Panasonic

KW8M
Eco-Power Meter
User's Manual

KW8M Eco-Power Meter User's Manual
ARCT1F440E-2 '08. 06

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.

- Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
- Do not use this product in areas with inflammable gas. It could lead to an explosion.
- Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

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

- To prevent abnormal exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
- Do not dismantle or remodel the product. It could lead to abnormal exothermic heat or smoke generation.
- Do not touch the terminal while turning on electricity. It could lead to an electric shock.
- Use the external devices to function the emergency stop and interlock circuit.
- Connect the wires or connectors securely. The loose connection might cause abnormal exothermic heat or smoke generation.
- Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It might cause exothermic heat or smoke generation.
- Do not undertake construction (such as connection and disconnection) while the power supply is on.

Copyright and trademark

- Modbus Protocol is a communication protocol that the Modicon Inc.developed for PLC.
- Other company names and the product names are the trademarks or registered trademarks of each company.

Introduction

Thank you very much indeed for purchasing “KW8M Eco-POWER METER”.
In this manual, we explain the usage of “KW8M 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 adopts 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

■With KW8M Eco-POWER METER, electrical power (voltage, current, etc.), power factor, frequency, etc are measured using AC voltage and AC current input via one of the following systems: single-phase two-wire system, single-phase three-wire system, three-phase three-wire system or three-phase four-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

Model No	Log function
AKW8111	Not available
AKW8111H	Available

(Common)

Phase and Wire system	Power supply	Measured voltage input	Measured current input	Current transformer	Terminal type
・Single-phase two-wire ・Single-phase three-wire ・Three-phase three-wire ・Three-phase four-wire	100-240V AC 50/60Hz	・400VAC ・100/200VAC	・ 50A ・100A ・250A ・400A	Dedicated CT type (5A,50A(common) /100A/250A/400A)	Screw Terminal (M3⊕screw)

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	Model No	Remarks
Terminal cover	AKT8801	-----
Spare Battery *1)	AFC8801	Required to back up memory and calendar

*1) This is attached to AKW8111H when shipped.

1-3 Measurement items

Item		Unit	Data range
Integrated electric power	Active	kWh	0.00 to 9999999.9
	Reactive	kvarh	0.00 to 9999999.9
	Apparent	kVAh	0.00 to 9999999.9
Instantaneous electric power	Active	kW	0.00 to 999999.99
	Reactive	kvar	-99999.99 to 0.00 to 999999.99
	Apparent	kVA	0.00 to 999999.99
Current	CT1	A	0.0 to 6000
	CT2	A	0.0 to 6000
	CT3	A	0.0 to 6000
Voltage	Between P1-P0	V	0.0 to 9999
	Between P2-P0	V	0.0 to 9999
	Between P3-P0	V	0.0 to 9999
Electricity charge ※			0.00 to 99999999
Power Factor	Unit display		0.00 to 1.00 (LEAD: Leading phase, LAG: lagging phase)
	Communication		-1.00 to 0.00 to 1.00 (Within the range of phase angle θ=-90 to 0 to 90 degree)
Frequency	Hz		47.5 to 63.0
Hour meter	ON-time	hour	0.0 to 99999.9
	OFF-time		
Pulse counter			0 to 99999999

※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

①Display indicator ・Lighting or Blinking according to the display

②LOCK indicator ・Lighting while in lock mode

③T/R indicator ・Blinking while communication

④OUT indicator ・Lighting when pulse output

⑤Display each value ・Display each measured value
・Display each setting value

⑥MODE Key

⑦SET Key

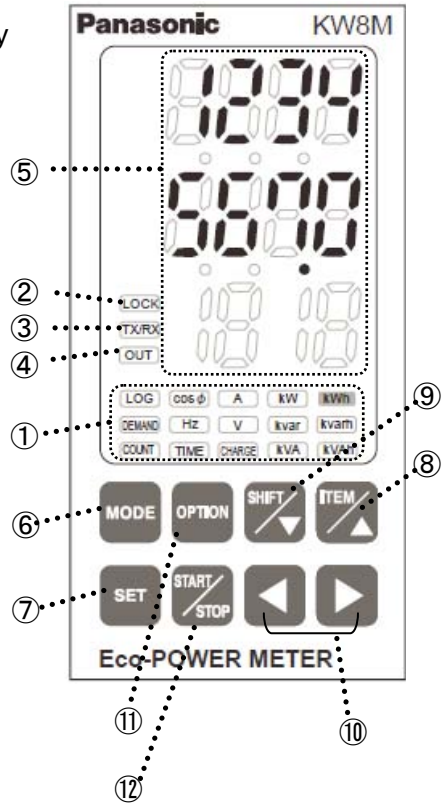
⑧ITEM / △ Key

⑨SHIFT / ▽ Key

⑩Left / Right (◁ /▷) Keys

⑪OPTION Key

⑫START/STOP Key



2-2 Select Keys' Functions

Key	Functions
⑥ **<MODE>**	・Use to select mode
⑦ **<SET>**	・Use to set each value entered
⑧ < ITEM / △ >	・To select measured display ・To shift each mode ・To change each setting value
⑨ < SHIFT / ▽ >	・To select measured display ・To shift each mode ・To change each setting value
⑩ **< Left / Right (◁ / ▷)>**	・To change each setting value
⑦ + ⑥ **<SET> + <MODE>**	・To reset the measured value
⑦ **<SET>** **(continuous press 3-sec)**	・All keys locked ・Release lock mode while in lock mode
⑪ **<OPTION>**	・To shift power monitoring mode and option mode (Only AKW8111H)
⑫ **<START/STOP>**	・To start and stop measuring integrated electric power (active) for arbitrary period. (from press this key until press it again) (Only AKW8111H)

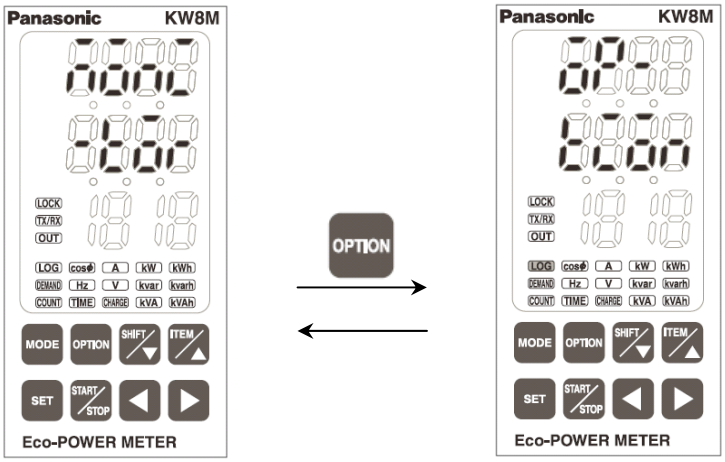
Chapter 3　Display of each Value

3-1 Working of Monitor Display

Turn on the power supply and it shifts displays for power monitoring mode and it for option mode by pressing <SHIFT> key. After selecting mode, it shifts to each measurement display in 1 second.
*Option mode is the function only for AKW8111H. AKW8111 doesn't have the option mode.

Power Monitoring Mode　　Option Mode

Monitor　　Option



Displayed measurement items are as below.

Power Monitoring Mode "Monitor"

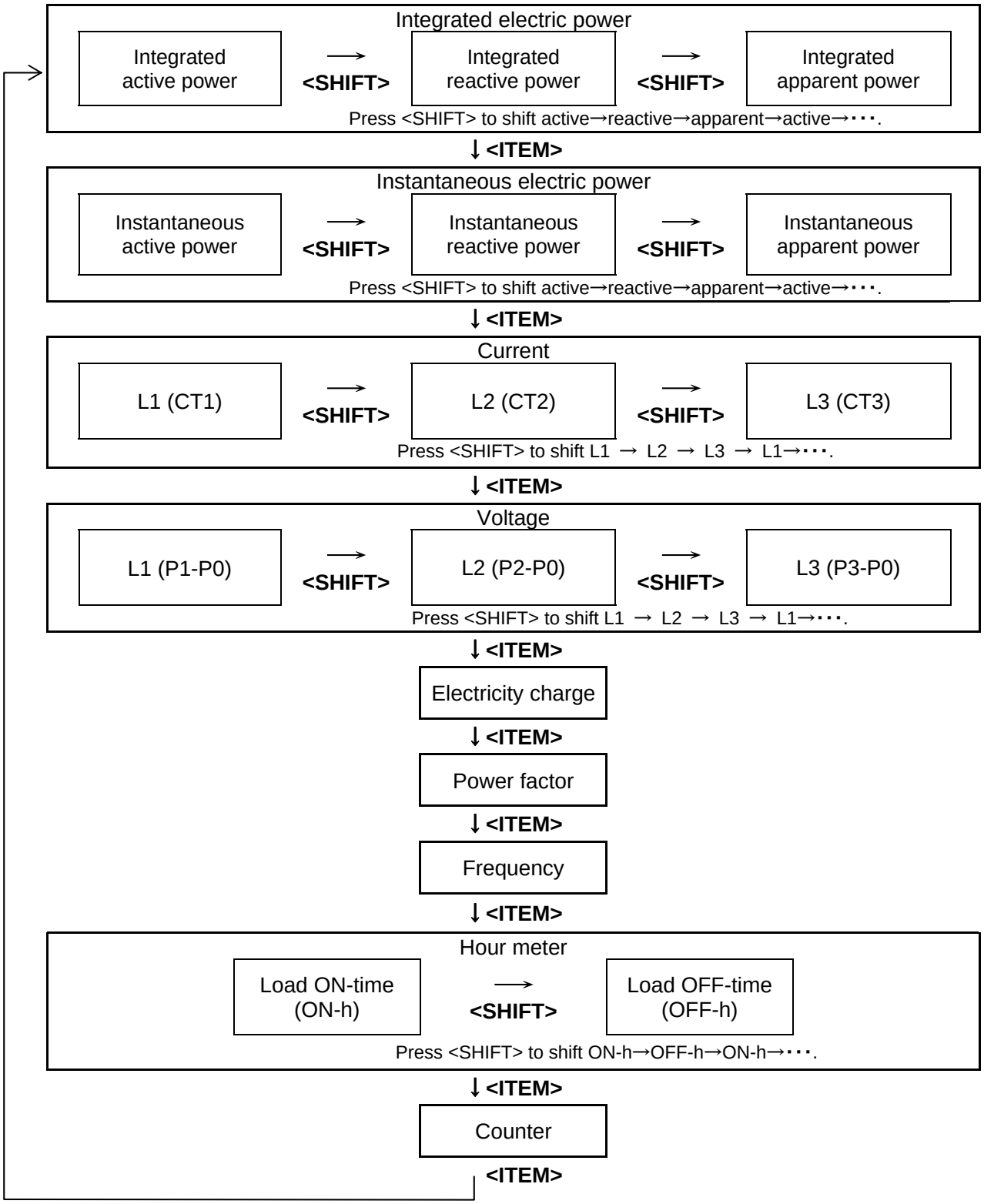
- ・Integrated electric power (Active, Reactive, Apparent)
- ・Instantaneous electric power (Active, Reactive, Apparent)
- ・Current (CT1,CT2,CT3)
- ・Voltage (Between P1-P0, Between P2-P0, Between P3-P0)
- ・Electricity charge
- ・Power Factor
- ・Frequency
- ・Hour meter
- ・Pulse counter

Option Mode "Option"

- ・Monthly integrated electric power (Active, Reactive, Apparent)
  Daily integrated electric power (Active, Reactive, Apparent)
  Hourly integrated electric power (Active, Reactive, Apparent)
- ・Integrated electric power (Active) for arbitrary period
- ・Calendar

3-2 Outline for the Working of Power Monitoring Mode Display

It displays measured value as below with Power Monitoring Mode.

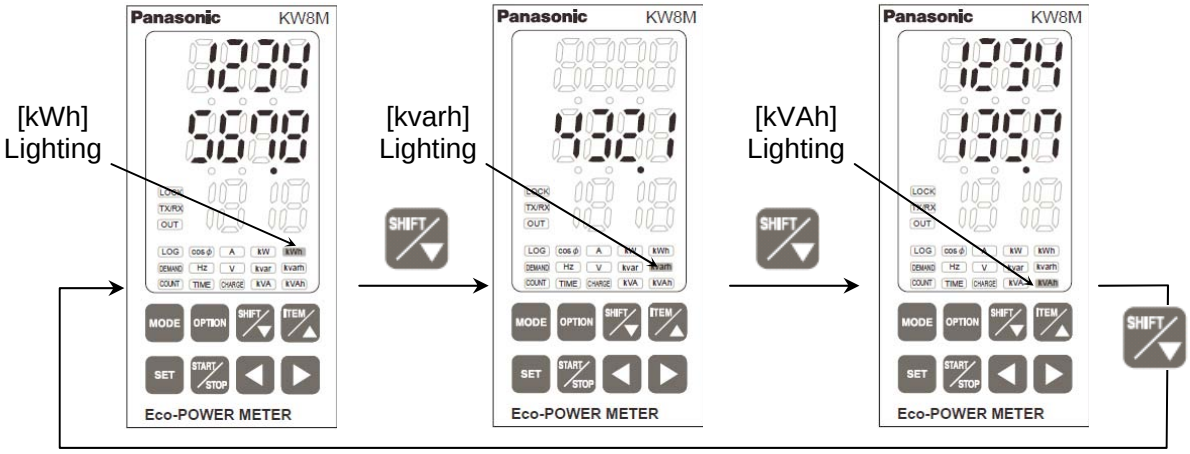


3-3 Integrated Electric power

・Power on to display the integrated electric power.

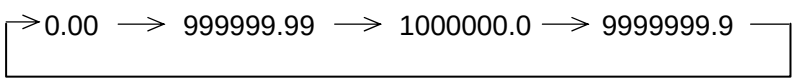
・Press <SHIFT>key to shift active power, reactive power, apparent power.

Integrated active power (kWh)	Integrated reactive power (kvarh)	Integrated apparent power (kVAh)
Sample of 1234567.8kWh	Sample of 432.1kvarh	Sample of 1234135.7kVAh



・Integrated electric power is measured and displayed from 0.00 to 9999999.9 (kWh/kvarh/kVAh).

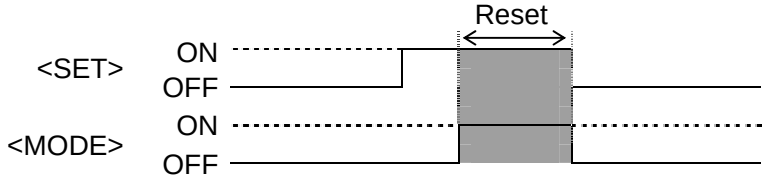
・The decimal point is changed automatically.



(After reaching the full-scale (9999999.9), the value reverts to 0.00 but continues to measure.)

How to reset the integrated electric power (active/reactive/apparent)

・Hold down <SET>key and press <MODE>key makes integrated electric power clear.
(Active power, reactive power, apparent power are reset by each.)



3-4 Instantaneous Electric power

・Press <ITEM> key to display the Instantaneous electric power.

・Press <SHIFT> key to shift active power, reactive power, apparent power.

Instantaneous active power (kW)

Instantaneous reactive power (kvar)

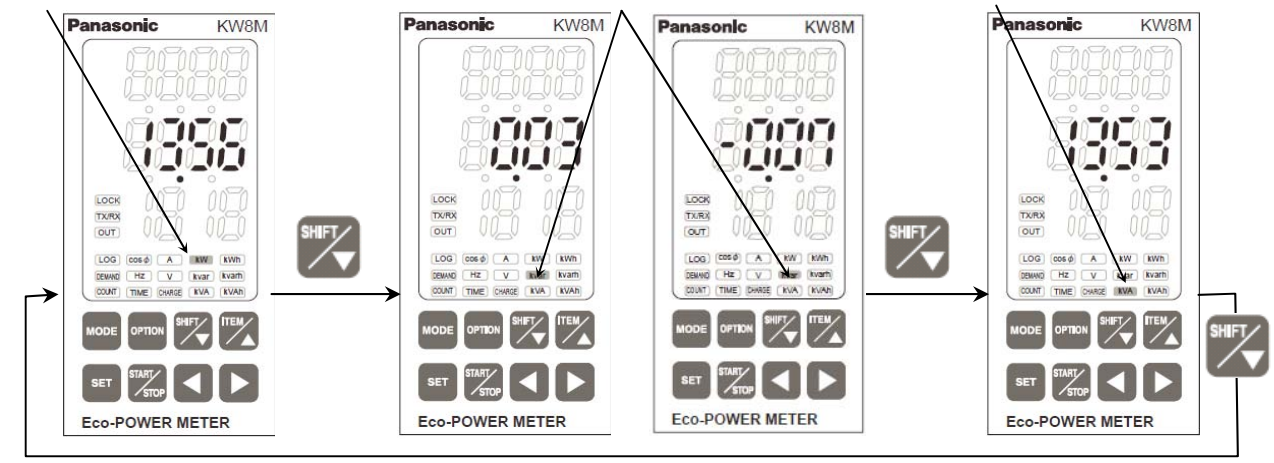
Instantaneous apparent power (kVA)

Sample of 13.56kW	Sample of (+)0.03kvar	Sample of -0.07kvar	Sample of 13.53kVA

[kW] Lighting

[kvar] Lighting

[kVA] Lighting



*Instantaneous reactive power is “－(minus)” value when leading phase and it shows “－(minus)“ in the display. It is “+ (plus)” value when lagging phase, but it doesn’t show “+ (plus)”.

3-5 Current

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

・Press <SHIFT>key to change L1(CT1)-phase, L2(CT2)-phase, L3(CT3)-phase current.

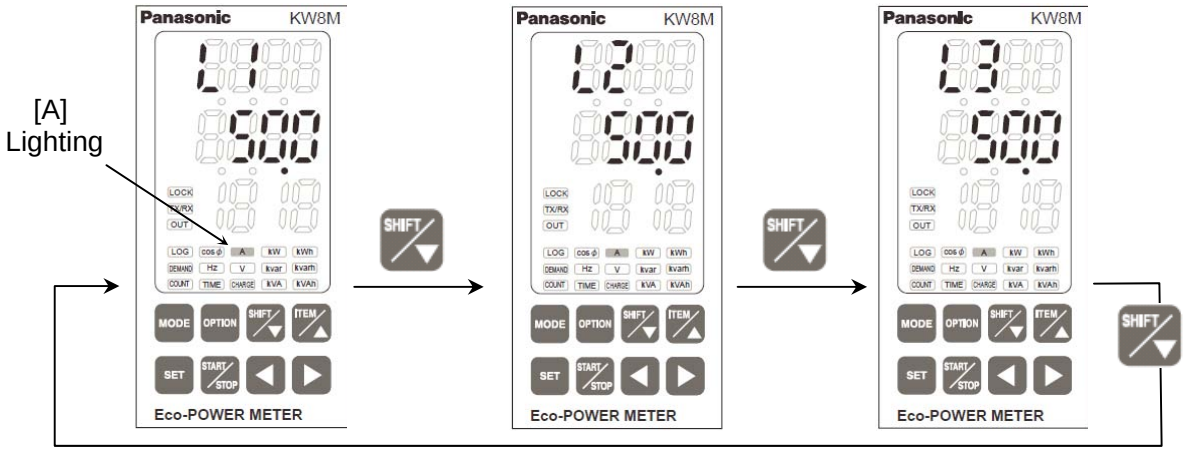
※Before start measuring, select phase and wire system according to the measured load.

When Single-phase 3-wire or Three-phase 3-wire is selected, it doesn't measure Single-phase 2-wire system correctly. When Three-phase 4-wire system is selected, it doesn't measure Single-phase 2-wire, Single-phase 3-wire, Three-phase 3-wire system correctly.

Select phase and wire system according to the measured system. (Refer to the explanation of setting mode.)

L1 (CT1)-phase current (A) **L2 (CT2)-phase current (A)** **L3 (CT3)-phase current (A)**

Sample of L1-phase 50.0A | Sample of L2-phase 50.0A | Sample of L3-phase 50.0A



・When input current exceeds 150%F.S. at each range,「 」will be displayed.

・Current measurement parts

Eco-POWER METER measures the current as below.

Display / System	L1 (CT1)	L2 (CT2)	L3 (CT3)
Single-phase two-wire	L1-phase current	-	-
Single-phase three-wire	L1(R)-phase current	L2 (S)-phase current	-
Three-phase three-wire	L1(R)-phase current	L2 (T)-phase current	-
Three-phase four-wire	L1(R)-phase current	L2 (S)-phase current	L3 (T)-phase current

3-6 Voltage

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

・Press <SHIFT>key to change voltage between P1 and P0, P2 and P0, P3 and P0.

※Before start measuring, select phase and wire system according to the measured load.

When Single-phase 3-wire or Three-phase 3-wire is selected, it doesn't measure Single-phase 2-wire system correctly. When Three-phase 4-wire system is selected, it doesn't measure Single-phase 2-wire, Single-phase 3-wire, Three-phase 3-wire system correctly. Select phase and wire system according to the measured system. (Refer to the explanation of setting mode.)

Voltage between P1 and P0 (V)

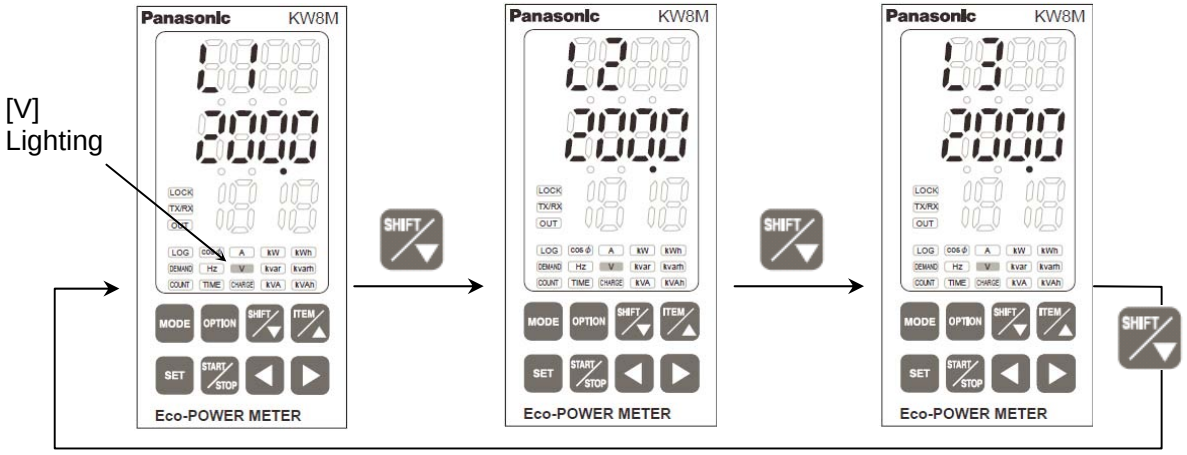
Sample of P1-P0 200.0V

Voltage between P2 and P0 (V)

Sample of P2-P0 200.0V

Voltage between P3 and P0 (V)

Sample of P3-P0 200.0V



・When input voltage is under 10.0V at 200V range, and when input voltage is under 20.0V at 400V range, it displays "0.0" and doesn't measure.

・When input voltage exceeds 150%F.S. at each range,「 」will be displayed.

・Voltage measurement parts

Eco-POWER METER measures the voltage as below.

Display / System	L1V	L2V	L3V
Single-phase two-wire	Voltage between P1 and P0	---	---
Single-phase three-wire	Voltage between P1 and P0	Voltage between P2 and P0	---
Three-phase three-wire	Voltage between P1 and P0	Voltage between P2 and P0	---
Three-phase four-wire	Voltage between P1 and P0	Voltage between P2 and P0	Voltage between P3 and P0

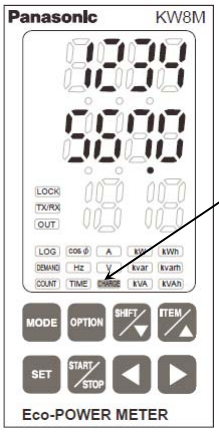
3-7 Electricity Charge

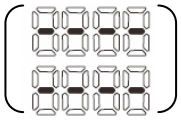
It displays the standard electricity charge for the integrated electrical power.

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

Electricity Charge

Sample of 1234567.8



※When the value exceeds '99999999',  will be displayed.

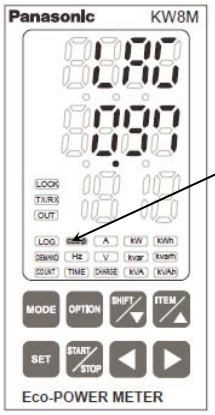
3-8 Power factor

・Press <ITEM>key to display the loads' power factor.

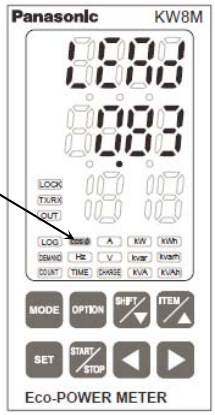
※Before start measuring, select phase and wire system according to the measured load. When selected system does not meet it, it can not measure correctly. (Refer to the explanation of setting mode.)

Power factor

Sample of lagging phase 0.97



Sample of leading phase 0.83

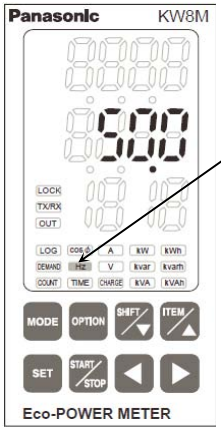


3-9 Frequency

・Press <ITEM>key to display the frequency.

Frequency

Sample of 50.0



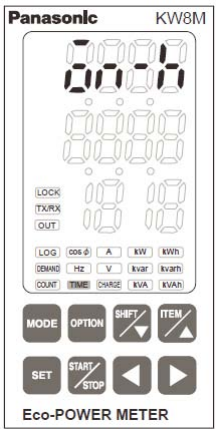
3-10 Hour meter

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

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

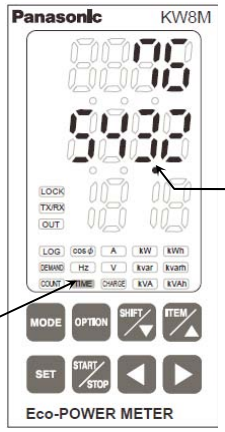
＊”ON-h” and “OFF-h” display disappears after a few seconds by pressing <ITEM> key or <SHIFT> key.

ON-time (h)



after a few seconds

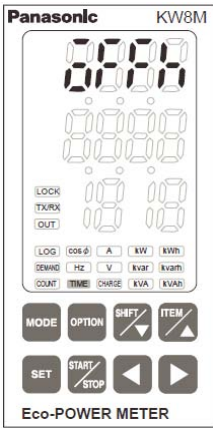
Sample of 76543.2h



Blinking the decimal point during measurement of ON-time

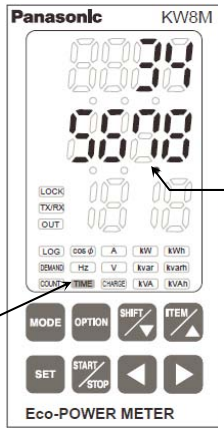
[TIME] Lighting

OFF-time (h)



after a few seconds

Sample of 34567.8h

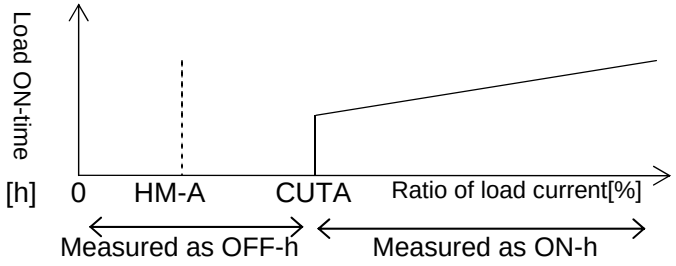


Blinking the decimal point during measurement of OFF-time

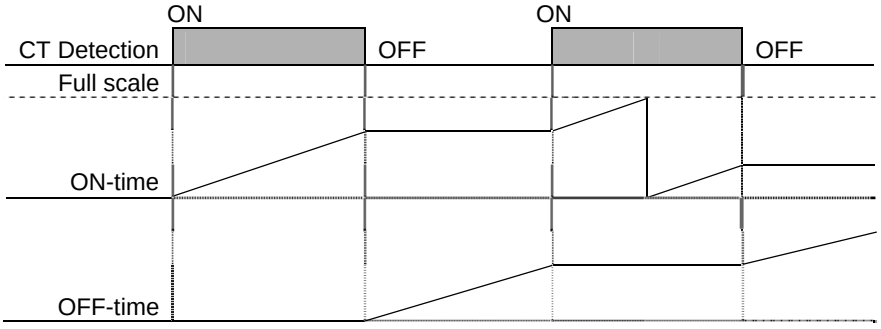
[TIME] Blinking

＊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

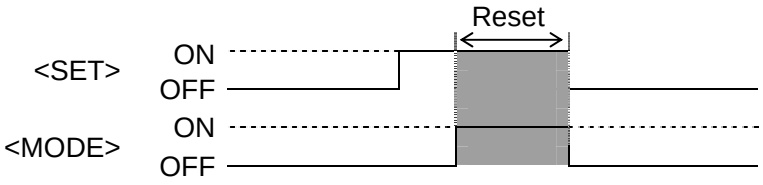


∗After reaching the full scale (99999.9h), the value reverts to 0.0h but continues to measure.



How to Reset ON/OFF-time

・Hold down <SET>key and press <MODE>key makes ON-time or OFF-time clear.
(ON-time and OFF-time are reset by each.)



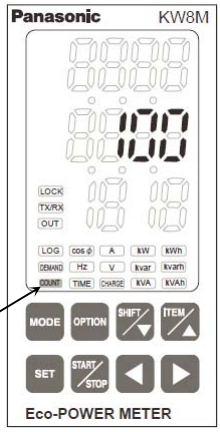
3-11 Counter

It displays present count value (pulse input value).

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

Count value (COUNT)

Sample of 100



[COUNT] Lighting

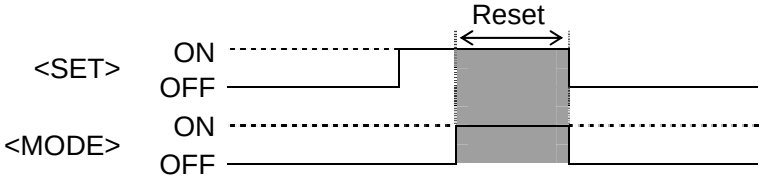
∗After reaching the full scale (99999999), the value reverts to 0 but continues to measure.

How to enter preset value

・It is entered and set at preset setting mode of MODE1. (Refer to the explanation of setting mode.)

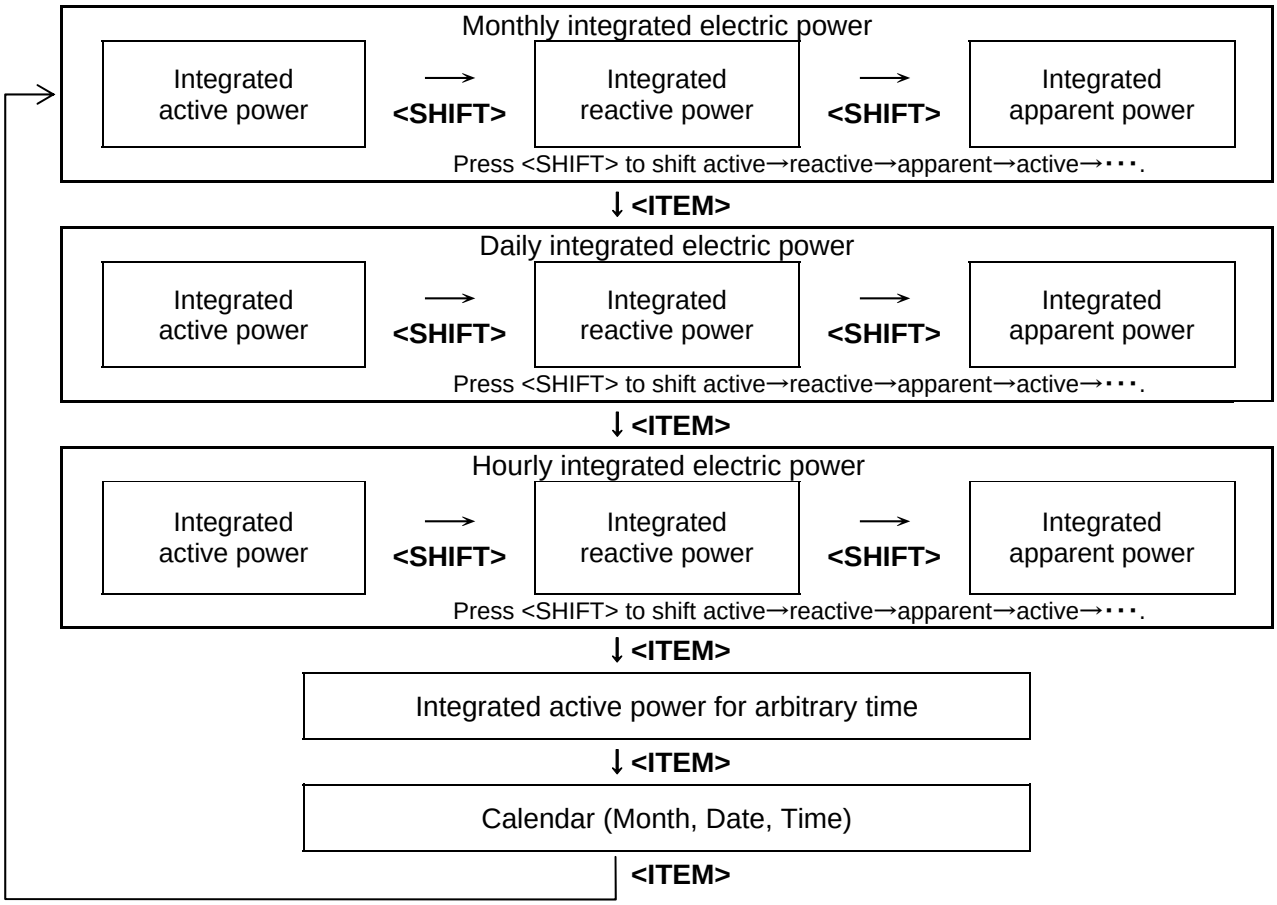
How to Reset Count value

・Hold down <SET>key and press <MODE>key makes count value clear.



3-12 Outline for the Working of Option Mode Display (only for AKW8111H)

It displays measured value as below with Option Mode.



3-13 Monthly integrated electric power (only for AKW8111H)

・Press <OPTION> key to display Monthly integrated electric power.
You can check a log data for 3 months (max.).
・Press <SHIFT> key to shift active power, reactive power, apparent power.
・Press <◁ >< ▷> key to change the month. *It doesn't shift to next month of calendar display.
・Period of month is designated as below table.

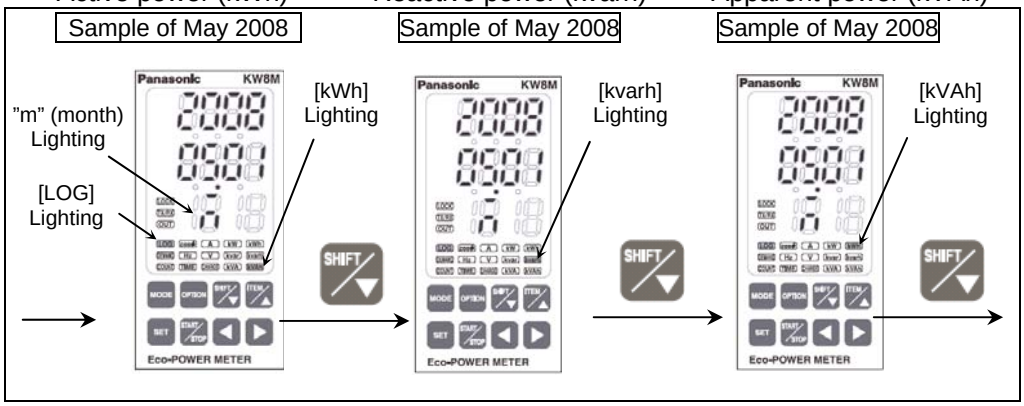
(Example)

Display (Lower line)	04.01 (April)		05.01 (May)		06.01 (June)	
Measuring period	From	To	From	To	From	To
	April 1st 00:00:00	April 30th 23:59:59	May 1st 00:00:00	May 31st 23:59:59	June 1st 00:00:00	June 31st 23:59:59

Monthly integrated electric power

Active power (kWh) | Reactive power (kvarh) | Apparent power (kVAh)

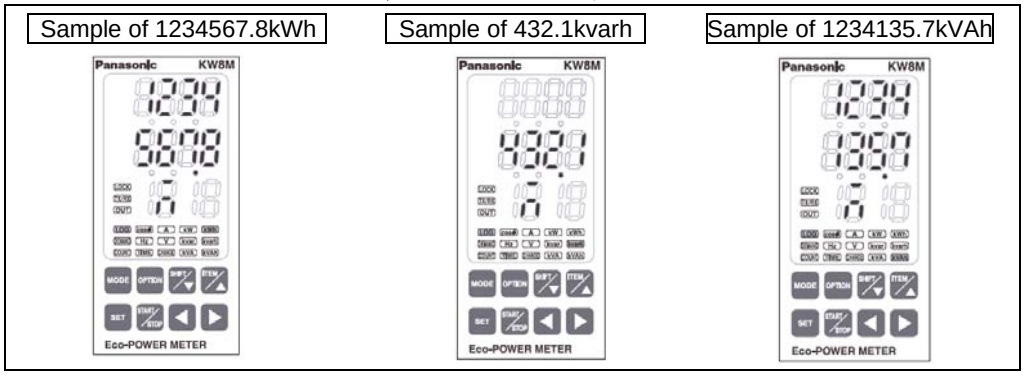
Press <SHIFT> to shift active -> reactive -> apparent.



Press SHIFT key

Auto change after 2 seconds

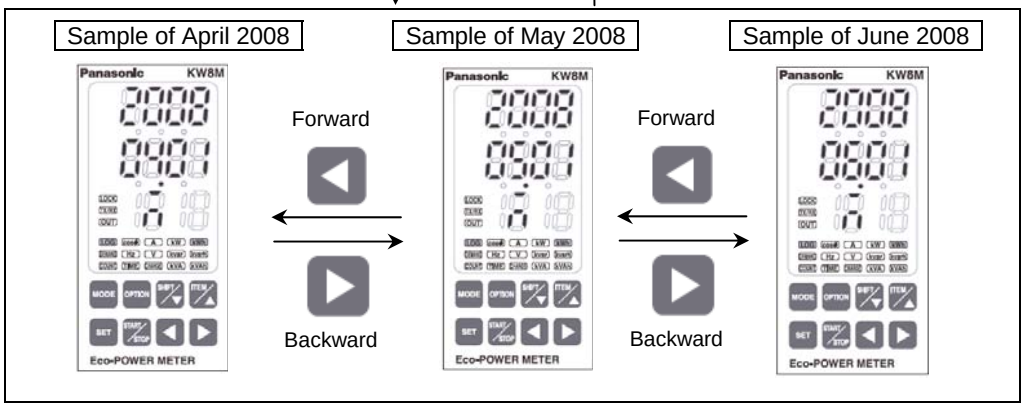
Select month and it displays monthly integrated power after 2 seconds



Press ◁ ▷ key

Auto change after 2 seconds

When date or electric power is displayed, press <◁/▷> key to change months.

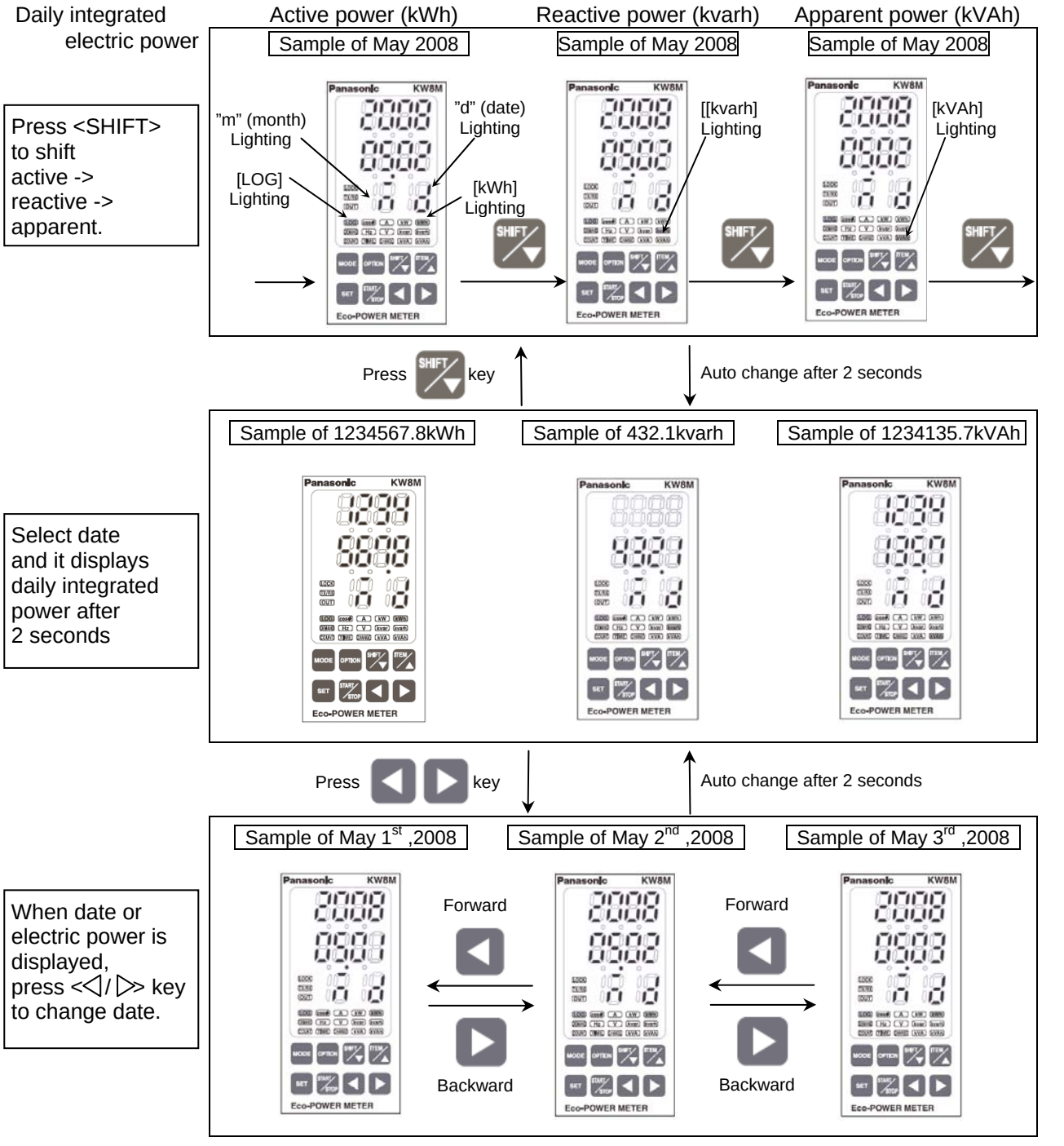


3-14 Daily integrated electric power (only for AKW8111H)

・Press <ITEM> key to display Daily integrated electric power.
You can check a log data for 93 days (max.).
・Press <SHIFT> key to shift active power, reactive power, apparent power.
・Press <◁ >< ▷> key to change the date. *It doesn't shift to next date of calendar display.
・Period of day is designated as below table.

(Example)

Display (Lower line)	05.01 (1st)		05.02 (2nd)		05.03 (3rd)	
Measuring period	From	To	From	To	From	To
	May 1st 00:00:00	May 1st 23:59:59	May 2nd 00:00:00	May 2nd 23:59:59	May 3rd 00:00:00	May 3rd 23:59:59

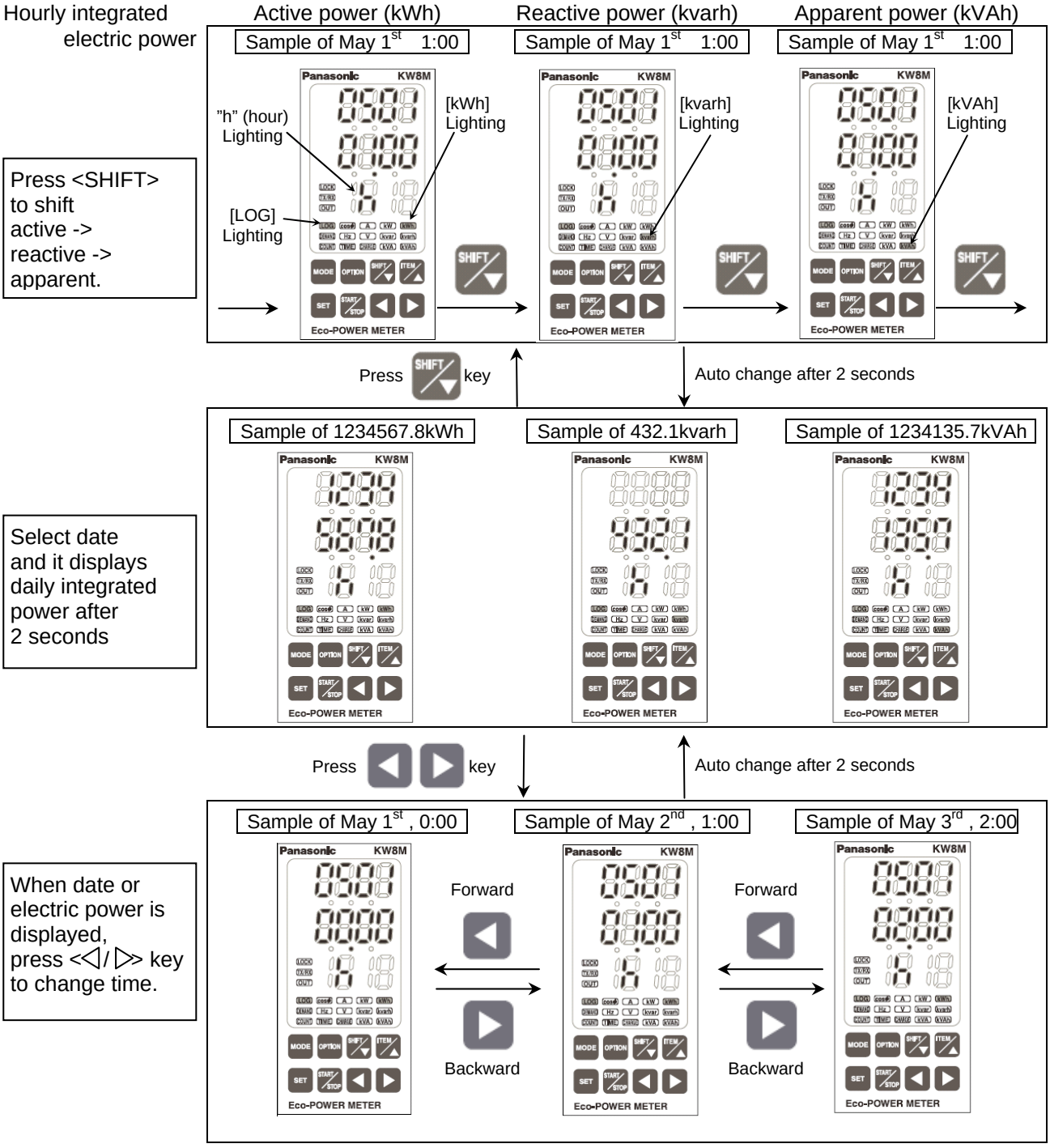


3-15 Hourly integrated electric power (only for AKW8111H)

・Press <ITEM> key to display Hourly integrated electric power.
You can check a log data for 2232 hours (max.).
・Press <SHIFT> key to shift active power, reactive power, apparent power.
・Press <◁ >< ▷> key to change the time. *It doesn't shift to next hour of calendar display.
・Period of hour is designated as below table.

(Example)

Display (Lower line)	00.00		01.00		02.00	
Measuring period	From	To	From	To	From	To
	00:00:00	00:59:59	01:00:00	01:59:59	02:00:00	02:59:59

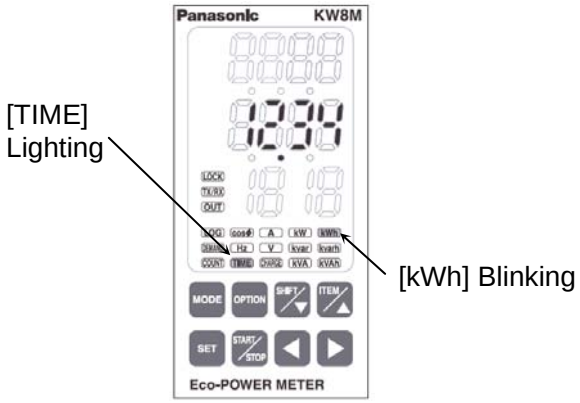


3-16 Integrated electric power (active) for arbitrary period (only for AKW8111H)

・You can measure an integrated electric active power for arbitrary period.
・Press <ITEM> key to display the Integrated electric active power.
・Press <START/STOP> key to start measuring.
・Press <START/STOP> key again to stop measuring.

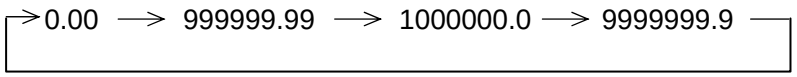
Integrated electric power (active) for arbitrary period

Sample of 12.34kWh



*Blinking the decimal point during measurement.

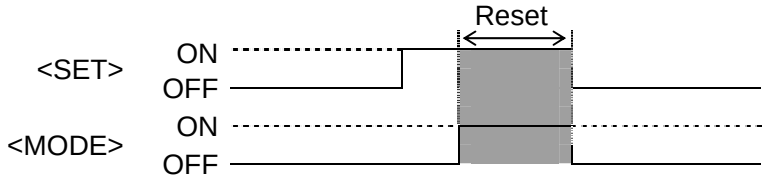
・Integrated electric power is measured and displayed from 0.00 to 9999999.9 (kWh).
・The decimal point is changed automatically.



(After reaching the full-scale (9999999.9), the value reverts to 0.00 but continues to measure.)

How to reset the integrated electric power (active)

・Hold down <SET> key and press <MODE> key makes integrated electric power clear.



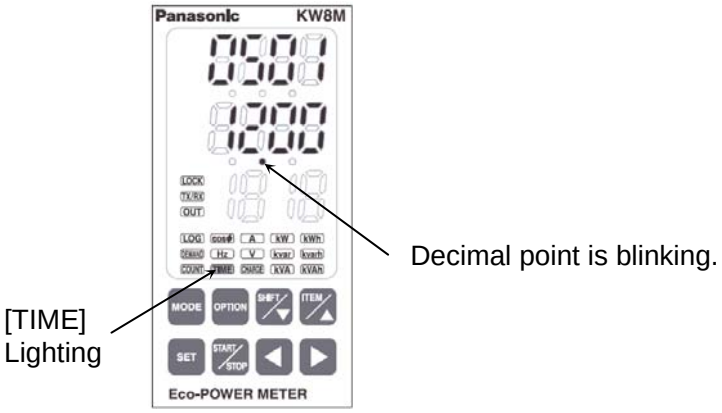
3-17 Calendar Timer (only for AKW8111H)

・It displays the present time.

・Press <ITEM> key to display the month, day and time.

Calendar timer

Sample of May 1st, 12:00



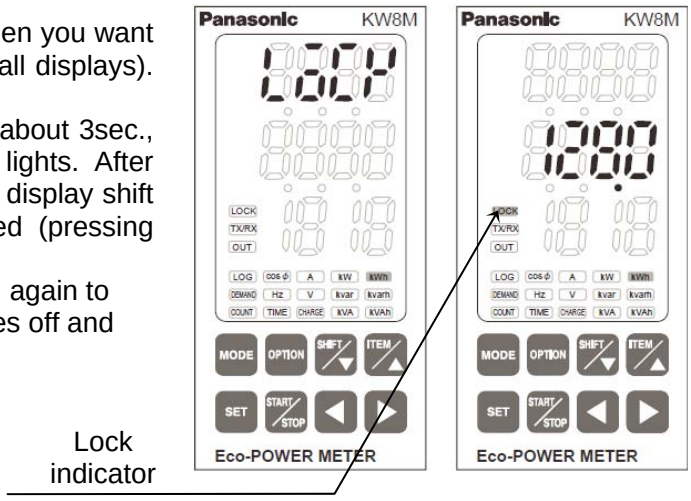
Chapter 4 Various Functions

4-1 LOCK mode

It is the mode makes all keys unable. Use when you want to fix one of the measurement displays (For all displays). In this mode, you can not input by any keys.

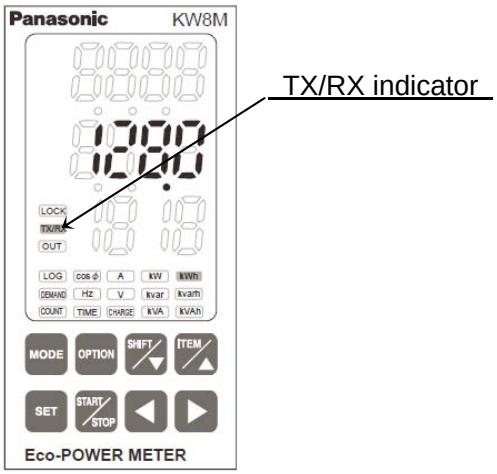
When you press <SET>key continuously for about 3sec., the “LOCK” is displayed and the indicator lights. After about 3 sec., “LOCK” is disappeared and the display shift to previous display. All keys become locked (pressing them will have no effect).

Press <SET>key continuously for about 3sec. again to release Lock mode. The “LOCK” indicator goes off and the lock mode is released (unlocked).



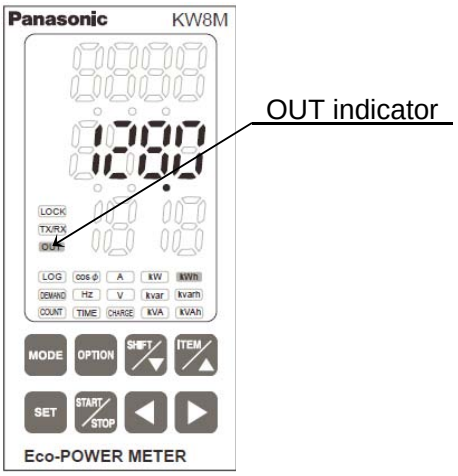
4-2 Display while communication

TX/RX indicator is blinking while Eco-POWER METER is under communication.



4-3 Display when pulse output

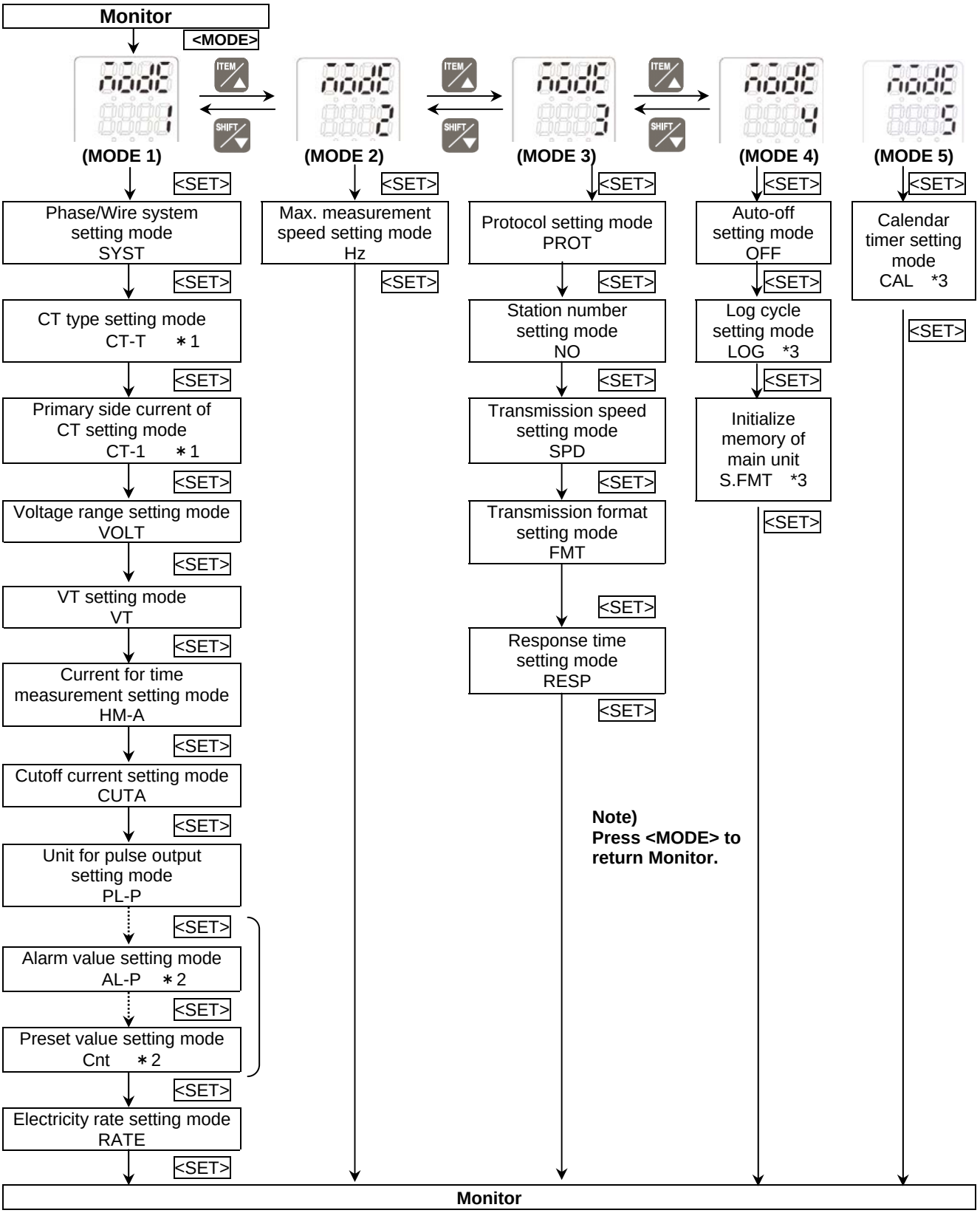
OUT indicator is lighting when pulse output.



Chapter 5 Settings

5-1 Operation procedure

- MODE1: Setting for power measurement
- MODE2: Setting for pulse measurement
- MODE3: Setting for serial communication (RS485)
- MODE4: Setting for optional function



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

＊2 Alarm value setting mode/Preset value setting mode is only when ‘ALARM’ or ‘Cnt’ is selected on Unit for pulse output setting mode.

5-2 Setting Mode Explanation

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

5-2-1 MODE1

(Mode for setting each parameter for power measurement.)

Phase/Wire system setting mode SYST

Mode defines phase and wire system to measure.

・Select from Single-phase 2-wire / Single-phase 3-wire / Three-phase 3-wire / Three-phase 4-wire.

※When Single-phase 3-wire or Three-phase 3-wire is selected, it doesn't measure Single-phase 2-wire system correctly. And when Three-phase 4-wire is selected, it doesn't measure Single-phase 2-wire, Single-phase 3-wire, Three-phase 3-wire system correctly. Select the accurate phase and wire system according to the measured system.

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 side 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.

・Primary side current of the existing CT can be set the range of 1 to 4000 (Initial 5).

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

ex) If primary current of measured existing CT is 400A(secondary side is 5A), set to "400".

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

Voltage range setting mode VOLT

Mode defines voltage range of Eco-Power Meter.

・Select from 400/200.

・When it measures load of 400V system, select "400".
When it measures load of 100/200V system, select "200".

※In case measuring the load of 100/200V system with selecting "400", the resolution will be down. Select the correct voltage range.

VT setting mode VT

Mode defines voltage input method to the main unit, input voltage directly or uses a voltage transformer (VT) (over 440V system).

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

Current for time measurement setting mode HM-A

Mode defines for time measured current. It 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 measure (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 electric power is not added.

・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 added.

Unit for pulse output setting mode **P L - P**

Mode defines unit used for pulse output.

・Select from 0.001/0.01/0.1/1/10/100/AL-P/Cnt.

When one of the “0.001/0.01/0.1/1/10/100” [kWh] is set, one pulse is output at reaching the setting value.

When “AL-P” is set, alarm is output at the time when instantaneous active power is over the setting value.

When “Cnt” is set, it output at the time when count value reaches preset value set by preset value setting mode.

Alarm value setting mode **A L - P**

Mode defines instantaneous electric power used for alarm output.

・It is set the range of 0.00 to 999999.99kW.

※This mode is only when “AL-P” is selected on unit for pulse output setting mode.

Preset value setting mode **A L - P**

Mode defines count value used for output.

・It is set the range of 0 to 99999999.

※This mode is only when “Cnt” is selected on unit for pulse output setting mode.

Electricity charge setting mode **RATE**

Mode defines electricity charge ratio used as a standard per 1kWh.

・It can be set the range of 0.00 to 99.99 /1kWh. (Initial 10.00)

Mode1 Setting flow chart

Monitor

↓ **<MODE>**

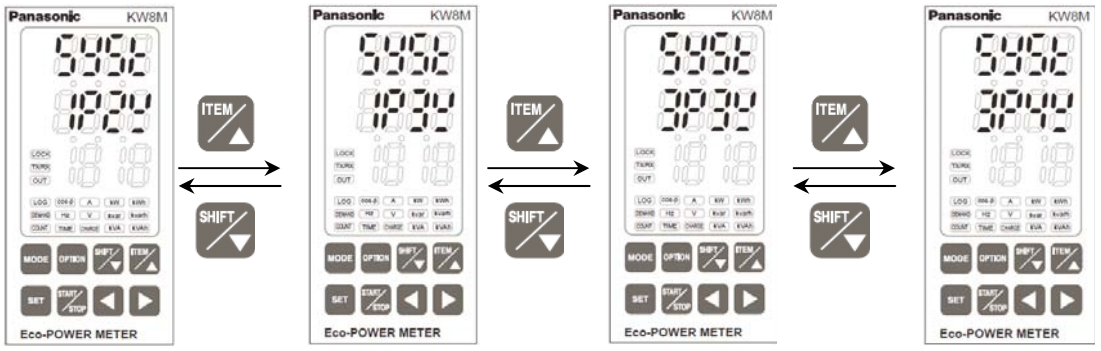
MODE1 display

↓ **<SET>**

Phase/Wire system setting mode

Press **<△>, <▽>** to change Phase/Wire system.

System is selected from Single-phase 2-wire ⇔ Single-phase 3-wire ⇔ Three-phase 3-wire ⇔ Three-phase 4-wire.



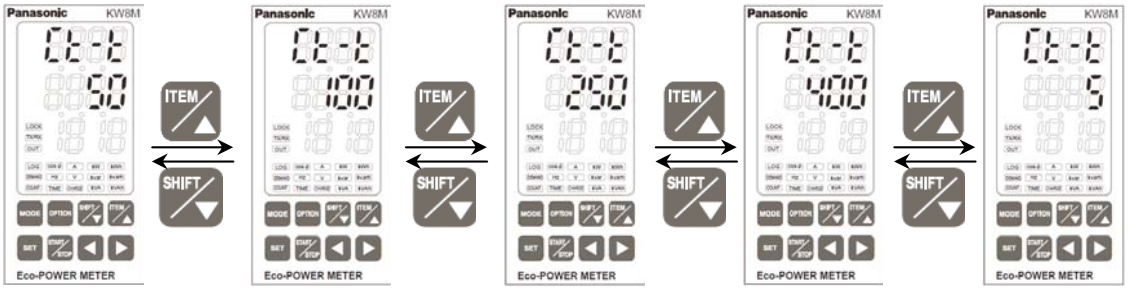
1P2W 1P3W 3P3W 3P4W

→ **<SET>**

CT type setting mode

Press **<△>, <▽>** to change CT type.

CT type is selected from 50 ⇔ 100 ⇔ 250 ⇔ 400 ⇔ 5.



50 100 250 400 5

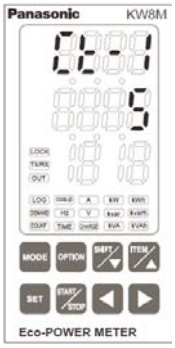
→ **<SET>**

Primary side current of CT setting mode

Enter primary side current of CT using **<△>, <▽>, <◁>, <▷>**.

If measured CT is 100A/5A, set to 100. If 5A is measured, set to 5.

(1～4000, Initial 5)



ITEM △ Increase value

SHIFT ▽ Decrease value

▷ Shift place to set

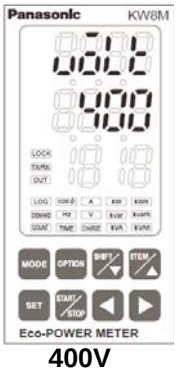
◁ Shift place to set

→ **<SET>**

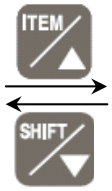
*It is only when “5A” is selected on CT type setting mode.

Voltage range setting mode

Press **<Δ>, <∇>** to change voltage range.
Voltage range is selected from 400V ⇔ 200V.



400V

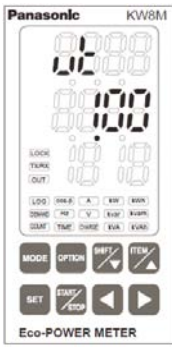


200V

→ **<SET>**

VT ratio setting mode

Enter VT ratio using **<Δ>, <∇>, <◁>, <▷>**.
If the VT is 440/110, set to “4.00”.



(1.00～99.99)

Increase value

Decrease value

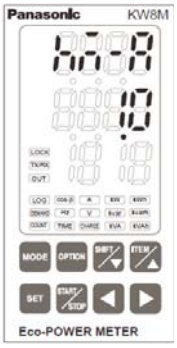

Shift place to set


Shift place to set

→ **<SET>**

Current for time measurement setting mode

Enter current for time measurement using **<Δ>, <∇>, <◁>, <▷>**.
If you measure the current over 50.0%F.S, set to “50.0”.



(1.0～100.0)

Increase value

Decrease value


Shift place to set


Shift place to set

→ **<SET>**

Cutoff current setting mode

Enter cutoff current using **<△>, <▽>, <◁>, <▷>**.
If you don't measure the current under 10.0%F.S, set to "10.0".
(1.0 ～50.0)

ITEM Increase value

SHIFT Decrease value

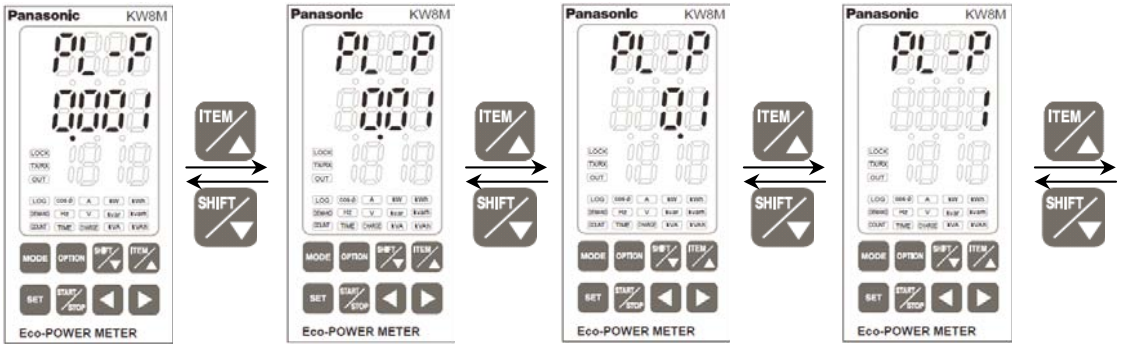
Shift place to set

Shift place to set

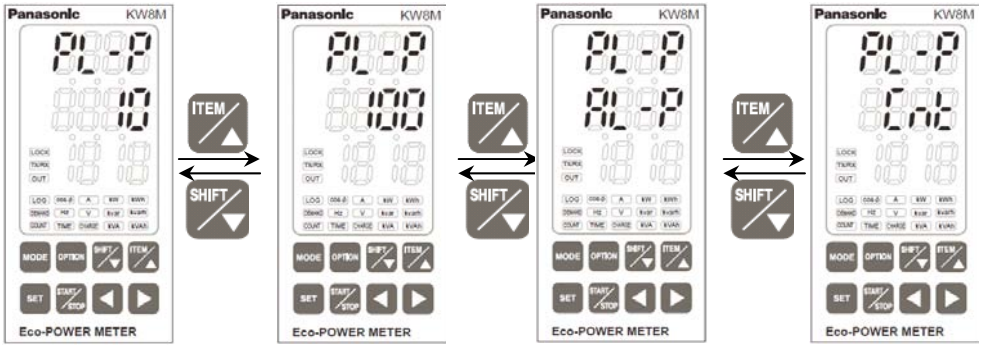
→ **<SET>**

Unit for pulse output setting mode

Press **<△>, <▽>** to change unit for pulse output.
Unit is selected from 0.001 ⇔ 0.01 ⇔ 0.1 ⇔ 1 ⇔ 10 ⇔ 100 ⇔ AL-P(Alarm) ⇔Cnt (Count output).



0.001kWh 0.01kWh 0.1kWh 1kWh

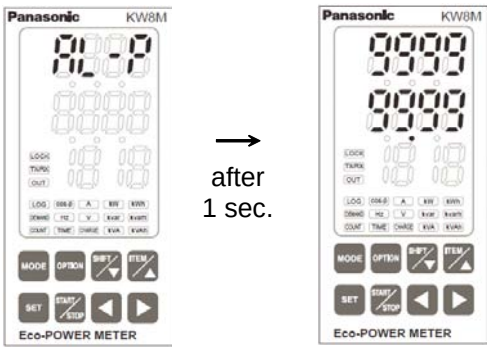


10kWh 100kWh AL-P Cnt

→ **<SET>**

Alarm value setting mode

Display changes to set an alarm value after "AL-P" is displayed at the upper line for 1 sec.
Enter power for alarm using **<△>, <▽>, <◁>, <▷>**. (0.00～999999.99)



→ after 1 sec.

ITEM Increase value

SHIFT Decrease value

Shift place to set

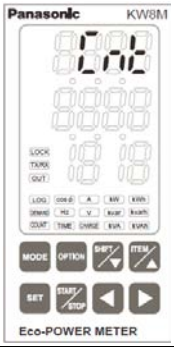
Shift place to set

→ **<SET>**

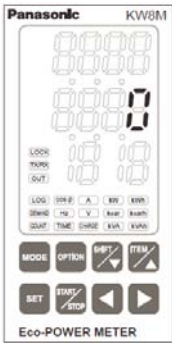
*It is only when "AL-P" is selected on unit for pulse output setting mode.

Preset value setting mode

Display changes to set an alarm value after “Cnt” is displayed at the upper line for 1 sec.
Enter preset value to output using **<△>, <▽>, <◁ >, <▷>**. (0 ～99999999)



→ after 1 sec.



ITEM/△ Increase value

SHIFT/▽ Decrease value

▷ Shift place to set

◁ Shift place to set

→ **<SET>**

Electricity charge setting mode

Enter the rate per 1kWh using **<△>, <▽>, <◁ >, <▷>**.
(0.00～99.99, Initial 10.00)

ITEM/△ Increase value

SHIFT/▽ Decrease value

▷ Shift place to set

◁ Shift place to set

↓ **<SET>**

Monitor

5-2-2 MODE2

(Mode for setting of each parameter for pulse measurement)

Max. counting speed setting mode Hz

Mode defines max. counting speed.

・Select from 2kHz/30Hz

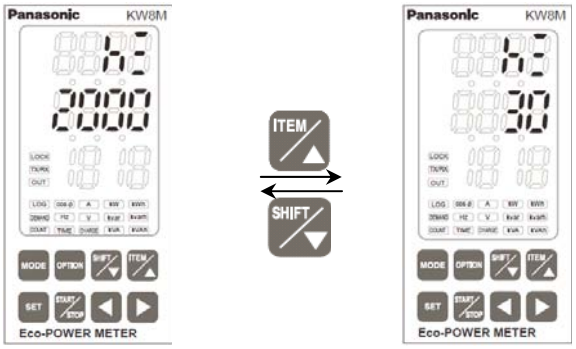
MODE2 Setting flow chart

Monitor

↓ **<MODE>**

MODE2 display

↓ **<SET>**

Max. counting speed setting mode
Press **<△>, <▽>** to change max.counting speed. Max. counting speed is selected from 2000 (2kHz) ⇔ 30(30Hz).
 **2000** **30**

↓ **<SET>**

Monitor

5-2-3 MODE3

(Mode for setting of each parameter for serial communication (RS485))

Protocol setting mode PROT

Mode defines communication protocol of main unit via serial communication (RS485).

・Select from MEWTOCOL / MODBUS(RTU).

Station number setting mode NO.

Mode defines an individual station no. for each unit when two or more units communicate via serial communication (RS485).

・It can be set the range of 01 to 99.

Transmission speed (Baud rate) setting mode SPD

Mode defines serial communication (RS485) 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 (RS485) 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.

"n (none)" means parity is not available.

"E (Even)" means parity is even number.

"o (odd)" means parity is odd number.

※With MODBUS(RTU) protocol, it works only with 8bit.

Response time setting mode RESP

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 99 ms.

MODE3 Setting flow chart

Monitor

↓ **<MODE>**

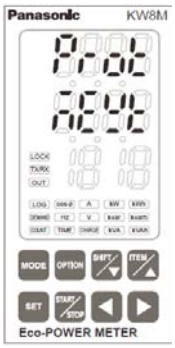
MODE3 display

↓ **<SET>**

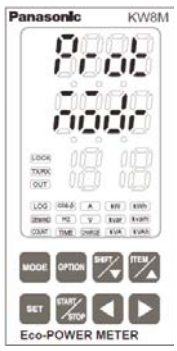
Protocol setting mode

Press **<△>, <▽>** to change communication protocol.

Communication protocol is selected from MEWTOCOL ⇔ MODBUS(RTU).



MEWTOCOL

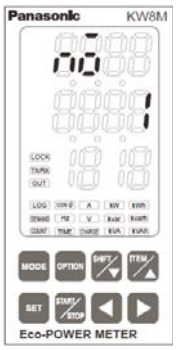


MODBUS (RTU)

→ **<SET>**

Station number setting mode

Enter the station number using **<△>, <▽>, <◁ >, <▷>**.
Station number can be entered the range of 1 to 99.



Increase value

Decrease value

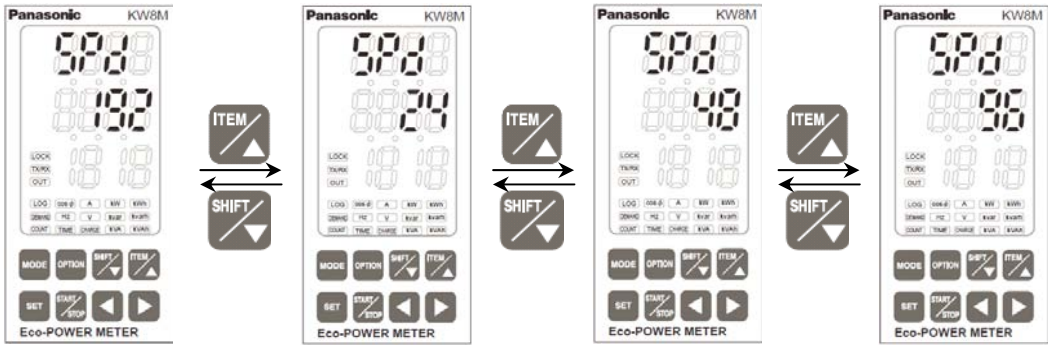
Shift place to set

Shift place to set

→ **<SET>**

Transmission speed setting mode

Press **<△>, <▽>** to change transmission speed.
Transmission speed is selected from 19200 ⇔ 2400 ⇔ 4800 ⇔ 9600.

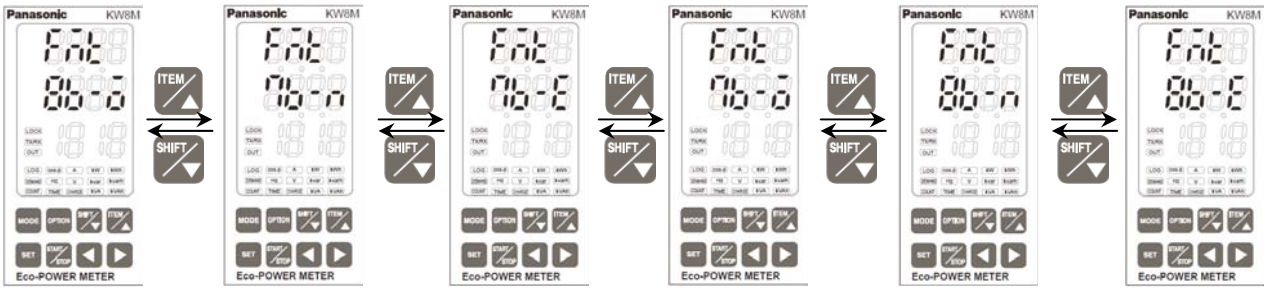


19200bps 2400bps 4800bps 9600bps

→ **<SET>**

Transmission format setting mode

Press **<△>, <▽>** to change transmission format (Data length / Parity).
Transmission format is selected from 8bit-o ⇔ 7bit-n ⇔ 7bit-E ⇔ 7it-o ⇔ 8bit-n ⇔ 8bit-E.
n: not available E: even number o: odd number

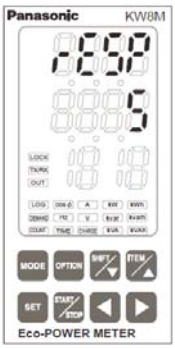


8bit-o 7bit-n 7bit-E 7it-o 8bit-n 8bit-E

↓ **<SET>**

Response time setting mode

Set the response time using **<△>, <▽>, <◁>, <▷>**.
Response time can be entered the range of 5 to 99 ms.



ITEM △ Increase value

SHIFT ▽ Decrease value

▷ Shift place to set

◁ Shift place to set

↓ **<SET>**

Monitor

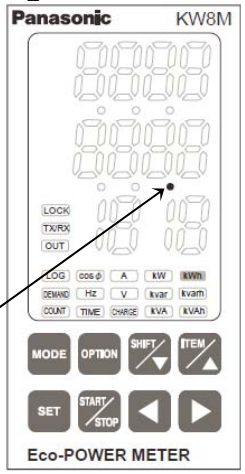
5-2-4 MODE4

(Mode for setting of each parameter for optional function)

Auto-off setting mode OFF

Display 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.
・After turns off the backlight, one decimal point at the right end is blinking.



Decimal point (Right end)

Log cycle setting mode LOG

Mode defines save cycle for selected logging.

・Select from 1/5/10/15/30/60.
・When you'd like to save log data every 1 minute, select "1".

※This setting is log save cycle to read out by some software(Selected logging).
In order to check the log data in the memory, software is required. The recommended software "KW Monitor" is available to download from our website (http://www.mew.co.jp/ac/e) in free of charge.

※Only hourly log data can be checked with the display of Eco-POWER METER.
As for the save cycle of log data (automatic log) displayed in the main unit, it is fixed 60 minute without relations for above setting for 60 minutes.

Initialize memory of main unit S.FMT

Use to initialize memory of main unit.

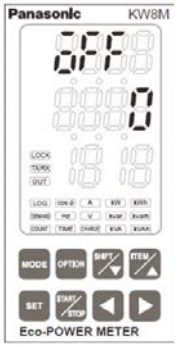
・Select OFF and press <SET>, it doesn't initialize.
・Select ON and press <SET>, it initialize memory of main unit.
※Once it initialized memory, it can not recover.

MODE4 Setting flow chart

Monitor
↓ **<MODE>**
MODE4 display
↓ **< SET >**

Auto-off setting mode

Enter auto-off time by minute using **<△>, <▽>, <◁>, <▷>**.
Auto-off time can be entered the range of 0 to 99.
"0" should be set to turn always light on.
"1~99" should be set to turn light off at setting time (minute).
While light off, press any key to light on.



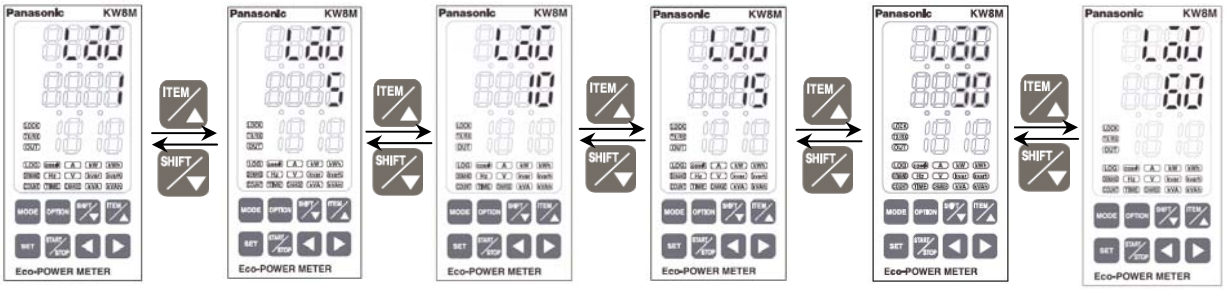
ITEM △ Increase value
SHIFT ▽ Decrease value
▷ Shift place to set
◁ Shift place to set

↓ **< SET >**

Log cycle setting mode

Press **<△>, <▽>** to change save cycle .

Save cycle is selected from 1 ⇔ 5 ⇔ 10 ⇔ 15 ⇔ 30 ⇔ 60 .



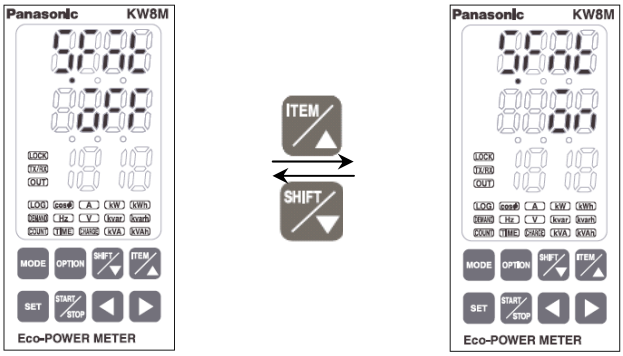
1 minute　5 minutes　10 minutes　15 minutes　30 minutes　60 minutes

↓ **< SET >**

Initialize memory of main unit

Press **<△>, <▽>** to change OFF/ON.

Set to ON and memory of main unit is initialized.



OFF　ON (initialize)

↓ **< SET >**

Monitor

5-2-5 MODE5

(Mode for setting the year, month, day and time.)

Calendar timer setting mode CAL

Mode defines the year, month, day and time.

・Set year -> month -> date -> hour-> minute.

※Do not set the false date, or it might occur a malfunction.

Initialize memory of the main unit by "initialize memory of main unit" (MODE4) after this setting. When it is not initialized, it may not display log data correctly.

MODE5 Setting flow chart

Monitor

↓ **<MODE>**

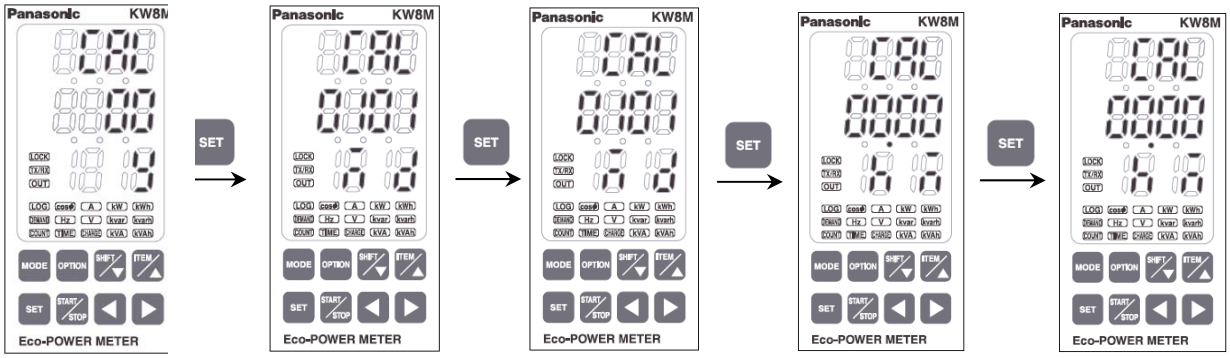
MODE5 display

↓ **< SET >**

Calendar timer setting mode

Enter the present time using **<△>, <▽>, <◁>, <▷>, <SET>**.

Calendar timer can be set the range of 2000, January 1st 00:00 to 2099, December 31st 23:59.



[00 y] Blinking Set Year | [01 m] Blinking Set Month | [01 d] Blinking Set Day | [00 h] Blinking Set Hour | [00 m] Blinking Set Minute

↓ **< SET >**

Monitor

Chapter 6 Wiring

6-1 Main unit terminal arrangement

Function		No.		Function	
GND		①	⑪	P1	Measured voltage input
Power supply	L	②	⑫	P0	
	N	③	⑬	P2	
Pulse input	+	④	⑭	P3	
	−	⑤	⑮	CT1 (+)	Measured CT input
Pulse output	+	⑥	⑯	CT1 (−)	
	−	⑦	⑰	CT2 (+)	
RS485	+	⑧	⑱	CT2 (−)	
	−	⑨	⑲	CT3 (+)	
	E	⑩	⑳	CT3 (−)	

Back view

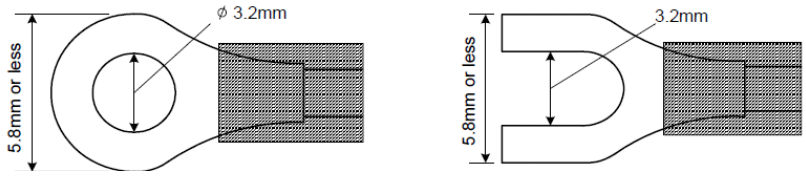
①		⑪
②		⑫
③		⑬
④		⑭
⑤		⑮
⑥		⑯
⑦		⑰
⑧		⑱
⑨		⑲
⑩		⑳

⚠ **The input voltage to each terminal is as follows.**

Terminal	Phase and wire	Terminal	Input voltage	
Operating power supply	Single-phase, two-wire	②−③	100-240VAC (100 - 240V～)	(Line voltage)
Measured voltage input	Single-phase, two-wire	⑪−⑫	0-440VAC (0-440V～)	(Line voltage)
	Single-phase, three-wire	⑪−⑫−⑬	0-220VAC (0-220V～:3W)	(Phase voltage)
	Three-phase, three-wire	⑪−⑫−⑬	0-440VAC (0-440V 3～)	(Line voltage)
	Three-phase, four-wire	⑪−⑫−⑬−⑭	0-254VAC (0-254V 3N～)	(Phase voltage)

Caution for Wiring

1) Terminal fastening torque should be **0.6 to 1.0N･m**.
2) This has no built-in power switch, circuit breaker for power supply part. To protect the device, it is necessary to install power switch and circuit breaker in the power supply circuit.
   And this has no built-in power switch, circuit breaker or fuse for measured voltage input parts.
   Therefore it is necessary to install them in the circuit near this unit.
3) The terminal block of KW8M is designed to be wired from left. Insert wires to the terminal from the left and fasten with terminal screws.
4) In case using insulation sleeve, use an insulation sleeve applicable to M3 screw. Fastening torque should be 0.6 to 1.0N･m. (Refer to the below.)



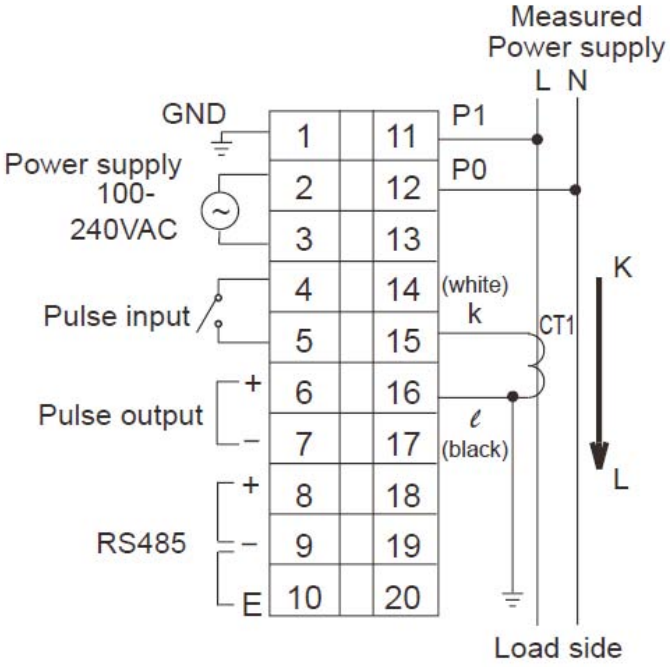
6-2 Wiring Diagrams

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

・Grounding CTs' secondary side (ℓ line) is recommended for the unit protection when CT break down.

Single-phase two-wire system

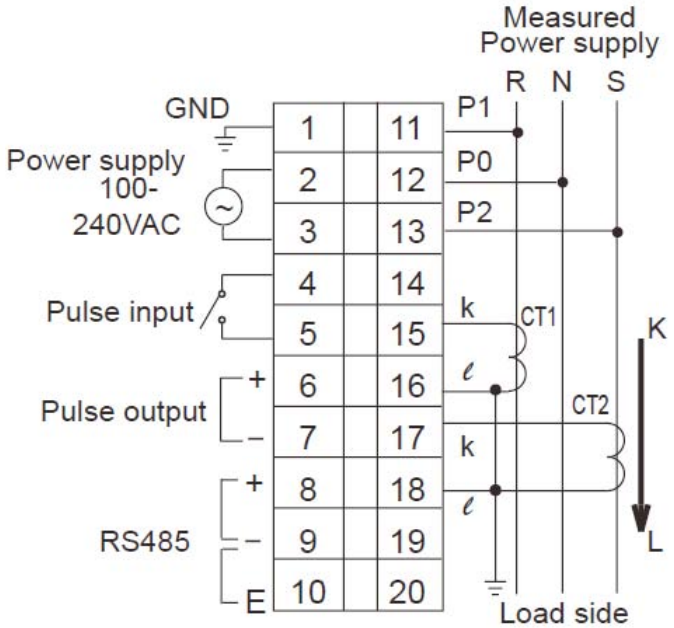
＊One current transformer (CT) is required to measure single-phase two-wire system.



Single-phase three-wire

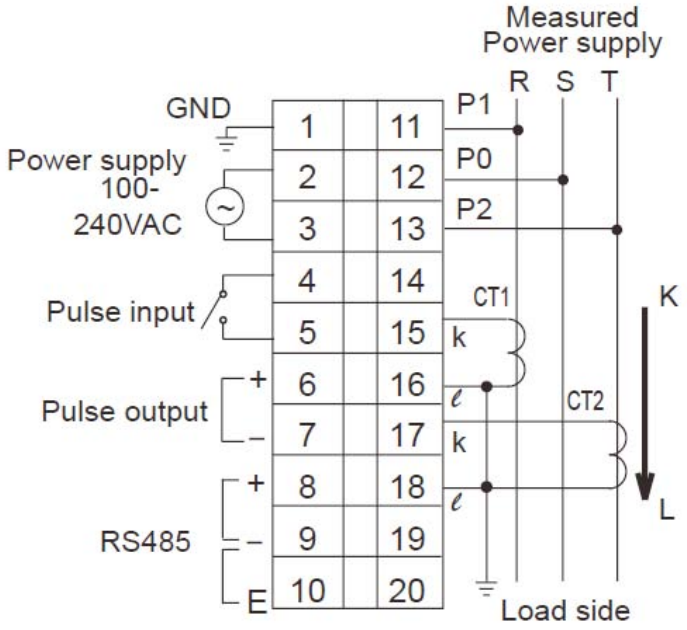
＊Two CTs are required to measure single-phase three-wire system.

＊Wire by diagram of single-phase 2-wire system when measure load using R-S with single-phase 3-wire system.



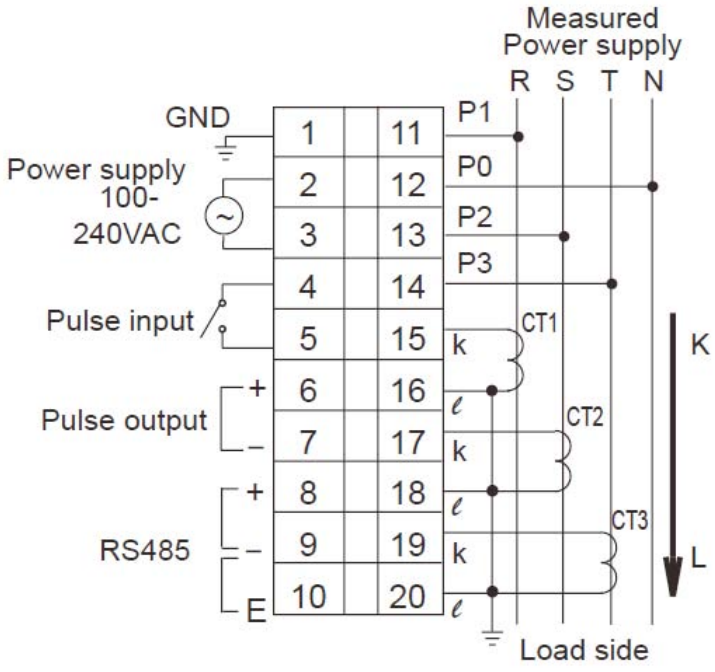
Three-phase three-wire system

∗ Two CTs are required to measure three-phase three-wire system.



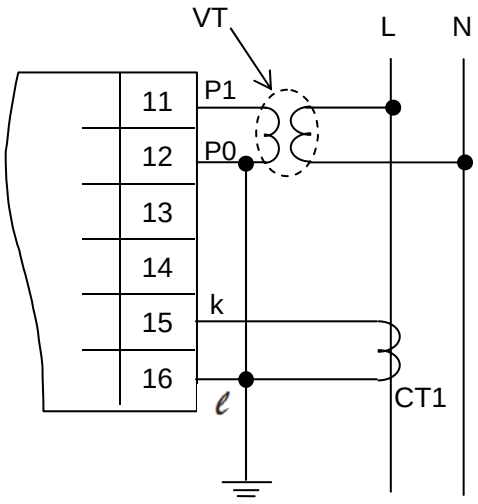
Three-phase four-wire system

∗ Three CTs are required to measure three-phase four-wire system.



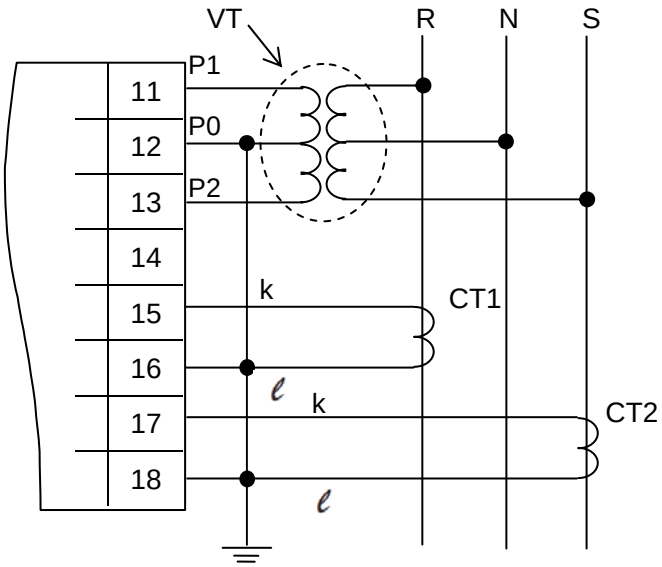
◇VT (Voltage transformer) is needed when you measure a load with voltage over 440V system.
Use commercial VT, those secondary rating is 110V.
*Grounding CT's secondary side (ℓ line) and VT's neutral line is recommended for the unit protection when CT or VT breaks down.

Single-phase two-wire system



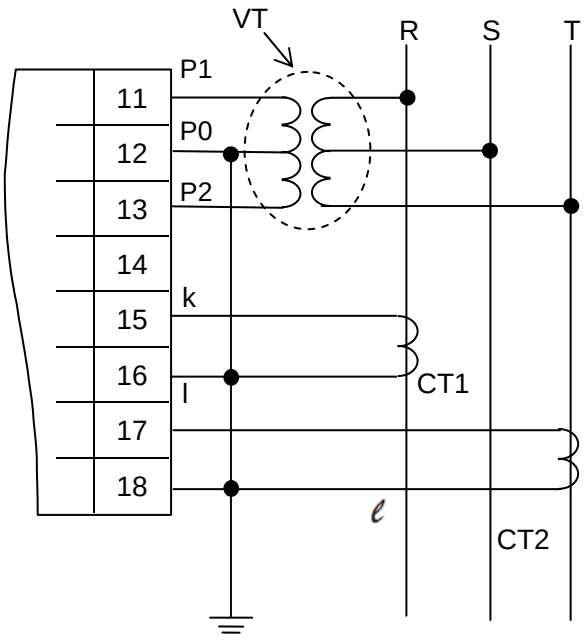
No.13,14,17～20 are not wired.

Single-phase, three-wire



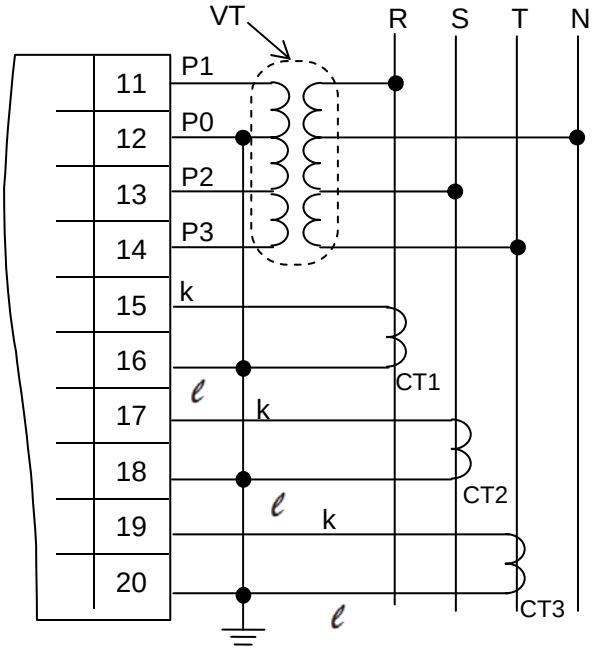
No.14, 19, 20 are not wired.

Three-phase, three-wire system



No.14, 19, 20 are not wired.

Three-phase, four-wire system



◇How to attach the Current Transformer (CT)

・One current transformer (CT) is required to measure a single-phase, two-wire system.

・Two CT are required to measure a single-phase, three-wire system or three-phase, three-wire system.

・Three CT are required to measure a three-phase, four-wire system.

・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. If it is wired wrong, it can not measure correctly.

・For the dedicated CT, ' 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.

◇To connect CT with secondary current 5A

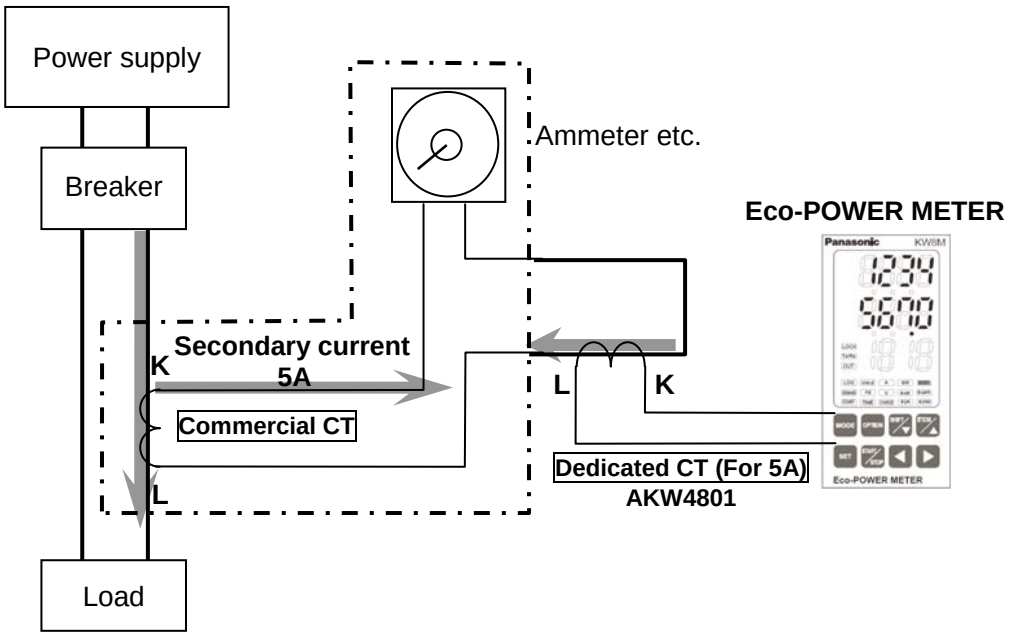
How to connect the unit to measure by combination with existing commercial CT

(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)



6-3 For input connection

◇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}=6μA 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. 7mA.)

Open-circuit impedance should be more than 100kΩ.

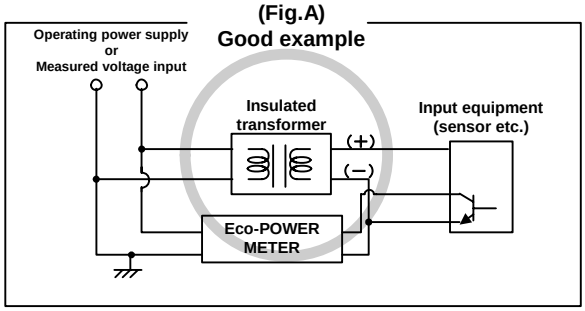
・Input wiring

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

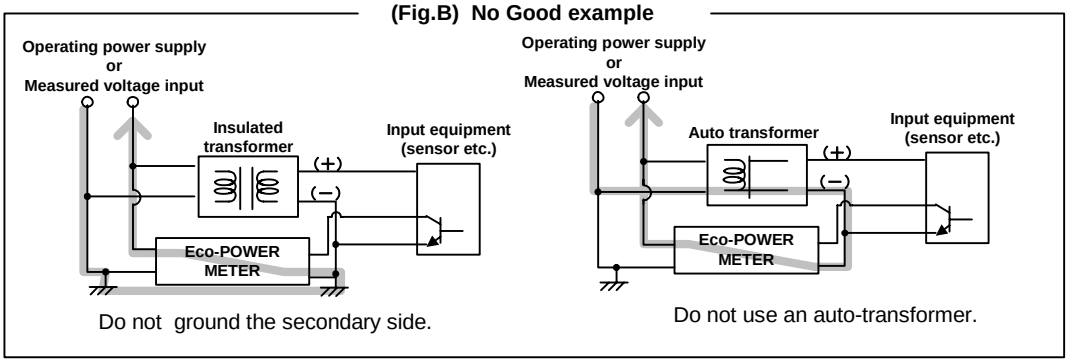
(Caution)

Operating power supply input part and measured voltage input are 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)

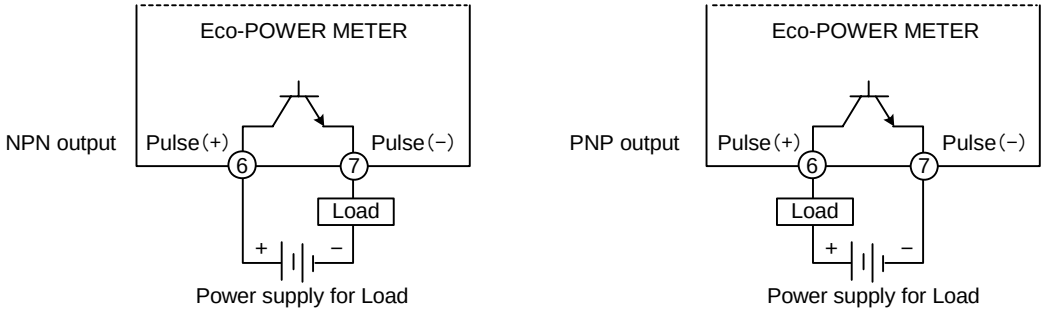


(Fig.B) No Good example



6-4 For Output connection

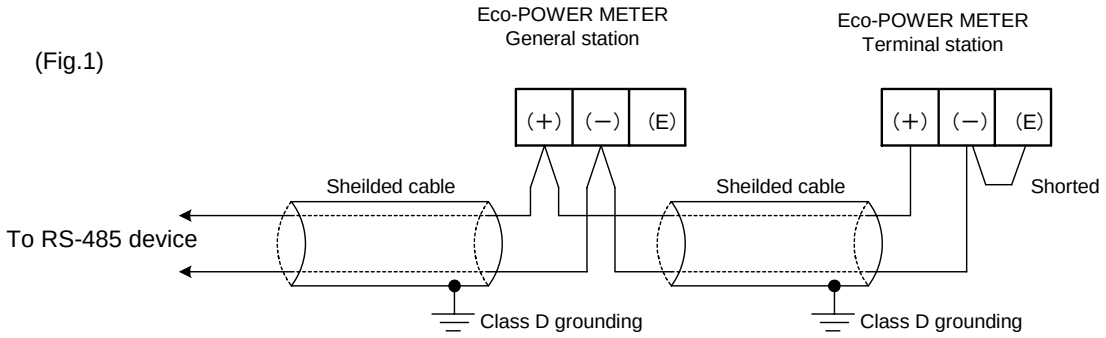
Since the transistor output is insulated from the internal circuit by a photo-coupler, it can be used both as a NPN output and PNP (equal value) output.



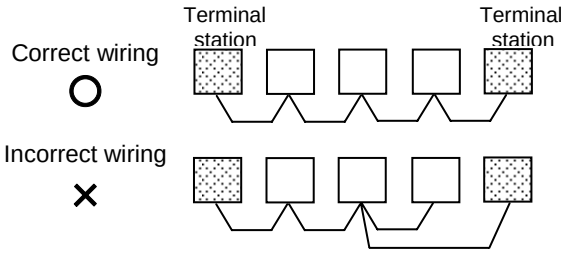
6-5 RS485 Communication

・When using shielded cable for the RS485 transmission line, ground one end.
Use a class D dedicated earth for grounding. Do not share a ground with other earth lines. (Fig.1)
・Be sure to connect with daisy chain the RS485 transmission line between each unit.
Do not use a splitter. (Fig.2)
・With a terminal station, RS485 (E) (No.10) and RS485 (-) (No.9) should be shorted.

(Fig.1)



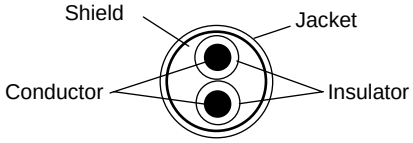
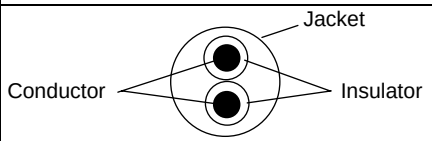
(Fig.2)



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	Polyethylene	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	Polyethylene	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.

6-6 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 and communication 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 for output part and secure basic insulation or more with communication system side for communication part.

(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

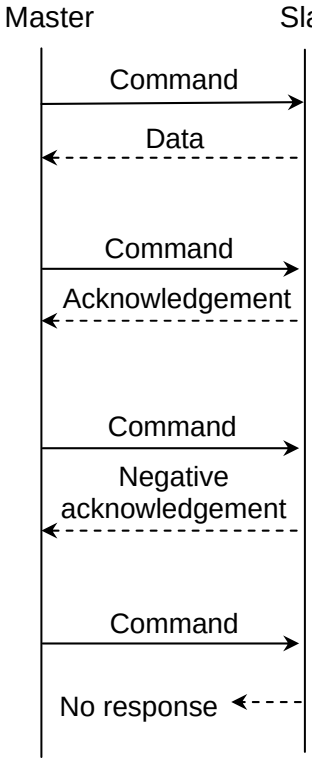
【Mount the product in a place with】

- ･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 MEWTOCOL 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 RS485

◇Eco-POWER METER (Slave) side

When Eco-POWER METER (Slave) starts transmission to RS485 communication line, it is arranged so as to provide an idle status transmission period of about 5 to 99ms (setting available)+Tb before sending the response to ensure the synchronization on the receiving side. After sending the response, master can disconnect the transmitter from the communication line within transmission period 20ms.
(Tb: Transmission period may be longer (0 to 60ms) due to Eco-POWER METER’s process.)

◇Master side (Cautions of setting a program)

At communication, keep the following conditions.

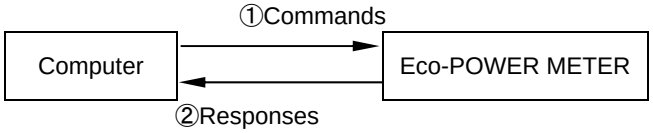
1) Set the program so that the master can disconnect the transmitter from the communication line within the transmission period of about 2ms after sending the command in preparation for reception of the response from Eco-POWER METER (Slave).
2) To avoid collision of transmissions between the master and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

7-3 MEWTOCOL Communication

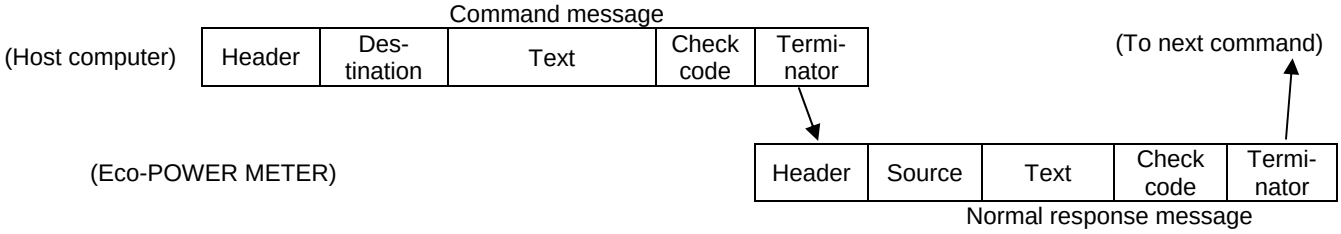
7-3-1 Overview of MEWTOCOL-COM (RS485)

◆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)

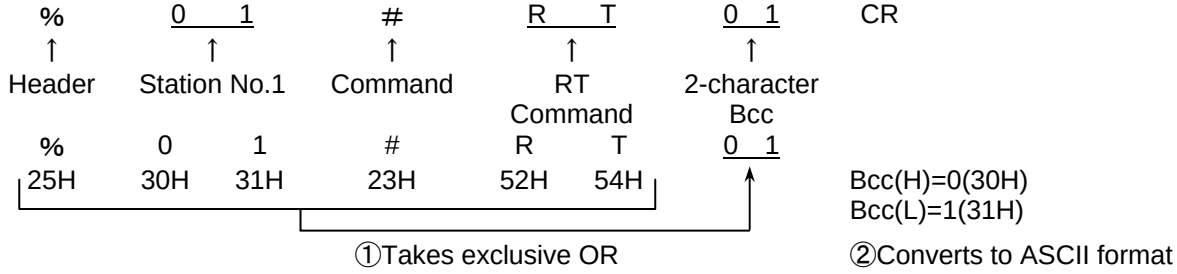
These indicate the content if an error occurs.

◆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

(Common to AKW8 series)

Data register	Name	Unit	Kind of data	Range	R/W
DT00050	Rate	0.01	Sign-less 16bit	0 to 9999	R/W
DT00060	CT type	Rated A (rms)	Sign-less 16bit	5 types: 5,50,100,250,400	R/W
DT00061 DT00062	Unit for Pulse output	—	Sign-less 32bit	1(0.001),10(0.01),100(0.1), 1000(1),10000(10),100000(100) 999 (Instantaneous electric power: Values of DT00064, 00065) 555 (Count value for output: Values of DT00154,00155)	R/W
DT00063	Primary side current value when CT 5A	1A	Sign-less 16bit	1 to 4000	R/W
DT00064 DT00065	Alarm value (Instantaneous active power)	0.01kW	Sign-less 32bit	0 to 99999999	R/W
DT00066	VT ratio	0.01	Sign-less 16bit	100 to 9999	R/W
DT00067	Current threshold for time measurement	0.1%	Sign-less 16bit	1 to 1000	R/W
DT00068	Cutoff current	0.1%	Sign-less 16bit	10 to 500	R/W
DT00070	Voltage range	—	Sign-less 16bit	1; 400V 2; 200V	R/W
DT00100 DT00101	Integrated active power	0.01kWh	Sign-less 32bit	0 to 999999999	R/W
DT00102 DT00103	Integrated reactive power	0.01kvarh	Sign-less 32bit	0 to 999999999	R/W
DT00104 DT00105	Integrated apparent power	0.01kVAh	Sign-less 32bit	0 to 999999999	R/W
DT00107	Current L1A(CT1)	0.1A	Sign-less 16bit	0 to 60000	R
DT00108	Current L2A(CT2)	0.1A	Sign-less 16bit	0 to 60000	R
DT00109	Current L3A(CT3)	0.1A	Sign-less 16bit	0 to 60000	R
DT00111	Power factor	0.01	Sign-less 16bit	-100 to 100	R
DT00112	Frequency	0.1Hz	Sign-less 16bit	0 to 1000	R
DT00150 DT00151	Load ON-time	0.1h	Sign-less 32bit	0 to 999999	R/W
DT00152 DT00153	Load OFF-time	0.1h	Sign-less 32bit	0 to 999999	R/W
DT00154 DT00155	Pulse count value	—	Sign-less 32bit	0 to 99999999	R/W
DT00158 DT00159	Preset value	—	Sign-less 32bit	0 to 99999999	R/W
DT00162	Max. counting speed	Hz	Sign-less 16bit	30, 2000	R/W
DT00163	Auto-off time	min	Sign-less 16bit	0 to 99 (0:always on)	R/W
DT00170 DT00171	Voltage L1V (Between P1-P0)	0.1V	Sign-less 32bit	0 to 99999	R
DT00172 DT00173	Voltage L2V (Between P2-P0)	0.1V	Sign-less 32bit	0 to 99999	R
DT00174 DT00175	Voltage L3V (Between P3-P0)	0.1V	Sign-less 32bit	0 to 99999	R
DT00176 DT00177	Instantaneous active power	0.01kW	Sign-less 32bit	0 to 99999999	R
DT00178 DT00179	Instantaneous reactive power	0.01kvar	Sign-less 32bit	-9999999 to 99999999	R
DT00180 DT00181	Instantaneous apparent power	0.01kVA	Sign-less 32bit	0 to 99999999	R

(Only for AKW8111H)

Data register	Name	Unit	Kind of data	Range	R/W
DT20000	Log data (Year/Month)	—	Sign-less 16bit	Higher word Y: 00H to 99H Lower word M: 01H to 12H	R
DT20001	Log data (Date/Hour)	—	Sign-less 16bit	Higher word D: 01H to 31H Lower word H: 00H to 23H	R
DT20002	Log data (Minute + Spare)	—	Sign-less 16bit	Higher word M: 00H to 59H	R
DT20003 DT20004	Log data Integrated active power	0.01kWh	Sign-less 32bit	0 to 999999999	R
DT20005 DT20006	Log data Integrated reactive power	0.01kvarh	Sign-less 32bit	0 to 999999999	R
DT20007 DT20008	Log data Integrated apparent power	0.01kVAh	Sign-less 32bit	0 to 999999999	R
DT20009 DT20010	Log data Voltage L1V	0.1V	Sign-less 32bit	0 to 99999	R
DT20011 DT20012	Log data Voltage L2V	0.1V	Sign-less 32bit	0 to 99999	R
DT20013 DT20014	Log data Voltage L3V	0.1V	Sign-less 32bit	0 to 99999	R
DT20015	Log data Current L1A(CT1)	0.1A	Sign-less 16bit	0 to 60000	R
DT20016	Log data Current L2A(CT2)	0.1A	Sign-less 16bit	0 to 60000	R
DT20017	Log data Current L3A(CT3)	0.1A	Sign-less 16bit	0 to 60000	R
DT20018 DT20019	Log data Pulse count value	—	Sign-less 32bit	0 to 99999999	R
⋮	⋮	⋮	⋮	⋮	⋮
DT63181	Log data (Year/Month)	—	Sign-less 16bit	Higher word Y: 00H to 99H Lower word M: 01H to 12H	R
DT63182	Log data (Date/Hour)	—	Sign-less 16bit	Higher word D: 01H to 31H Lower word H: 00H to 23H	R
DT63183	Log data (Minute + Spare)	—	Sign-less 16bit	Higher word M: 00H to 59H	R
DT63184 DT63185	Log data Integrated active power	0.01kWh	Sign-less 32bit	0 to 999999999	R
DT63186 DT63187	Log data Integrated reactive power	0.01kvarh	Sign-less 32bit	0 to 999999999	R
DT63188 DT63189	Log data Integrated apparent power	0.01kVAh	Sign-less 32bit	0 to 999999999	R
DT63190 DT63191	Log data Voltage L1V	0.1V	Sign-less 32bit	0 to 99999	R
DT63192 DT63193	Log data Voltage L2V	0.1V	Sign-less 32bit	0 to 99999	R
DT63194 DT63195	Log data Voltage L3V	0.1V	Sign-less 32bit	0 to 99999	R
DT63196	Log data Current L1A(CT1)	0.1A	Sign-less 16bit	0 to 60000	R
DT63197	Log data Current L2A(CT2)	0.1A	Sign-less 16bit	0 to 60000	R
DT63198	Log data Current L3A(CT3)	0.1A	Sign-less 16bit	0 to 60000	R
DT63199 DT63200	Log data Pulse count value	—	Sign-less 32bit	0 to 99999999	R

(Only for AKW8111H)

DT00071	Calendar timer monitor (Hour/Minute)	—	Sign-less 16bit	Higher word H: 00H to 23H Lower word M: 00H to 59H	R
DT00072	Calendar timer (Minute/Second)	—	Sign-less 16bit	Higher word M: 00H to 59H Lower word S: 00H to 59H	R/W
DT00073	Calendar timer (Date/Hour)	—	Sign-less 16bit	Higher word D: 01H to 31H Lower word H: 00H to 23H	R/W
DT00074	Calendar timer (Year/Month)	—	Sign-less 16bit	Higher word Y: 00H to 99H Lower word M: 01H to 12H	R/W
DT00075	Calendar timer (Day)	—	Sign-less 16bit	Higher word Day: 00H to 06H	R/W
DT00076	Logging cycle setting	—	Sign-less 16bit	6 types; 1(1),2(5),3(10),4(15),5(30),6(60)	R/W
DT00080	SRAM Initialize	—	Sign-less 16bit	0;OFF 1;ON	R/W
DT00098	Integrated active power for arbitrary period	0.01kWh	Sign-less 32bit	0 to 999999999	R/W
DT00099					

Note1) R: Read W: Write

2) Data register except specified is 0.

3) DT00061, 00062 (Unit for pulse output) 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. ・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. is specified without decimal.（0000F etc.） ・The starting word No. is bigger than the ending word No. ・Writing data has a code that is not hexadecimal.
62H	Registration error	・Too many registrations have been entered (more than 17). ・“MD” command was sent when some registration has been exist. ・“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 $\times10^1$ $\times10^0$	#	R	D	D	Starting word No. 5 characters $\times10^4$ $\times10^3$ $\times10^2$ $\times10^1$ $\times10^0$	Ending word No. 5 characters $\times10^4$ $\times10^3$ $\times10^2$ $\times10^1$ $\times10^0$	Bcc $\times16^1$ $\times16^0$	CR

◇Normal response (Read successful)

%	Source $\times10^1$ $\times10^0$	$	R	D	First register contents 4 characters $\times16^1$ $\times16^0$ $\times16^3$ $\times16^2$	Last register contents 4 characters $\times16^1$ $\times16^0$ $\times16^3$ $\times16^2$	Bcc $\times16^1$ $\times16^0$	CR

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

◇Error response

%	Source $\times10^1$ $\times10^0$	!	Error code $\times16^1$ $\times16^0$	Bcc $\times16^1$ $\times16^0$	CR

(Common to each command)

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

◇Command

%	Destination $\times10^1$ $\times10^0$	#	W	D	D	Starting word No. 5 characters $\times10^4$ $\times10^3$ $\times10^2$ $\times10^1$ $\times10^0$	Ending word No. 5 characters $\times10^4$ $\times10^3$ $\times10^2$ $\times10^1$ $\times10^0$	First writing data 4 characters $\times16^1$ $\times16^0$ $\times16^3$ $\times16^2$	⇒

(lower word) (higher word)

◇Normal response (Write successful)

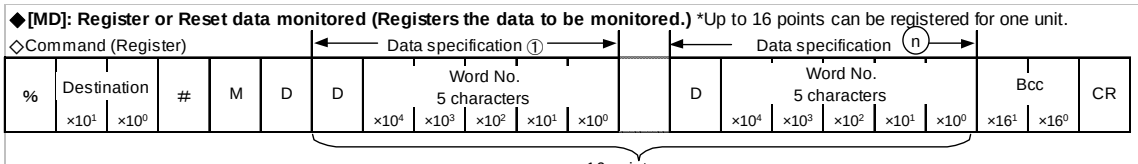
%	Source $\times10^1$ $\times10^0$	$	W	D	Bcc $\times16^1$ $\times16^0$	CR

⇒	Last writing data 4 characters $\times16^1$ $\times16^0$ $\times16^3$ $\times16^2$	Bcc $\times16^1$ $\times16^0$	CR

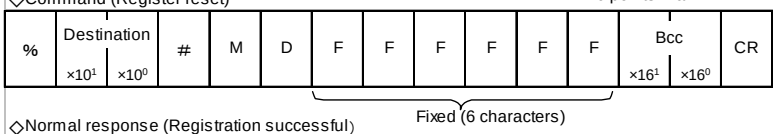
(lower word) (higher word)

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

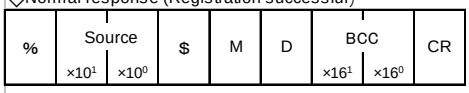
◇Command (Register)



◇Command (Register reset)

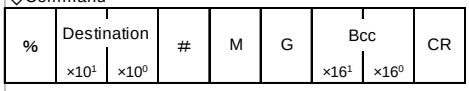


◇Normal response (Registration successful)

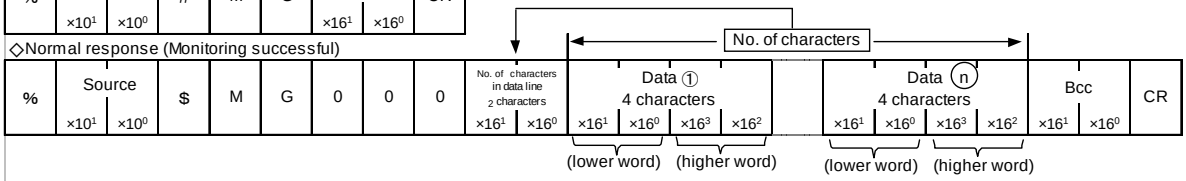


◆[MG]: Monitoring start (Monitors a registered data.)

◇Command



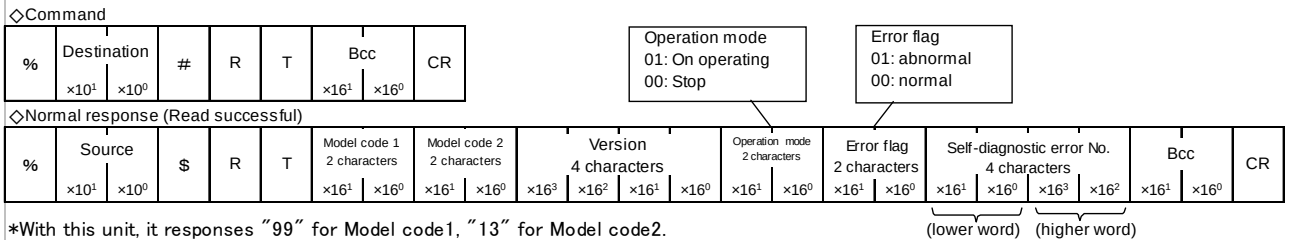
◇Normal response (Monitoring successful)



◆[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)



*With this unit, it responses ″99″ for Model code1, ″13″ for Model code2.

note1) Even if it commands to write 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).

7-4 MODBUS (RTU) Communication

7-4-1 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 devise 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

(Common to AKW8 series)

MODBUS Function code	Data item (MEWTOCOL)	Name	Unit	Kind of date	Range: Hexadecimal (Range: Decimal)
03H/06H/10H	0032H (DT00050)	Rate	0.01	Sign-less 16bit	0H to 270FH (0 to 9999)
03H/06H/10H	003CH (DT00060)	CT type	Rated A (rms)	Sign-less 16bit	5 types: 5H(5), 32H(50), 64H(100), FAH(250), 190H(400)
03H/06H/10H	003DH (DT00061)	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) <Instantaneous electric power: Values of DT00064, 00065> 22B(555) <Count value for output: Values of DT00154,00155>
	003EH (DT00062)				
03H/06H/10H	003FH (DT00063)	Primary side current value when CT 5A	1A	Sign-less 16bit	1H to FA0H (1 to 4000)
03H/06H/10H	0040H (DT00064)	Alarm value (Instantaneous active power)	0.01kW	Sign-less 32bit	0H to 5F5E0FFH (0 to 99999999)
	0041H (DT00065)				
03H/06H/10H	0042H (DT00066)	VT ratio	0.01	Sign-less 16bit	64H to 270FH (100 to 9999)
03H/06H/10H	0043H (CT00067)	Current threshold for time measurement	0.1%	Sign-less 16bit	1H to 3E8H (1 to 1000)
03H/06H/10H	0044H (DT00068)	Cutoff current	0.1%	Sign-less 16bit	AH to 1F4H (10 to 500)
03H/06H/10H	0046H (DT00070)	Voltage range	—	Sign-less 16bit	1H(1):400V 2H(2):200V
03H/06H/10H	0064H (DT00100)	Integrated active power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)
	0065H (DT00101)				
03H/06H/10H	0066H (DT00102)	Integrated reactive power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)
	0067H (DT00103)				
03H/06H/10H	0068H (DT00104)	Integrated apparent power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)
	0069H (DT00105)				
03H	006BH (DT00107)	Current L1A(CT1)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	006CH (DT00108)	Current L2A(CT2)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	006DH (DT00109)	Current L3A(CT3)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	006FH (DT00111)	Power factor	0.01	Sign-less 16bit	FF9CH to 64H (-100 to 100)
03H	0070H (DT00112)	Frequency	0.1	Sign-less 16bit	0H to 3E8H (0 to 1000)

(Common to AKW8 series)

03H/06H/10H	0096H (DT00150) 0097H (DT00151)	Load ON-time	0.1h	Sign-less 16bit	0H to F423FH (0 to 999999)
03H/06H/10H	0098H (DT00152) 0099H (DT00153)	Load OFF-time	0.1h	Sign-less 16bit	0H to F423FH (0 to 999999)
03H	009AH (DT00154) 009BH (DT00155)	Pulse count value	—	Sign-less 32bit	0H to 5F5E0FFH (0 to 999999999)
03H/06H/10H	009EH (DT00158) 009FH (DT00159)	Preset value	—	Sign-less 32bit	0H to 5F5E0FFH (0 to 999999999)
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 to 63H (0 to 99)
03H	00AAH (DT00170) 00ABH (DT00171)	Voltage L1V (Between P1-P0)	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	00ACH (DT00172) 00ADH (DT00173)	Voltage L2V (Between P2-P0)	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	00AEH (DT00174) 00AFH (DT00175)	Voltage L3V (Between P3-P0)	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	00B0H (DT00176) 00B1H (DT00177)	Instantaneous active power	0.01kW	Sign-less 32bit	0H to 5F5E0FFH (000 to 99999999)
03H	00B2H (DT00178) 00B3H (DT00179)	Instantaneous reactive power	0.01kW	Sign-less 32bit	FF676981H to 5F5E0FFH (-9999999 to 99999999)
03H	00B4H (DT00180) 00B5H (DT00181)	Instantaneous apparent power	0.01kW	Sign-less 32bit	0H to 5F5E0FFH (000 to 99999999)

(Only for AKW8111H)

MODBUS Function code	Data item (MEWTOCOL)	Name	Unit	Kind of date	Range: Hexadecimal (Range: Decimal)
03H	4E20H (DT20000)	Log data (Year/Month)	—	Sign-less 16bit	Y:00H to 99H, M:01H to 12H
03H	4E21H (DT20001)	Log data (Date/Hour)	—	Sign-less 16bit	D:01H to 31H, H:00H to 23H
03H	4E22H (DT20002)	Log data (Minute + Spare)	—	Sign-less 16bit	M:00 to 59H
03H	4E23H (DT20003) 4E24H (DT20004)	Log data Integrated active power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)
03H	4E25H (DT20005) 4E26H (DT20006)	Log data Integrated reactive power	0.01kWh	Sign-less 16bit	0H to 3B9AC9FFH (0 to 999999999)
03H	4E27H (DT20007) 4E28H (DT20008)	Log data Integrated apparent power	0.01kWh	Sign-less 16bit	0H to 3B9AC9FFH (0 to 999999999)
03H	4E29H (DT20009) 4E2AH (DT20010)	Log data Voltage L1V	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	4E2BH (DT20011) 4E2CH (DT20012)	Log data Voltage L2V	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	4E2DH (DT20013) 4E2EH (DT20014)	Log data Voltage L3V	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	4E2FH (DT20015)	Log data Current L1A(CT1)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	4E30H (DT20016)	Log data Current L2A(CT2)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	4E31H (DT20017)	Log data Current L3A(CT3)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	4E32H (DT20018) 4E33H (DT20019)	Log data Pulse count value	—	Sign-less 32bit	0H to 5F5E0FFH (0 to 99999999)
⋮	⋮	⋮	⋮	⋮	⋮
03H	F6CDH (DT63181)	Log data (Year/Month)	—	Sign-less 16bit	Y:00H to 99H, M:01H to 12H
03H	F6CEH (DT63182)	Log data (Date/Hour)	—	Sign-less 16bit	D: 01H to 31H,H:00H to 23H
03H	F6CFH (DT63183)	Log data (Minute + Spare)	—	Sign-less 16bit	M: 00 to 59H
03H	F6D0H (DT63184) F6D1H (DT63185)	Log data Integrated active power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)

(Only for AKW8111H)

03H	F6D2H (DT63186) F6D3H (DT63187)	Log data Integrated reactive power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)
03H	F6D4H (DT63188) F6D5H (DT63189)	Log data Integrated apparent power	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)
03H	F6D6H (DT63190) F6D7H (DT63191)	Log data Voltage L1V	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	F6D8H (DT63192) F6D9H (DT63193)	Log data Voltage L2V	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	F6DAH (DT63194) F6DBH (DT63195)	Log data Voltage L3V	0.1V	Sign-less 32bit	0H to 1869FH (0 to 99999)
03H	F6DCH (DT63196)	Log data Current L1A(CT1)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	F6DDH (DT63197)	Log data Current L2A(CT2)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	F6DEH (DT63198)	Log data Current L3A(CT3)	0.1A	Sign-less 16bit	0H to EA60H (0 to 60000)
03H	F6DFH (DT63199) F6E0H (DT63200)	Log data Pulse count value	—	Sign-less 32bit	0H to 5F5E0FFH (0 to 99999999)
03H	0047H (DT00071)	Calendar timer monitor (Hour/Minute)	—	Sign-less 16bit	H:00H to 23H, M:00H to 59H
03H/06H/10H	0048H (DT00072)	Calendar timer (Minute/Second)	—	Sign-less 16bit	M:00H to 59H, S:00H to 59H
03H/06H/10H	0049H (DT00073)	Calendar timer (Date/Hour)	—	Sign-less 16bit	D:01H to 31H, H:00H to 23H
03H/06H/10H	004AH (DT00074)	Calendar timer (Year/Month)	—	Sign-less 16bit	Y:00H to 99H, M:01H to 12H
03H/06H/10H	004BH (DT00075)	Calendar timer (Day)	—	Sign-less 16bit	Day:00H to 06H
03H/06H/10H	004CH (DT00076)	Logging cycle setting	—	Sign-less 16bit	6 types; 1H(1)<1>,2H(2)<5>, 3H(3)<10>,4H(4)<15>, 5H(5)<30>,6H(6)<60>
03H/06H/10H	0050H (DT00080)	SRAM Initialize	—	Sign-less 16bit	0H(0)<OFF>,1H(1)<ON>
03H/06H/10H	0062H (DT00098) 0063H (DT00099)	Integrated active power for arbitrary period	0.01kWh	Sign-less 32bit	0H to 3B9AC9FFH (0 to 999999999)

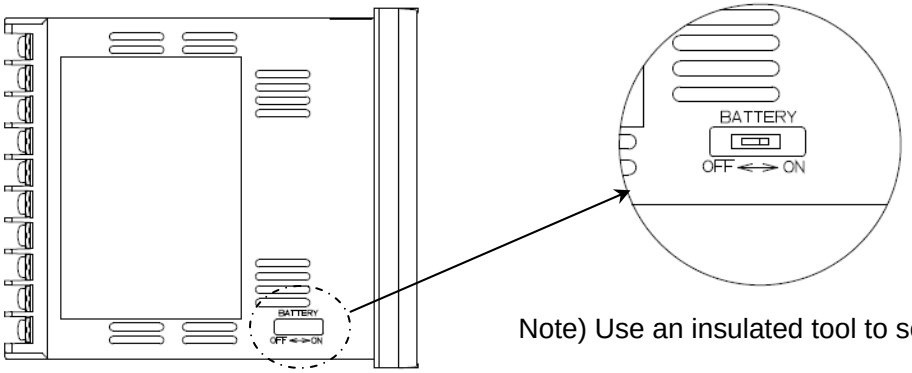
note 1) 03H: Read 06H/10H: Write
note 2) Data register except specified is “0”.
note 3) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM’s life short. Avoid to usage like this.
note 4) Write a data within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

Chapter 8 Battery for Memory Backup (only for AKW8111H)

8-1 Setting before using

・Battery is set to the unit AKW8111H, when shipping. Be sure to set the battery switch ON before starting the unit. It can backup the logging data and calendar time.

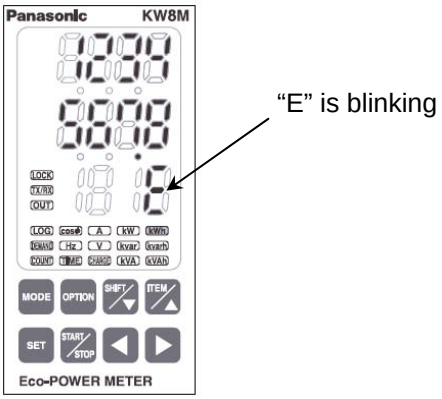
・When starting to use the unit first or passing long time with battery OFF, initialize the memory by memory initialize mode (MODE4), or it can not indicate logging data correctly.



Note) Use an insulated tool to set switch.

8-2 How to Replace Battery

Battery life is about 5 years (at 25℃).
However, using under high-temperature makes the life short.
When battery has abnormal or battery power is reduced, “E” is blinking in the bottom line.
Please replace the battery according to the procedures.



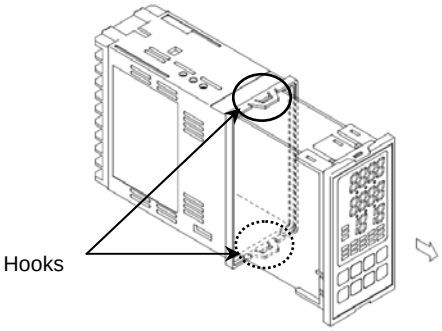
“E” is blinking

・Battery (Option)

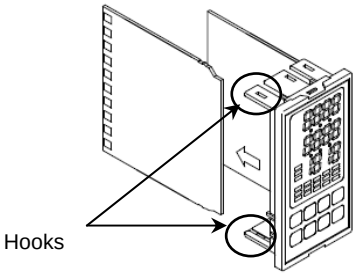
Product name	Model No.
Spare Battery (CR2450)	AFC8801

8-3 How to Remove

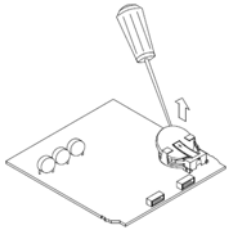
When disposing the unit or replacing battery, refer to the below procedure and remove the battery.
Undo wiring when disposing the unit or replacing battery. Electrical shock may occur if you touch places where high voltage is present. Also, release any static electricity in your body before proceeding.



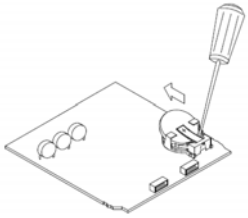
1. Remove 2 hooks at the top and bottom of the case and draw PC board block from the case.



2. Remove 2 hooks from the block and remove the PC board with battery.



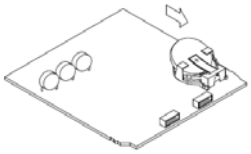
3. Insert a tool between holder and battery and take battery and put it on the stopper.



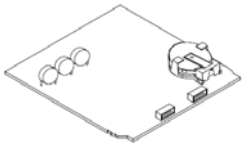
4. Push battery to the marked direction from back and take it.

8-4 How to Mount

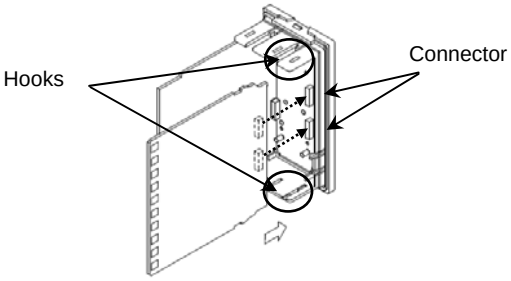
***Mount new battery within 3 minutes after removing the old battery.**



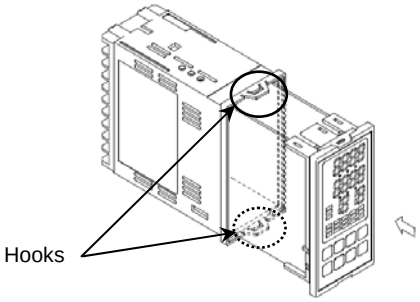
1. Insert the battery in a battery holder horizontally, and insert by the marked direction with + side facing up.



2. Make sure the battery is securely placed in the battery holder.



3. Insert PC board block with battery to connector so that it is fixed with 2 hooks of top and bottom.
The side with battery is inside.



4. Insert PC board block to the end not to make mistake the direction and fix with 2 hooks correctly.
* If the direction is different, it can not be inserted to the end. Be sure to check the direction.

Chapter 9 Specifications

9-1 Main unit

<table>
<tr><td>Rated operating voltage</td><td colspan="2">100-240V 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">85-264V AC (85% to 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 to +50℃(-25℃ to +70℃ at storage)</td></tr>
<tr><td>Ambient humidity</td><td colspan="2">30 to 85%RH(at 20℃ non-condensing)</td></tr>
<tr><td>Breakdown voltage(initial)</td><td>Between the isolated circuits:
2000V for 1min
note) Cut-off current: 10mA
However protective varistor excluded.</td><td rowspan="2">A)Outer edge (case)－All terminals
B)Insulated circuit
・GND－All other terminals
・Operating power supply terminals－Analog input terminals
・Operating power supply terminals－Pulse input terminal
・RS485－All other terminals
・Pulse output terminals－All other terminals note1)</td></tr>
<tr><td>Insulation resistance(initial)</td><td>Between the isolated circuits:
100MΩor more
(measured at 500V DC)</td></tr>
<tr><td>Vibration resistance</td><td colspan="2">10 to 55Hz (1cycle/min) single amplitude : 0.375mm(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">8-digit, 7-segment LED</td></tr>
<tr><td>Power failure memory method</td><td colspan="2">EEP-ROM (more than 100,000 overwrite)</td></tr>
<tr><td>Size</td><td colspan="2">48 x 96 x 98.5 mm</td></tr>
<tr><td>Weight</td><td colspan="2">AKW8111: approx.235g (without mounting bracket)
AKW8111H: approx.250g (without mounting bracket)</td></tr>
</table>

note1) Analog input terminals: No.11 to 20 / Pulse input terminal: No.4 and 5

9-2 Input Specifications

9-2-1 Electric power input

Measuring item	Power		Instantaneous active power **(kW)** Instantaneous reactive power **(kvar)** Instantaneous apparent power **(kVA)**
			Integrated active power **(kWh)** Integrated reactive power **(kvarh)** Integrated apparent power **(kVAh)**
	Voltage		Actual value Voltage (Between P1-P0, Between P2-P0, Between P3-P0) **(V)**
	Current		Actual value Current (L1-phase current, L2-phase current, L3-phase current) **(A)**
	Electricity charge		Integrated electricity charge
	Others		Power factor, Frequency
Display range	Measured electric power (Active, Apparent)		0.00 to 999999.99 **(kW / kVA)**
	Measured electric power (Reactive)		-99999.99 to 999999.99 **(kvar)**
	Integrated electric power (Active, Reactive, Apparent)		0.00 to 9999999.9 **(kWh/ kvarh/ kVAh)**
	Voltage		0.0 to 9999 **(V)**
	Current		0.0 to 6000 **(A)**
	Electricity charge		0.00 to 99999999
	Power factor		0.00 to 1.00 (with display “LEAD” when leading phase or “LAG” when lagging phase)
	Frequency	Rating	50.0 to 60.0 **(Hz)**
		Allowable	47.5 to 63.0 **(Hz)** (95 to 105% of rating)
Phase and wire system			Single-phase two-wire system Single-phase three-wire system Three-phase three-wire system (common) Three-phase four-wire system
Measured input voltage	Rating		Single-phase two-wire : 0-440V AC (Line voltage) Single-phase three-wire : 0-220V AC (Phase voltage) Three-phase three-wire : 0-440V AC (Line voltage) Three-phase four-wire : 0-254V AC (Phase voltage)
	Allowance		85% to 120% of rated input voltage
	Allowable measurement voltage		Single-phase two-wire : 0-528V AC (Line voltage) Single-phase three-wire : 0-264V AC (Phase voltage) Three-phase three-wire : 0-528V AC (Line voltage) Three-phase four-wire : 0-300V AC (Phase voltage)
	VT ratio		1.00 to 99.99 (Set with setting mode) **※Voltage transformer (VT) is required when you measure a load with voltage over 440V system.** **※Secondary current rating of commercial VT is 110V.**
Input current	Primary side rating		・5A/50A/100A/250A/400A (In case using dedicated CT.) (Select with setting mode) ・1 to 4000A (Set with setting mode) **※Use a commercial CT with secondary side current of 5A when measure 400A or more.** **※Accuracy coverage：10 to 100% of rated current of CT**
Special functions	Cut-off current		1.0 to 50.0%F.S
	Current threshold for hour meter		1.0 to 100.0%F.S.

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

9-2-2 Pulse input

Input mode	Addition (Fixed)
Max. counting speed	2kHz /30Hz (Select with setting mode)
Pulse input	Min. input signal width: 0.25ms (When 2kHz selected) /16.7ms (When 30Hz selected) ON:OFF ratio = 1 : 1
Input signal	Contact / No contact (open collector) ・Impedance when shorted: 1kΩ ・Residual voltage when shorted: Max. 2V ・Impedance when open: 100kΩ
Output mode	HOLD (Over count)
Number of Digit	8-digit (0 to 99999999)

9-3 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. 100ms
ON state voltage drop	1.5V or less
OFF state leakage current	100μA or less
Pulse output unit	0.001/0.01/0.1/1/10/100kWh/Alarm(AL-P)/Counter(Cnt) (Selectable with setting mode)

* 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.

9-4 Communication Specifications

Interface		Conforming to RS485
Protocol		MEWTOCOL/MODBUS(RTU) (selectable with setting mode)
Isolation status		Isolated with the internal circuit
Number of connected units		99 (max.) ※2 ※3
Transmission distance		1200m (max.) ※1
Transmission speed		19200/9600/4800/2400bps (selectable with setting mode)
Transmission Format	Data length	8bit/7bit (selectable with setting mode) ※4
	Parity	Not available / Odd number / Even number (selectable with setting mode)
	Stop bit	1bit（fixed）
Communication method		Half-duplex
Synchronous system		Synchronous communication method
Ending resistance		approx. 120Ω (built-in)

◆Factory settings

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

※1 Please check with the actual devices when some commercial devices with RS485 interface are connected. The number of connected devices, transmission distance, transmission speed may be different according to using transmission line.

※2 For RS485 converter on the computer side, we recommend SI-35 and SI-35USB (from LINE EYE Co.,Ltd.).

※3 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.

※4 With MODBUS(RTU) protocol, it works only with 8bit.

9-5 Option Specifications (only for AKW8111H)

Log function Memory of main unit	Automatic logging	Save cycle	60 minutes
		Saved data	Integrated active power, Integrated reactive power, Integrated apparent power
		Saved data amount	Max. 2232 records *3 months
		Display	Monthly integrated electric power, Daily integrated electric power, Hourly integrated electric power (active, reactive, apparent)
	Selected logging *5	Save cycle	1, 5, 10, 15, 30, 60 min.
		Saved data	Integrated active power, Integrated reactive power, Integrated apparent power, Current, Voltage, Pulse count value
		Saved data amount	Max. 2160 records *1.5 days (when save cycle is 1 min.)
Calendar timer			Time accuracy Monthly accuracy 240 seconds (at -10℃) Monthly accuracy 70 seconds (at 25℃) Monthly accuracy 240 seconds (at 50℃)
Integrated active power for arbitrary period			Integrated active power in arbitrary period Display range: 0.00 to 9999999.9 (kWh)
Backup contents by battery			Time measurement and log data storage
Battery life *6,*7			About 5 years (at 25℃)

*5 Some software is required to check the saved data by selected logging function in memory of main unit. The recommended tool software “KW Monitor” is available for download from our website. (http://www.mew.co.jp/ac/e)

*6 When battery power is reduced, “E” is blinking. Replace battery according to the procedures.

*7 Battery life will be shorten if using this under high-temperature.

9-6 Dedicated Current Transformer Specifications

Par 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		±2.0% F.S.			
Hole Dia (mm)		ϕ10	ϕ16	ϕ24	ϕ36
Breakdown voltage(initial)		AC1000V/1min (Between through hole and output lead wire)	AC2000V/1min (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 to 55Hz(1cycle/ minute) single amplitude of 0.375mm (1 hrs. on X,Y and Z axes)			
	Destructive	10 to 55Hz(1cycle/ minute) single amplitude of 0.15mm (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 to 80%RH (at 20℃ non-condensing)			
Weight		Approx. 50g (Trunk cable included)	Approx. 80g (Trunk cable included)	Approx. 200g (without trunk cable)	Approx. 300g (without trunk cable)

Note) Dedicated current transformers (CT), AKW4801, 4802, 4803, 4804, are dedicated for low voltage under 440V system. 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).

9-7 Self-diagnostic function

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

Indicator	Meaning	Output status	To recover
ERR0	CPU error	OFF	Turn the power off and then on again.
ERR1	Memory error*		EEP-ROM life ended. Replace the unit.

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

9-8 Power Failure Memory

Eco-POWER METER memories integrated electric power and working status to internal EEP-ROM until when power supply is off. (Power failure guarantee)

And every time to change each setting, each setting value is memorized to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM's life short. Avoid to usage like this.

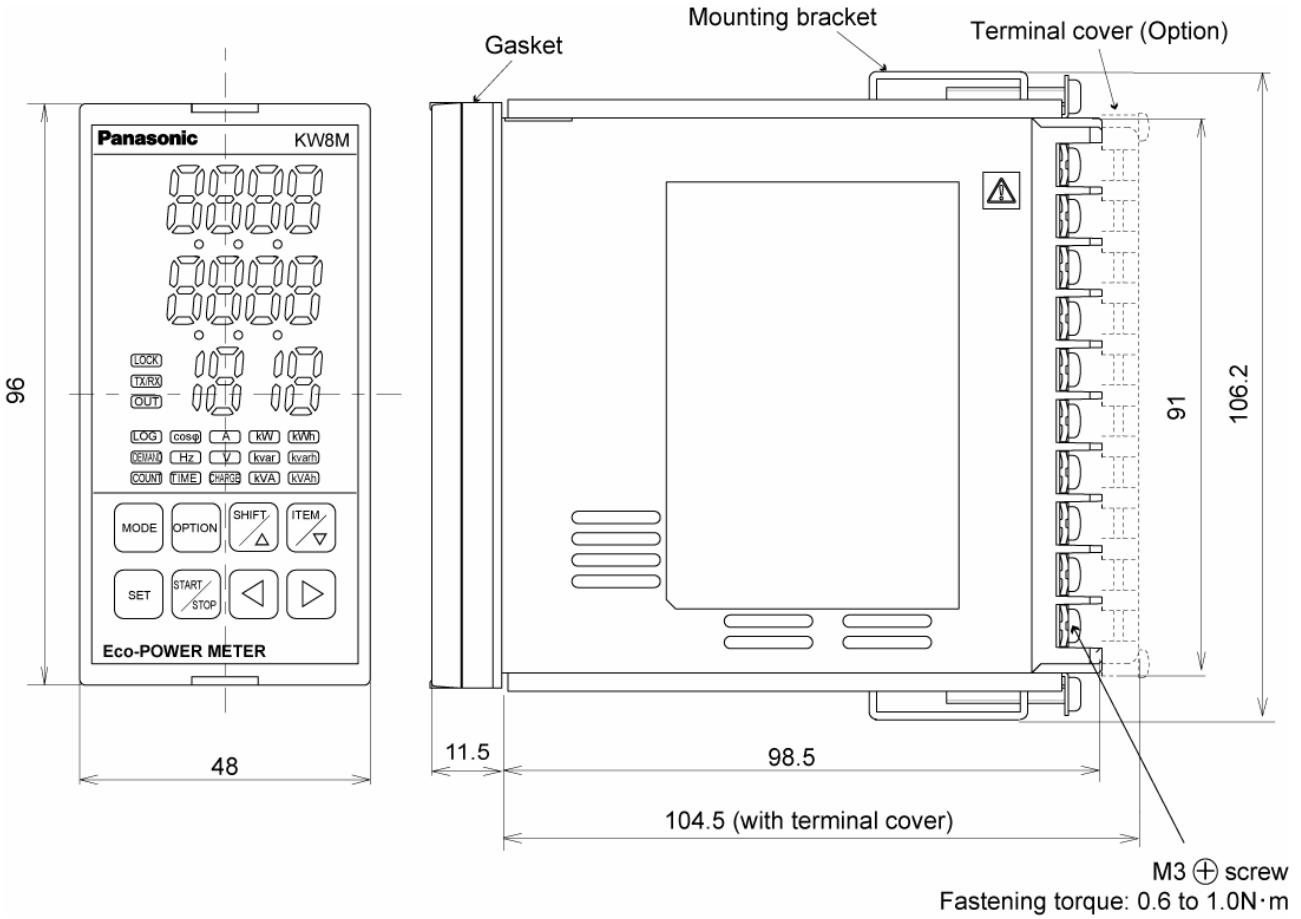
*Especially be careful if you set by communication.

Chapter 10 Mounting

10-1 Dimensions

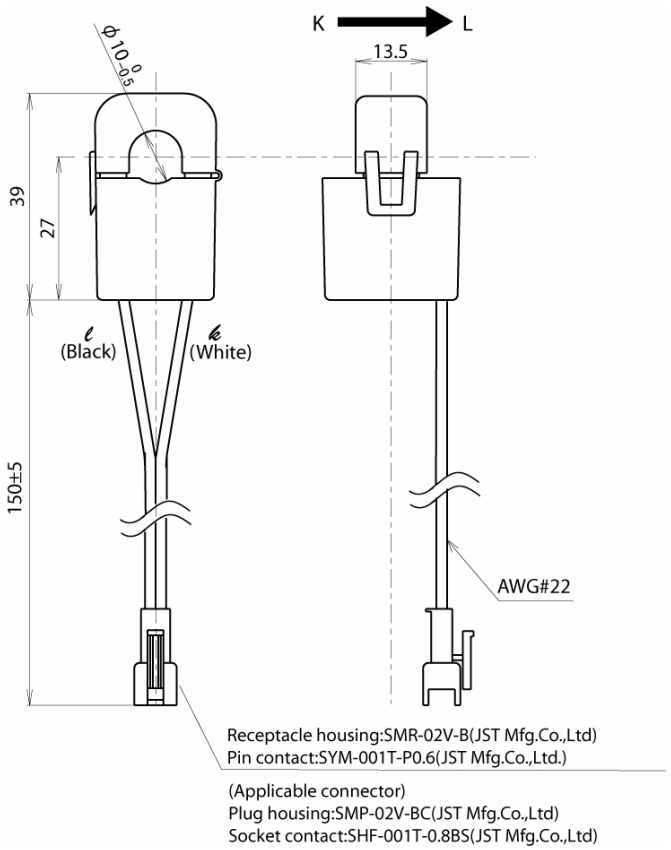
10-1-1 Main unit

(Unit: mm)
(Clearance: ±1.0)

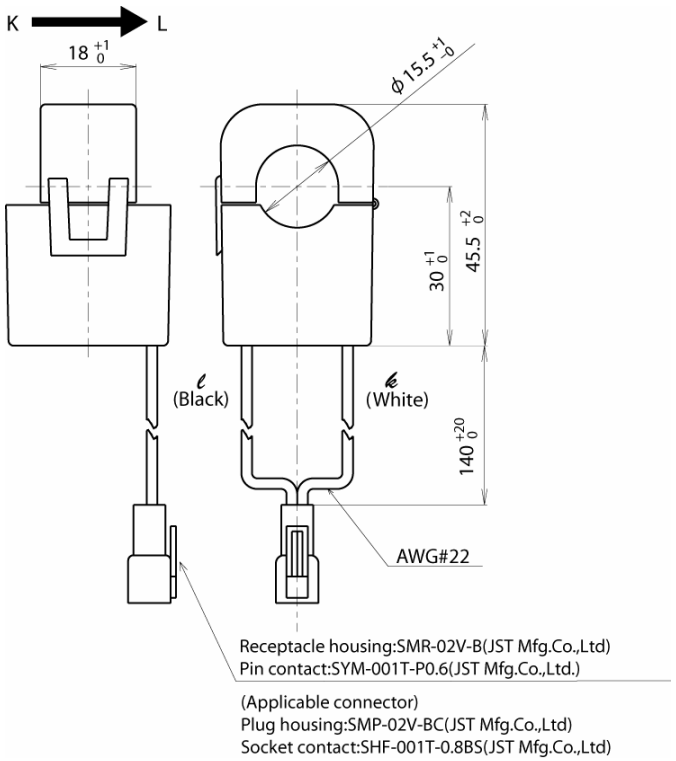


10-1-2 Dedicated CT

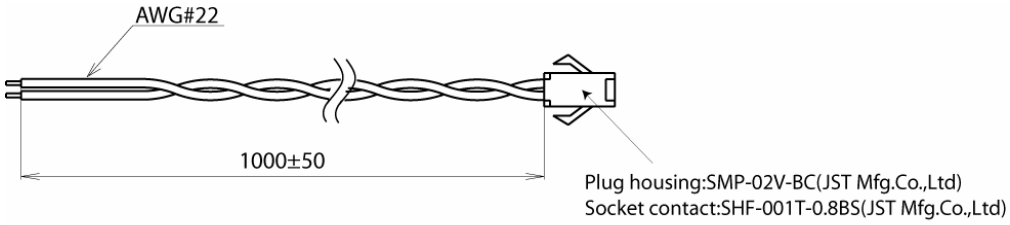
◆For 5A/50A(AKW4801)



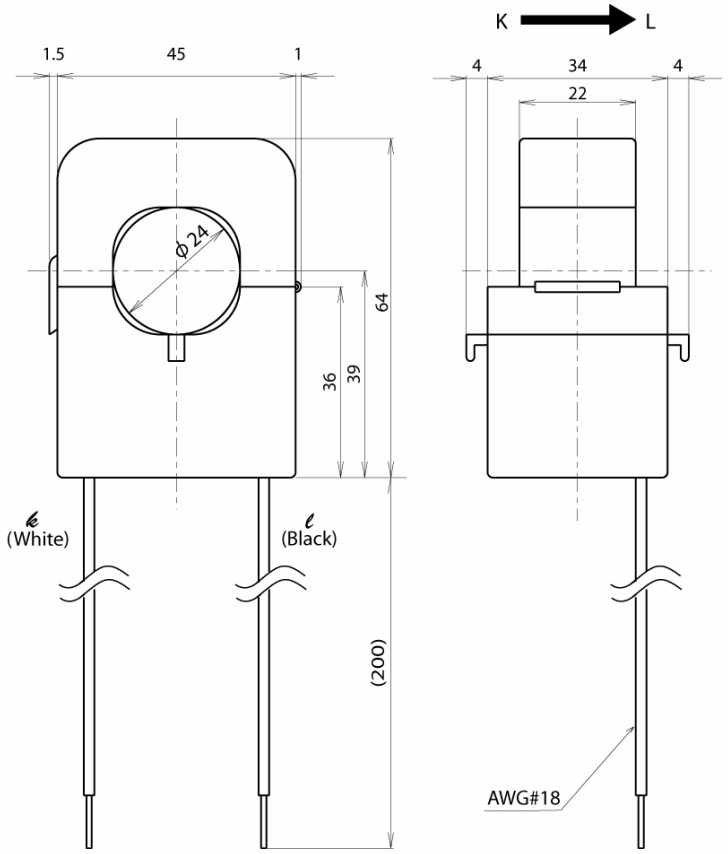
◆For 100A（AKW4802）



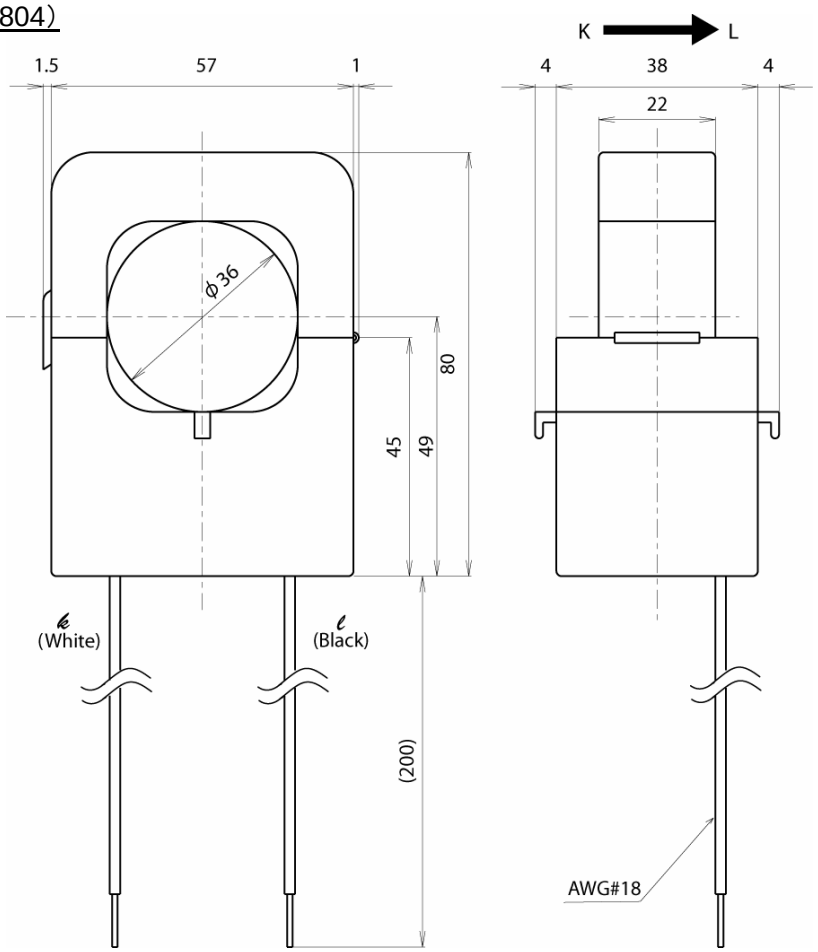
◆Attached trunk cable: L=(1000)



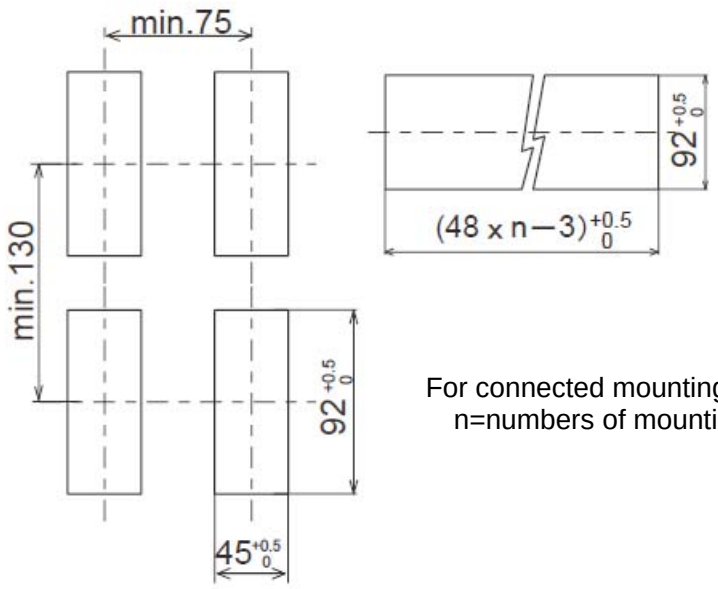
◆For 250A（AKW4803）



◆For 400A（AKW4804）

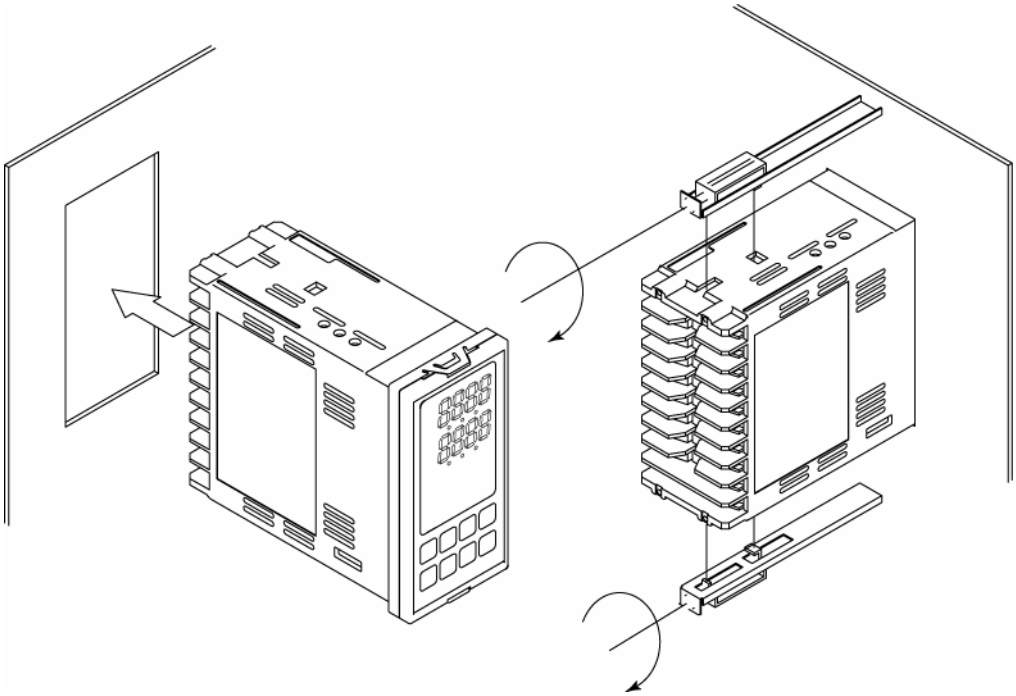


10-2 Panel cutout



For connected mounting
n=numbers of mounting units

10-3 Panel mounting



1) Insert a unit from the front of the panel.
2) Attach the mounting bracket by the holes at the top and bottom of case and secure in place with screws.
・Fastening torque: approx. 0.12N・m)
・Panel thickness: 1 to 15mm

Revision History

Issue Date	Manual no.	Content of revision
August, 2007	ARCT1F440E	First edition
October, 2007	ARCT1F440E-1	Second edition Correct the error
June, 2008	ARCT1F440E-2	Third edition Product AKW8111H is added. Add the explanation of new function (Option function, Logging function etc.)

Please contact .....

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Specifications are subject to change without notice. Printed in Japan.