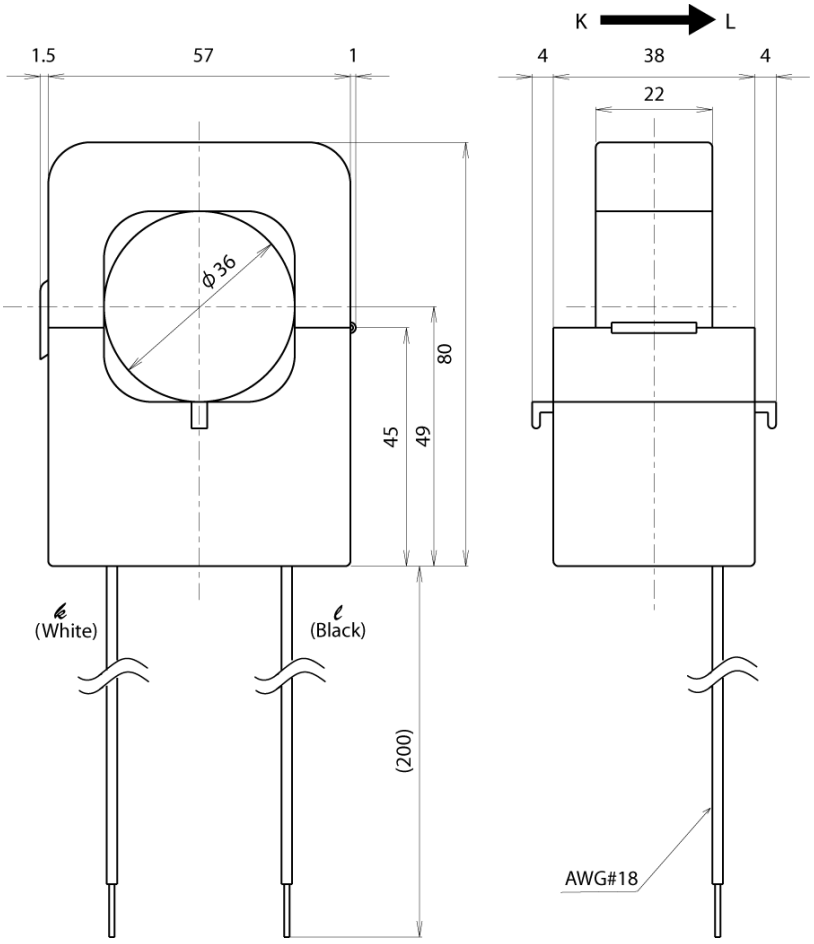

◆Attached trunk cable: L=(1000)



◆For 250A（AKW4803）




◆For 400A（AKW4804）



# Revision History

| Issue Date | Manual no. | Content of revision |
|---|---|---|
| June, 2005 | ARCT1F413E | First edition |
| October, 2007 | ARCT1F413E-1 | Second edition<br>6-3 Wiring:<br>Add the explanation in detail. |
| March, 2008 | ARCT1F413E-2 | Third edition<br>MODBUS type series addition<br>・Model No.<br>・MODBUS communication<br>・MODBUS specifications |
| | | |

Please contact .....


Matsushita Electric Works, Ltd.

Automation Controls Business Unit
Head Office: 1048, Kadoma, Kadoma-shi, Osaka 571-8686, Japan
Telephone: +81-6-6908-1050
Facsimile: +81-6-6908-5781
**http://www.mew.co.jp/ac/e/**





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