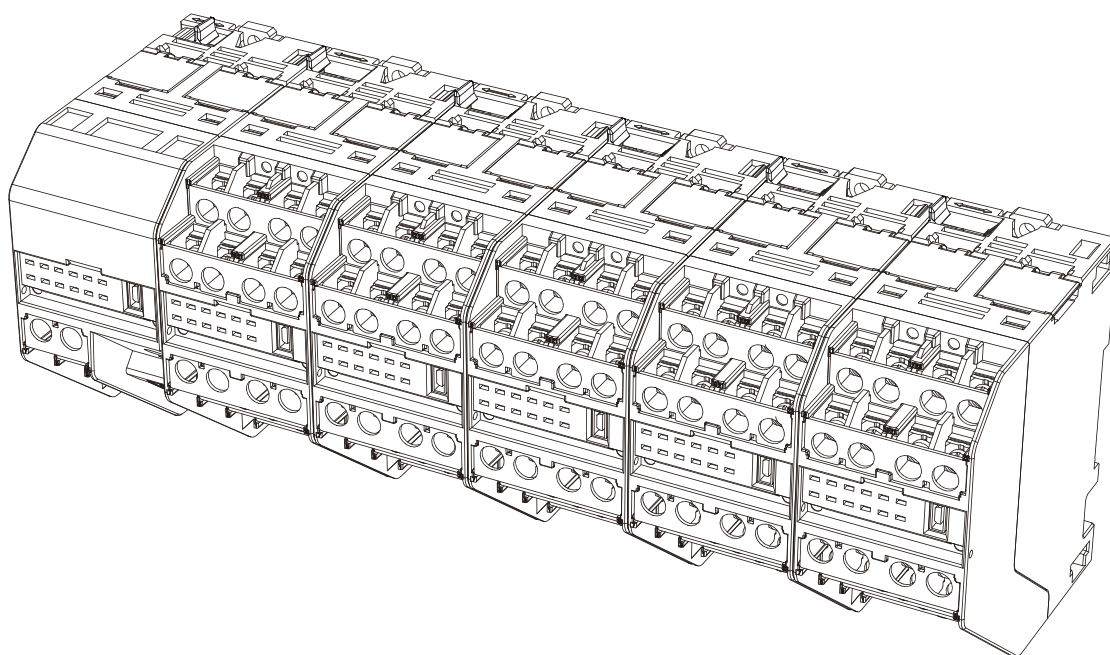


# **Model KE1 Smart Power Measuring Monitor User's Manual**





# INTRODUCTION

Thank you for purchasing the Model KE1.

The Model KE1 is a board built-in type Smart Power Monitor. The Model KE1 is divided into the following units. The operation is performed by using the master unit independently or connecting slave units. The system can be expanded according to the number of power measurement points. A combination with the Model KE1-CTD8E can make measurements at 36 points maximum.

>> Measurement master unit

Model KE1-PGR1C-FLK : Allows measuring electric power and detecting electric leakage.

Model KE1-PVS1C-FLK : Allows measuring electric power and detecting instantaneous voltage sag.

>> Functional slave unit

Model KE1-VSU1B-FLK : Allows detecting instantaneous voltage sag.

Model KE1-VAU1B-FLK : Allows monitoring voltage and current.

>> CT extension slave unit

Model KE1-CTD8E : Allows adding CT (current transformer) to enable the measurement of electric currents in multiple circuits.

Model KE1-ZCT8E : Allows adding ZCT (zero-phase-sequence current transformer) to enable the monitoring of earth leakage in multiple circuits.

>> Communication slave unit

Model KE1-DRT-FLK : Allows DeviceNet communication.

Each of measurement master unit and functional slave unit can operate independently. Connecting each slave unit to the measurement master unit allows enhancing functionality, e.g. measurement of up to 35 points according to the number of points where power is measured and use of DeviceNet communication, with the combination of necessary functions.

In addition, connecting this product to "Model KM1-EMU8A-FLK" of Model KM1 series allows enhancing the temperature measurement functionality.

Model KM1 series contain the following units.

>> Measurement master unit

Model KM1-PMU1A-FLK : Allows measuring electric power.

Model KM1-PMU2A-FLK : Allows measuring electric power of two different systems.

>> Functional slave unit

Model KM1-EMU8A-FLK : Allows measuring temperature. Event input is also available.

\* For information on Model KE1-DRT-FLK, refer to "Model KE1 DeviceNet Communication Unit User's Manual" (SGTE-718).

\* For information on Model KM1, refer to "Model KM1 User's Manual" (KANC-701).

This User's Manual describes information on the functions, performances, and usage necessary for using this product.

When using this product, be sure to observe the following points.

- Only the experts having practical knowledge of electricity shall be allowed to handle this product.
- Go through and fully understand this User's Manual, and use the product correctly.
- Keep this User's Manual at hand for quick reference.

In addition to this manual, refer to the "Model KM1/KE1 Communication Manual" (SGTE-719) on the web site for the explanation of communication functions.

# Items on which you Agree by Using this Product

## 1. Warranty details

### [1] Warranty period

The warranty period for this product is one year from purchase or delivery to a specified site.

### [2] Warranty scope

If faults attributable to Omron arise with this product within the above warranty period, a replacement product will be provided or repair services will be provided for free at the site where the user purchased the product.

However, if any of the following are the cause of the fault, the product will be out-of-scope for the warranty.

- a) If the product is used in a condition, environment, or handling other than that stated in the catalog or Instruction Manual.
  - b) If the fault was due to other products
  - c) If the fault was due to modifications or repairs other than those by Omron
  - d) If the product was used in different ways from those for which the product was originally intended
  - e) If the fault could not be expected based on the level of science and technology as of the time delivery from Omron.
  - f) If the fault is due to reasons not attributable to Omron, such as natural disasters
- Also, the warranty stated in this manual refers to the warranty for a single unit of this product, and damage caused by faults with this product is out-of-scope for the warranty.

## 2. Liability limitation

- [1] Omron shall not bear any responsibility for special damage, indirect damage, or consequential damage arising due to this product.
- [2] Omron shall not bear any responsibility for results arising from programs run by parties other than Omron for this product, which can be programmed.

## 3. Conditions for compatibility purposes

- [1] If this product is used with other products, you need to check standards and regulations or restrictions that need to be complied with. Also, you need to check the compatibility of systems, machines and devices to be used with this product. If you do not perform the above, Omron shall not bear any responsibility for the compatibility of this product.
- [2] If this product is used for the following use applications, you shall use the specifications, etc., for the confirmation after consultation with an Omron sales representative. In addition, you shall use this product within the rated values and performance and take safety measures, e.g., use of a safety circuit, to minimize risks even if a failure occurs.
  - a) Outdoor use and use which may have a potential chemical contamination or electric impedance, or use in conditions or environments other than those stated in the catalog or User's Manual
  - b) Use for equipment such as nuclear control, incineration facilities, train/ aviation system, vehicle facilities, medical machines, entertainment machines, safety devices, or for facilities covered by regulations of administrative bodies or individual industries.
  - c) Systems, machines, and devices which may cause harm to human lives and assets
  - d) Facilities which require a high reliability such as gas, water, and electricity supply systems, and 24-hour continuous operation system.
  - e) Other purposes requiring a high level of safety as per the above a) – d)

- [3] If the product is used for purposes which may cause harm to human lives or assets, you must notify concerned parties of such risks related to overall systems, and you must check beforehand that a redundant design is created to ensure required safety, and that wiring and installation have been appropriately completed for the overall intended purposes for this product.
- [4] Application examples stated in catalogues are for reference purposes. When you use product, you must check the performance and safety of related machines and devices.
- [5] You must fully understand prohibited items and precautions for use, so that there will be no unexpected damage to you or to third parties due to incorrect use of this product.

#### 4. Specification Change

The specifications of this product and accessories may be changed if necessary for reasons such as improvements. Please contact an Omron sales representative to check the current specifications of this product.

#### 5. Applicable scope

The details given above are based on the assumption that the product will be traded and used within Japan

If trading and using disparate outside Japan, please contact an Omron sales representative.

#### About this manual

- (1) No part of this publication may be copied or reproduced in any form without the prior written permission of OMRON.
- (2) The contents of this manual, e.g., specifications, may be revised for improvement without prior notice.
- (3) OMRON takes all possible measures to ensure the contents of this manual. However, if you find any part unclear or incorrect, contact our branch office or sales office listed at the end of this manual. In doing so, please also state the catalog number given at the end of the manual.

# Safety Precautions

## ● Symbols for Safe Use and Their Meanings

This manual employs the following indications or symbols for points to note for the user to use Model KM1 safely.





The points to note shown here indicate important details related to safety. You must adhere to them.

The following indications and symbols can be shown.






### Meaning of Warning

 <b>Caution</b>	<b>Handling this product incorrectly is dangerous. This may lead to mild to moderate severity ended injuries, or this may lead to damage to objects</b>
--	---

## ● Explanation of Symbols

Symbol	Meaning
	<ul style="list-style-type: none"><li>● Prohibition of assembly Notice of prohibition indicated when disassembly of equipment may cause an electric shock or injuries.</li></ul>
	<ul style="list-style-type: none"><li>● General mandatory notice Indication for instructing behaviors of unspecified general users not specified.</li></ul>
	<ul style="list-style-type: none"><li>● Caution, electricity Notice for giving attention about the possibility of electric shock under a specific condition.</li></ul>
	<ul style="list-style-type: none"><li>● Caution, explosion risk Wrong use may cause an explosion.</li></ul>

● Display of warning

 <b>Caution</b>	
<p>Ignition may occur and this may cause damage to objects.            Make sure you tighten terminal screws with standard tightening torque.            Recommended tightening torque of terminal screw: 0.69 to 0.88 N•m            After the screw is tightened, ensure that it is not tilted.</p>	
<p>Explosion may cause a medium or minor degree of injuries or physical loss or damage. Do not use the product at a place where it is exposed to flammable or explosive gas.</p>	
<p>Breakage or explosion may occur.            When using the product, put the supply voltage and load in the specified or rated range.</p>	
<p>Breakage or explosion may occur.            The portion between the voltage input circuit and the CT secondary side circuit is not insulated. If the dedicated CT is grounded, the portion between the voltage input circuit and the CT secondary circuit is short-circuited due to wrong wiring.            Do not ground the dedicated CT to prevent failures.            This product, which uses a dedicated CT, can make normal measurements with the CT not grounded.</p>	
<p>Electric shocks may occur.            When the CT is connected, disconnect voltage inputs connected to the power supply and system of the main body.</p>	
<p>Electric shocks may occur.            When power is distributed, do not touch the terminals.</p>	
<p>Electric shocks may occur.            For the primary side electric wire where the CT is clamped, be sure to use a covered electric wire, which has been at least basically insulated.            When clamping is done for a conductive object, such as bus bar, ensure the basic insulation, at least, by covering it with insulating material, etc.</p>	
<p>Electric shocks, minor degree of injuries, ignition, or equipment failures may occur.            Do not perform assembling, repairing, or remodeling.</p>	

# Safety Points

To prevent operation failure or malfunction of the product, and prevent affecting performances and function, observe the following.

- 1) Prevent the operation and storage (including transportation) of the product under the following environment.
  - In a place with large vibrations or which is greatly influenced by shocks
  - In an unstable place
  - In a place at a temperature or humidity outside the specification range
  - Places with large changes in temperature and humidity, or where there is a possibility of condensation or freezing
  - Place where the product is exposed to direct sunlight.
  - Outdoors or in a place directly exposed to wind and rain
  - In a place affected by static electricity or noise
  - In a place where the product is exposed to oil or salt water.
  - In a place where corrosive gas (sulfurizing gas, ammonia gas, etc.) exists
  - In a place with a lot of dust or iron powder
  - In a place that is affected by electrical fields or magnetic fields
- 2) When installing the DIN rail with screws, prevent looseness. Securely install the DIN rail on the main body. Looseness, if any, causes the DIN rail, the main unit of the product or wiring to come off due to vibration, impact, etc.
- 3) Use the DIN rail of 35 mm in width (Model PFP-50N/-100N manufactured by OMRON).
- 4) When wiring on the main body of the product, use a crimp-style terminal suitable for M3.5 screw.
- 5) Before distributing energy, confirm that the specification and wiring are correct.
- 6) Before performing operation and maintenance, fully understand the instruction manual. Not doing so may result in electric shock, faults, accidents, injury, or incorrect operation.
- 7) For the worker to turn OFF the power supply, install a switch or a circuit breaker matching the requirements of IEC60947-1 and IEC60947-3, and display it appropriately.
- 8) When setting the equipment, fully understand the manual.
- 9) When installing this product, keep it away as far as possible from the equipment generating strong high-frequency noise or surge.
- 10) Touch this product after taking measures against static electricity, such as touching metal that has been earthed.
- 11) To prevent inductive noise, isolate the wiring on the main body from the power line of high voltage or large current. In addition, avoid wiring in parallel to or shared with power lines. Use of a different conduit, a duct, or a shield line is an effective method of wiring.
- 12) Do not install this product close to heating equipment (equipment having a coil, winding wire, etc.).
- 13) Take measures to prevent metal, conductive wire, or chip generated during processing from entering this product.
- 14) Do not use thinner-type products when cleaning. Use a commercially-available alcohol.
- 15) Use an appropriate electrical power source and wiring to supply a power voltage and in/output to this product. Otherwise, failures, burnout, or electric shocks may be caused.
- 16) When installing the product on a wall, use screws to prevent looseness. Looseness, if any, causes the main unit of the product or wiring to come off due to vibration, impact, etc.
- 17) When multiple units are used, slide a horizontal connection hook until it is clicked.
- 18) When installing the product in a DIN rail, slide the DIN hook until it is clicked.



19) Use the dedicated CT, ZCT and dedicated CT cable specified by OMRON.

Dedicated CT	Split type	Model KM20-CTF-5A	Model KM20-CTF-50A	Model KM20-CTF-100A
	Through type	Model KM20-CTF-200A	Model KM20-CTF-400A	Model KM20-CTF-600A
Split core type for earth wire only		Model KM20-CTB-5A/50A		
Dedicated ZCT	Split type	Model K6ER-CN22 (With cable)		
		Model OTG-CN52	Model OTG-CN77	Model OTG-CN112
	Through type	Model OTG-CN36W		
		Model OTG-L21	Model OTG-L30	Model OTG-L42
		Model OTG-L68	Model OTG-L82	Model OTG-L156
		Model OTG-LA30W		

Dedicated CT cable: Model KM20-CTF-CB3 (3 m) (\* Use also to the Dedicated ZCT)

- 20) It is not available for measuring inverter secondary side measurements.
- 21) Do not block the air ventilation holes of this product and the area surrounding them, in order to allow heat to be emitted.
- 22) Check the terminal number and carry out wiring correctly. Connect nothing to the terminals not used.
- 23) This product is a "Class A" (industrial environment product). Using this product in a residential setting environment may cause electronic jamming. In that case, appropriate measures for electronic jamming must be taken.
- 24) Use the dedicated CT in a low voltage circuit of 600 V or less.

## Requests for Installation

### ● To use this product for a long time

Use this product within the following temperature and humidity ranges.

Temperature: -10 to +55°C (without freezing and condensation)

Humidity: 25 to 85%RH

Not the temperature around the board but the temperature around this product must be within 55°C.

This product has a product service life that is determined by the service life of electronic parts used inside. The service life of parts depends on the ambient temperature. As the ambient temperature is higher, the service life is shorter, and as the temperature is lower, the life is longer. Therefore, lowering the internal temperature of the product can lengthen its life.

Installing more than one Model KM1 close to each other or by arranging them in the up-down direction requires the consideration of forced cooling by, e.g., sending air to the products through a fan.

### ● To achieve resistance against peripheral noise

To prevent inductive noise, isolate the wiring in the terminal block of the main body from the power line of high voltage or large current. In addition, avoid wiring in parallel to or shared with power lines. Use of a different conduit, a duct, or a shield line is an effective method of wiring.

Attach a surge absorber or a noise filter to the equipment (equipment having inductance components in particular, e.g., motor transformer, solenoid, and magnet coil) generating noise around the product.

When installing this product, keep it away as far as possible from the equipment (high frequency welder, high frequency machine, etc.) generating strong high-frequency noise or surge.

# Precautions for Use

- 1) Make correct settings according to the targets to be monitored.
- 2) Do not hold and pull a cable.
- 4) When discarding this product, appropriately treat it as an industrial waste.
- 5) If this product is used in the environment of overvoltage category III, install a varistor between lines on the power supply of this product/outside voltage measurement input.

# Before Using this Product

Referring to the instruction manual that came with this product, confirm the relevant items below.

When	Confirmation item	Confirmation contents
When the product is purchased	Appearance of the product	After purchasing the product, check the packing box for dents. If the inside has been damaged, measurements cannot be made properly depending on the point of damage.
	Product format and specification	Confirm that the specification of the purchased product matches that desired.
At the time of installation	Installation place of the product	When installing the product, allow the heat to radiate by preventing covering the area around the product. Do not cover the vent holes of the main body. When installing the products close to each other, consider forced cooling, such as by sending air to the products through a fan.
At the time of wiring	Wiring of terminals	When tightening a screw, be careful to prevent giving excessive stress. In addition, tighten the screw to the specified torque (0.69 to 0.88 N · m) and confirm that it does not loosen. Confirming the polarity of each terminal, perform wiring correctly.
	Power supply/voltage input	Perform correct wiring of power supply/voltage input. Incorrect wiring may cause the destruction of the internal circuit.
Working environment	Ambient temperature	The working ambient environment of this product ranges from -10 to +55°C (without condensation or freezing). To make the service life longer, install the product in such a way that the ambient temperature becomes as low as possible. If the temperature is high, consider forced cooling by a fan.
	Vibration/impact	Confirm that the vibration/impact of the installation environment satisfies the specified standard. (If the product is installed near a conductor, keep it away as far as possible from the conductor, because vibration/impact is applied to it.)
	Entry of foreign matter	Do not install the product in a place where liquid or foreign matter may enter it. If corrosive gas, such as sulfur or chlorine, is generated, the environment should be improved by removing the generation source or by installing a fan.

## Relevant Manuals

Man. No.	Model	Manual Name	Details
SGTE-717	Model KM1-□□□□-FLK	Model KM1 User' s Manual for Smart Measurement and Monitoring Instrument	Describes the overview, characteristics, functions and settings of Model KM1
SGTE-718	Model KE1-DRT-FLK	Model KE1 User' s Manual for Device Net Communication Unit	Describes the functions and settings of DeviceNet Communication Unit
SGTE-719	Model KM1/KE1	Model KM1/KE1 Smart Power Monitor Communication Manual for Smart Measurement and Monitoring Instrument	Describes the details of communication for the Model KM1/KE1 series
GAMS-010	Model KM1/KE1	KM1/KE1-Setting User' s Manual	Describes how to use setting tools for the Model KM1/KE1 series and the setting procedure.

# Abbreviation

Abbreviation	Format	Name	Unit type
PMU1A (Electric power)	Model KM1-PMU1A-FLK	Power Measuring Unit	Measurement master (*1) (*3)
PMU2A (Power Two-System)	Model KM1-PMU2A-FLK	Power Two-System Measurement Unit	
EMU8A (Pulse/temperature)	Model KM1-EMU8A-FLK	Pulse/Temperature Input Unit	Functional slave (*2)/(*3)
PGR1C (Power/Earth leakage)	Model KE1-PGR1C-FLK	Power/Earth Leakage Monitor Unit	Measurement master (*1) (*2) (*3)
PVS1C (Power instantaneous voltage drop)	Model KE1-PVS1C-FLK	Power/Instantaneous Voltage Drop Monitoring Unit	
VSU1B (Instantaneous voltage drop)	Model KE1-VSU1B-FLK	Instantaneous Voltage Drop Monitoring Unit	Functional slave (*2) (*3) (*4)
VAU1B (voltage/current)	Model KE1-VAU1B-FLK	Voltage/Current Monitoring Unit	
CTD8E (CT expansion)	Model KE1-CTD8E	CT Expansion Unit	CT expansion slave (*2) (*4)
ZCT8E (ZCT expansion)	Model KE1-ZCT8E	ZCT Expansion Unit	
DRT (DeviceNet)	Model KE1-DRT-FLK	DeviceNet Communication Unit	Communication slave (*2) (*4)

\*1 Slaves can be connected.

\*2 Can be connected to the measurement master.

\*3 Can be operated independently.

\*4 Product of KE1.

In addition, for the combinations, refer to Page A-20.

# Manual Revision History

The manual revision symbol is given at the end of the catalog number on the front cover and the bottom left of the back cover of the manual.

**Catalog number N176-E1-01**

Revision symbol

Revision symbol	Date of revision	Reason for revision/ pages revised
01	Aug 2013	Initial version

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# Chapter 1. Overview

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# 1.1 Main features and functions

## ■ Main features

This section describes the main features for Model KE1.

- Models providing the following functions are lined up and are selectable according to intended end-usage.
  - Power measurement
  - Overvoltage/undervoltage detection
  - Voltage sag (instantaneous voltage drop) detection
  - Addition of ZCT (eight circuits)
  - Opposite phase detection
  - Overcurrent/undercurrent detection
  - Leakage detection
  - Addition of CT (Up to eight circuits)
  - Open-phase detection
  - Logging function
- \* Adding CT and ZCT requires connecting them to the measurement master.
- \* Chapter 3 describes the functions in details including the ones not described above.

[Connection of multiple units]

- For example, electric power and current of up to 35 circuits can be measured by connecting the CT extension unit (KE1-CTD8E) to the measurement master unit.
- \* For information on the combination of units that can be connected, refer to page A-20.

[Connection with Model KM1]

Connection with Model KM1 series is available. Connecting "Model KM1-EMU8A-FLK" to Model KE1 measurement master unit allows enhancing the temperature measurement functionality.

- \* For information on the combination of units that can be connected, refer to page A-20.
- \*1 CompoWay/F is a unified communication procedure within Omron's generic serial communication. It has commands conforming to the time-proven FINS in the unified frame format and Omron's programmable controller, making easy the communication between the personal computer and the components.
- \*2 Communication control system conforming to RTU Mode of Modbus Protocol. Modbus is a registered trademark of Schneider Electric.
- \* For information on Model KM1, refer to "Model KM1 User's Manual" (KANC-701).

## ■ Main functions

This section describes main functions of Model KE1.

### ● Function by unit

- PGR1C (Electric power/leakage) : Allows measuring current, voltage, and electric power and detecting leakage.
- PVS1C (Electric power/voltage sag) : Allows measuring current, voltage, and electric power and detecting voltage sag.
- VSU1B (Voltage sag) : Allows measuring voltage and detecting voltage sag.
- VAU1B (Voltage/current) : Allows measuring current and voltage.
- CTD8E (CT extension) : Allows adding CT and measuring electric power and current in multiple circuits.
- ZCT8E (ZCT extension) : Allows adding ZCT and monitoring leakage in multiple circuits.

### ● Output function

The following function is provided as an output function.

#### 1) Total power consumption pulse output

PGR1C (Electric power/leakage)	PVS1C (Electric power/voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	×	×

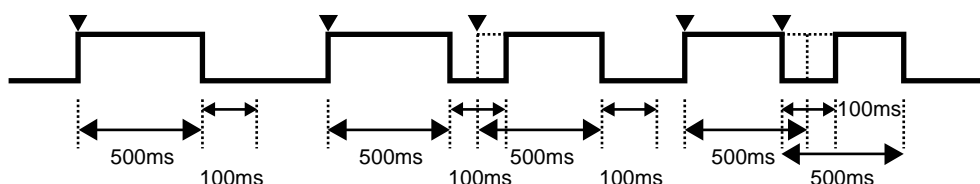
○: With function    ×: Without function

When the total power consumption reaches the pulse output unit set by the user, pulses are output from output terminal 1, and output terminal 2 (terminal set by the output terminal function setting).

The pulse ON time is normally fixed to 500 ms. The time for turning OFF the pulse is 100 ms minimum. However, if it reaches the pulse output unit again within 600 ms after having reached the pulse output unit, the pulse ON time becomes shorter, because higher priority is given to the next output. After that, pulse of 100 ms is turned OFF, and then the next pulse is turned ON. (The minimum pulse ON time is 100 ms.)

Pulse output is judged at sampling intervals.

Pulse output timing



\* ▼ indicates that the pulse output unit is reached.

\* For information on the output function, refer to page 3-18.

## 2) Alarm output

	PGR1C (Electric power/leakage)	PVS1C (Electric power/voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Voltage sag alarm	×	○	○	×	×	×
Leakage alarm	○	×	×	×	×	○
Active power alarm	○	○	×	×	○	×
Reactive power alarm	○	○	×	×	○	×
Power factor alarm	○	○	×	×	○	×
Over current alarm	○	○	×	○	○	×
Under current alarm	○	○	×	○	○	×
Over voltage alarm	○	○	○	○	×	×
Under voltage alarm	○	○	○	○	×	×
Open-phase alarm (Fixed unbalance factor)	○	○	○	○	×	×
Reverse phase alarm	○	○	○	○	×	×

○: With alarm output  
 ×: Without alarm output

\* For information on the alarm function (output function), refer to page 3-21.

## ● Communication function

The communication function using CompoWay/F and Modbus (RTU) is available.

## ● Logging function of measurement data

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	△	△

○: With function    △: Backup at intervals of 5 min and alarm history only.

Model KM1 has a data logging function. Log data is divided into the three types: data that is backed up every 5 min, data that is backed up at arbitrary timing (5 min, 10 min, 30 min, 1 hour, 2 hours, 6 hours, 12 hours, or 24 hours), and alarm history that is backed up when an alarm is generated.

### 1) Data that is backed up every 5 min

This data includes the following items.

Total active power consumption, total regenerated energy, and total reactive power

### 2) Data that can be saved as log data at arbitrary timings

Log data is saved in conjunction with the time of the main body.

For the items, refer to "List of log data to be saved" on Page A-18.

### 3) Alarm history

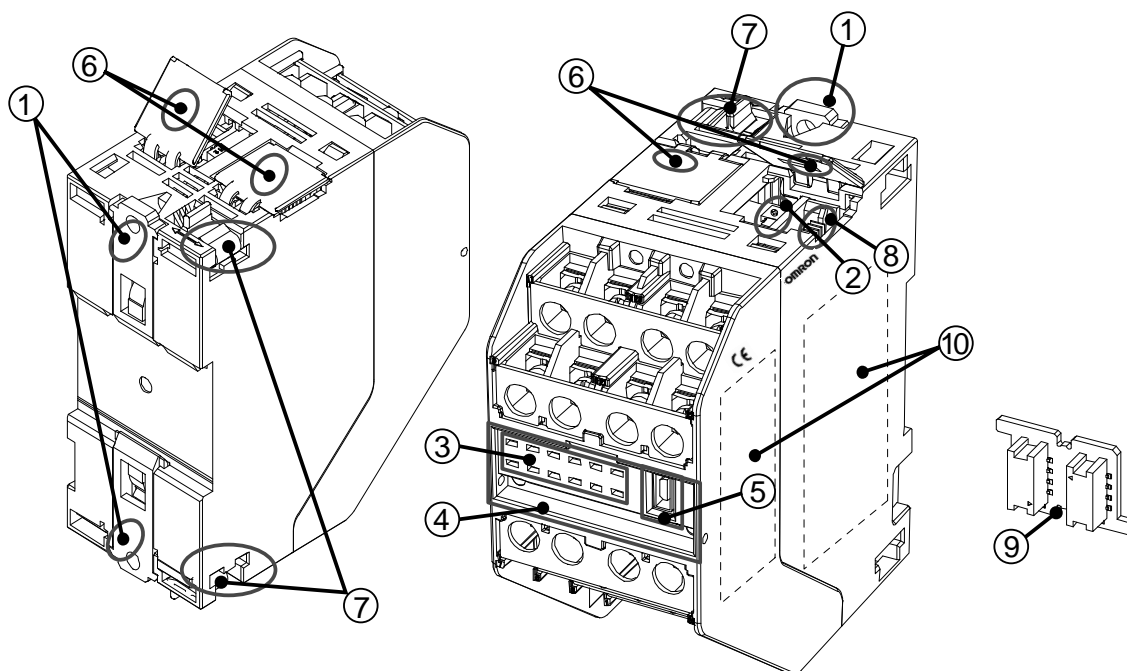
Histories of alarms generated in the past can be confirmed via communication.

Data is saved every 5 min.

For details, refer to Page 3-21.

## 1.2 Name and function of each part

### ■ Name of each part



[1] DIN hook

A hook, which is mounted in each of the upper and lower parts of the main body, is used to install the product in the DIN rail or on a wall. For the installation procedure, refer to Page 2-9 to 2-11.

[2] Setting switch

DIP switch and rotary switch are used. For the functions and setting procedure, refer to Page 1-7.

[3] Display unit

Displays the operating status of the main body by lighting or blinking LED. For details on the function of each LED, refer to Pages 1-6 to 4-3.

[4] Display cover

This cover protects the display unit and USB port.

[5] USB port

Insert a USB cable to carry out USB communication with the main body.

[6] Connection connector cover

This cover protects the connection connector (on the main body side).

[7] Horizontally connecting hook

A hook is installed in each of the upper and lower positions. These hooks are used to connect units to each other.

For the connection procedures ([7] to [9]), refer to Pages 2-7 to 2-8.

[8] Connector (on the main body side)

When connecting units to each other, insert the connector (accessory).

[9] Connector (accessory)


















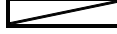




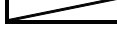
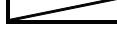


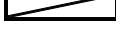
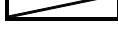
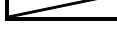





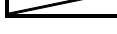
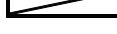


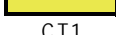





















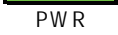











Inserted into the connector to connect connectors to each other (main body side).

\* It does not come with the measurement master.

[10] Rating name plate

Displays the model name, ratings, terminal assignments, etc.

## ■ Explanation of the display unit

PGR1C (Electric power /leakage)						
	PWR	ALM	CT1	CT2	CT3	ZCT
						
	CONN	COMM	OUT1	OUT2		
PVS1C (Electric power /voltage sag)						
	PWR	ALM	CT1	CT2	CT3	
						
	CONN	COMM	OUT1	OUT2		
VSU1B (Voltage sag)						
	PWR	ALM				
						
	CONN	COMM	OUT1	OUT2		
VAU1B (Voltage/current)						
	PWR	ALM	CT1	CT2	CT3	
						
	CONN	COMM	OUT1	OUT2		
CTD8E (CT extension)						
	PWR	ALM	CT1	CT2	CT3	CT4
						
	CONN	COMM	CT5	CT6	CT7	CT8
ZCT8E (ZCT extension)						
	PWR	ALM	ZCT1	ZCT2	ZCT3	ZCT4
						
	CONN	COMM	ZCT5	ZCT6	ZCT7	ZCT8

### \* Explanation of abbreviations

PWR (Green) : Lights when the power supply is turned ON. Blinks when an EEPROM, RAM, or RTC error occurs.

CONN (Yellow) : Lights when multiple units are connected.

ALM (Red) : Lights when an alarm is output.

COMM (Yellow): Lights when RS-485 or USB communication is carried out.

CT (Yellow) : Corresponding LED lights at the time of CT input.

ZCT (Yellow) : Corresponding LED lights at the time of ZCT input.

OUT (Yellow) : Corresponding LED lights at the time of output.

\* Normal and abnormal states are displayed by combining above LEDs that lights up or blink.  
For details, refer to Page 4-3.

## ■ Setting switch

DIP switches and a rotary switch are used for setting switches. DIP switches select communication protocols, while a rotary switch sets a slave ID. When multiple units are connected, slave IDs are used to identify the units. (A rotary switch is used only for functional slaves and CT extension slaves. The slave for measurement master will have a fixed ID of 0. )

- DIP switch

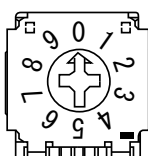
No.1  $\Rightarrow$  Idle

No.2 ⇒ Selection of communication protocol: OFF CompoWay/F  
ON Modbus



- Rotary switch

Set a slave ID. : Do not use the IDs of 0 and 6-9.)



- \* The slave ID 5 setting is available in Model KM1-EMU8A-FLK only. Do not use the setting in Model KE1 series.
- \* If multiple units are connected, set slave IDs in a way to avoid duplicates.

- \* For information on Model KM1 series, refer to "Model KM1 User's Manual" (KANC-701).
- \* For information on the communication slave (DRT (DeviceNet)), refer to Model KE1 DeviceNet Communication Unit User's Manual" (SGTE-718).

## ● How to use setting switches

- Be sure to use the switch when the power supply is turned OFF. The settings will be read only when connected to a power supply and any change made during power distribution will not be reflected. To make change, switch off the power first and change the settings. And switch on the power again.
- When selecting a switch, set it to the specified position securely by using a small flat-head screwdriver.

## 1.3 System configuration

### ■ Model type

In this manual, an object that has been set in a state where various measurements and monitor can be performed is defined as "System."

This product allows an independent unit (single-unit configuration) or multiple units connected (multiple-unit connection configuration) to perform data measurements and status monitor. From here, the description of this manual therefore employs as "a system" an object that has been set in a state where various measurements and monitor can be done, regardless of whether one-unit configuration or multiple-unit connection configuration is used.

		Measurement master		Functional slave		CT extension slave		Communication slave
		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)	DRT (DeviceNet)
Master behavior		○	○	×	×	×	×	×
Independent behavior		○	○	○	○	×	×	×
CT expansion		○	○	×	×	×	×	×
ZCT expansion		○	×	×	×	×	×	×
Measurement (Monitoring) function	Voltage sag	×	○	○	×	×	×	×
	Leakage	○	×	×	×	×	○	×
	Electric power	○	○	×	×	○	×	×
	Electric currents	○	○	×	○	○	×	×
	Voltage	○	○	○	○	×	×	×
	Open phase	○	○	○	○	×	×	×
	Reverse phase	○	○	○	○	×	×	×
Power voltage		AC100~240V 50/60Hz				None (supplied from measurement master)		AC100~240V 50/60Hz

○: Enabled (with)  
X: Disabled (without)

- \* Master behavior is an operation for setting connections with slaves or sending or receiving measurement data on slaves.
- \* Independent behavior is an operation that is performed for measurements or status monitor with a single unit configuration adopted.
- \* CT expansion is a function by which CT extension slaves can be connected.
- \* ZCT extension is the function allowing the connection of ZCT extension slaves..



## ■ Configuration

This product is used in the unit independent or multiple-unit connection configuration (connection of the measurement master with functional slave and CT extension slave).

- \*1. For information on the communication slave, refer to "Model KE1 DeviceNet Communication Unit User's Manual" (SGTE-718).
- \* 2. For information on the combination of units, refer to "Model KM1/KE1 Series List of Combinations" on page A-20.

### ● Multiple-unit connection

Connecting the measurement master to a functional slave or a CT extension slave can expand functions.

(Functional slaves cannot be connected to each other.)

In addition, a CT extension slave must be connected to the measurement master.

- \* A CT extension slave behaves when power voltage is applied from the measurement master.

Connection of units uses a horizontally connecting hook and a connector. Appropriately insert the connector to send and receive data between the units and to apply power voltage.

Inappropriate insertion may cause problems, such as data communication error and power failure in the unit. (Figure 2)

- \* For the connection procedures, refer to Page 2-7.

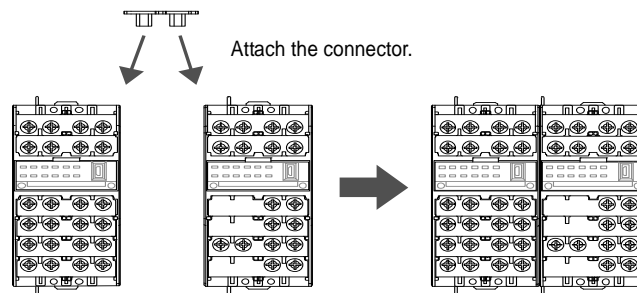


Figure 1

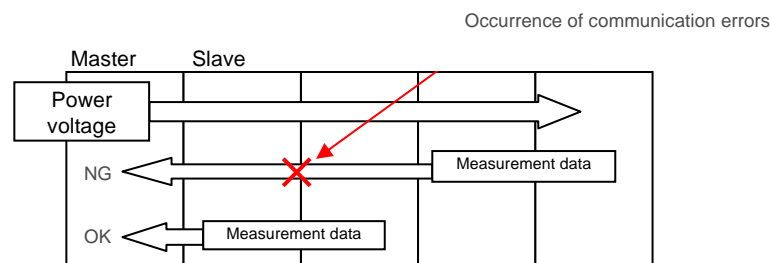


Figure 2

Note: Power voltage is applied to the CT extension slave only.

If settings of a functional slave or a CT extension slave are changed directly not via the master when multiple units are connected, supply the power to the system all over again.

- \* As shown in Figure 3, prevent multiple wiring for RS-485 connection within a system.

### RS-485

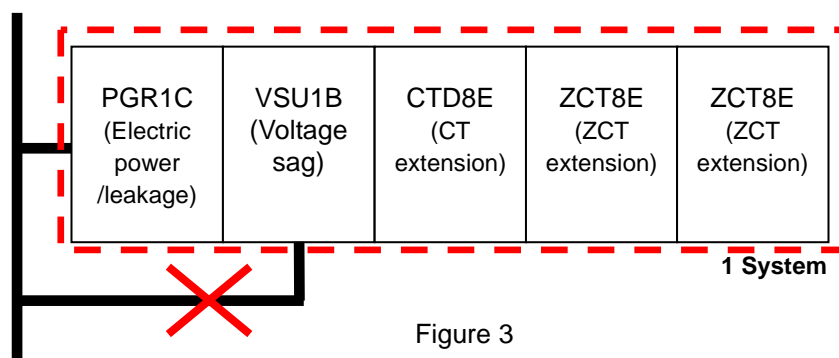
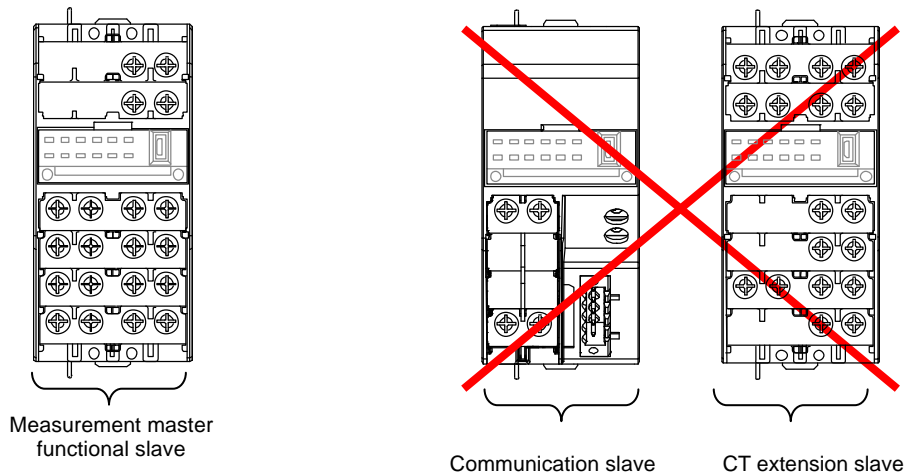


Figure 3

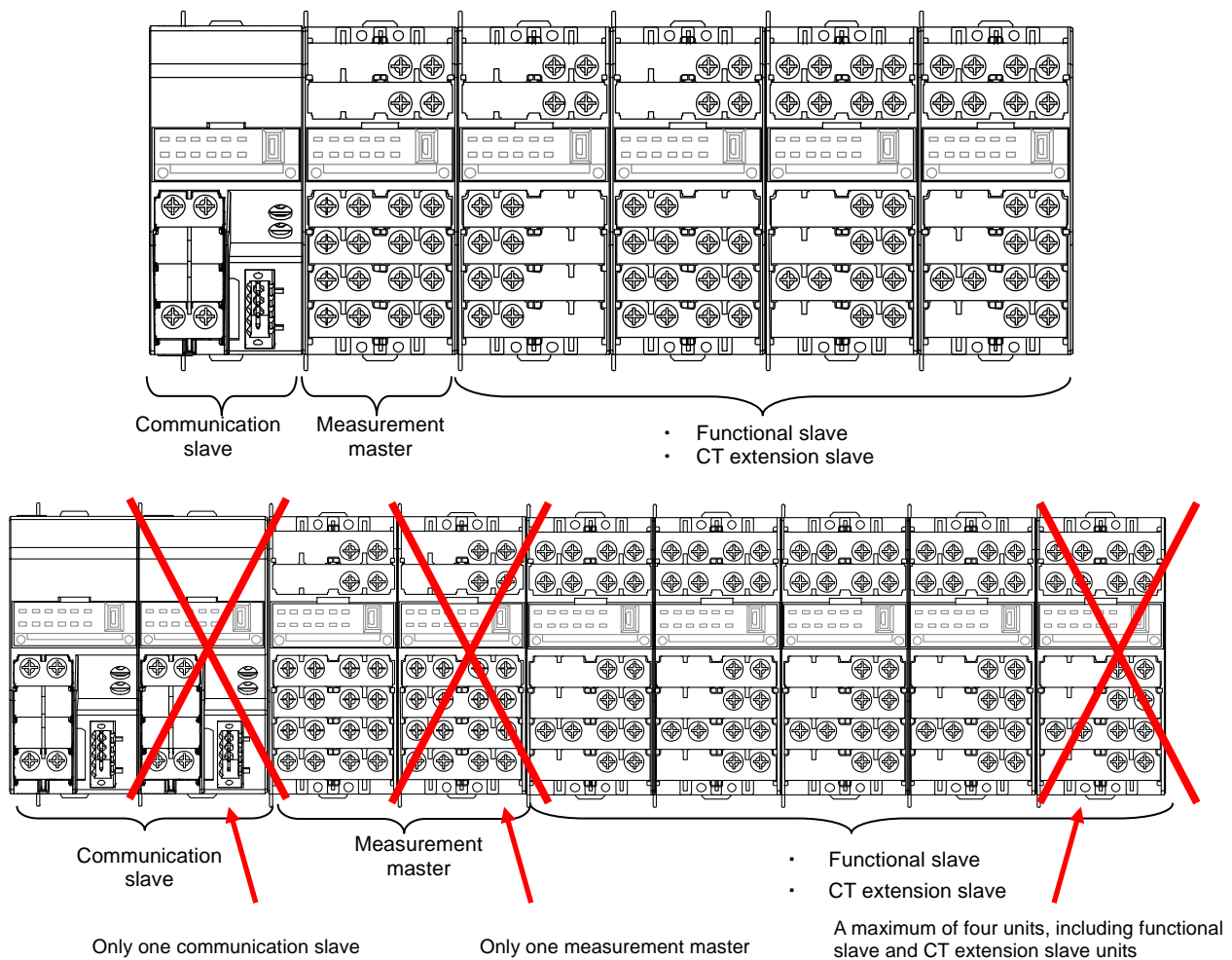
## ● Minimum configuration

- A measurement master or functional slave can be used independently.
- \* A single unit of CT expansion slave is not available.



## ● Maximum configuration

- One measurement master can connect to a maximum of four units, including functional slave and CT extension slave units. A communication slave can connect to only one unit.



- \* For the communication slave (DRT (DeviceNet)), refer to "Model KE1 User's Manual" (SGTE-717) and "Model KE1 User's Manual for DeviceNet Communication Unit" (SGTE-718).

## ● Multiple-system configuration

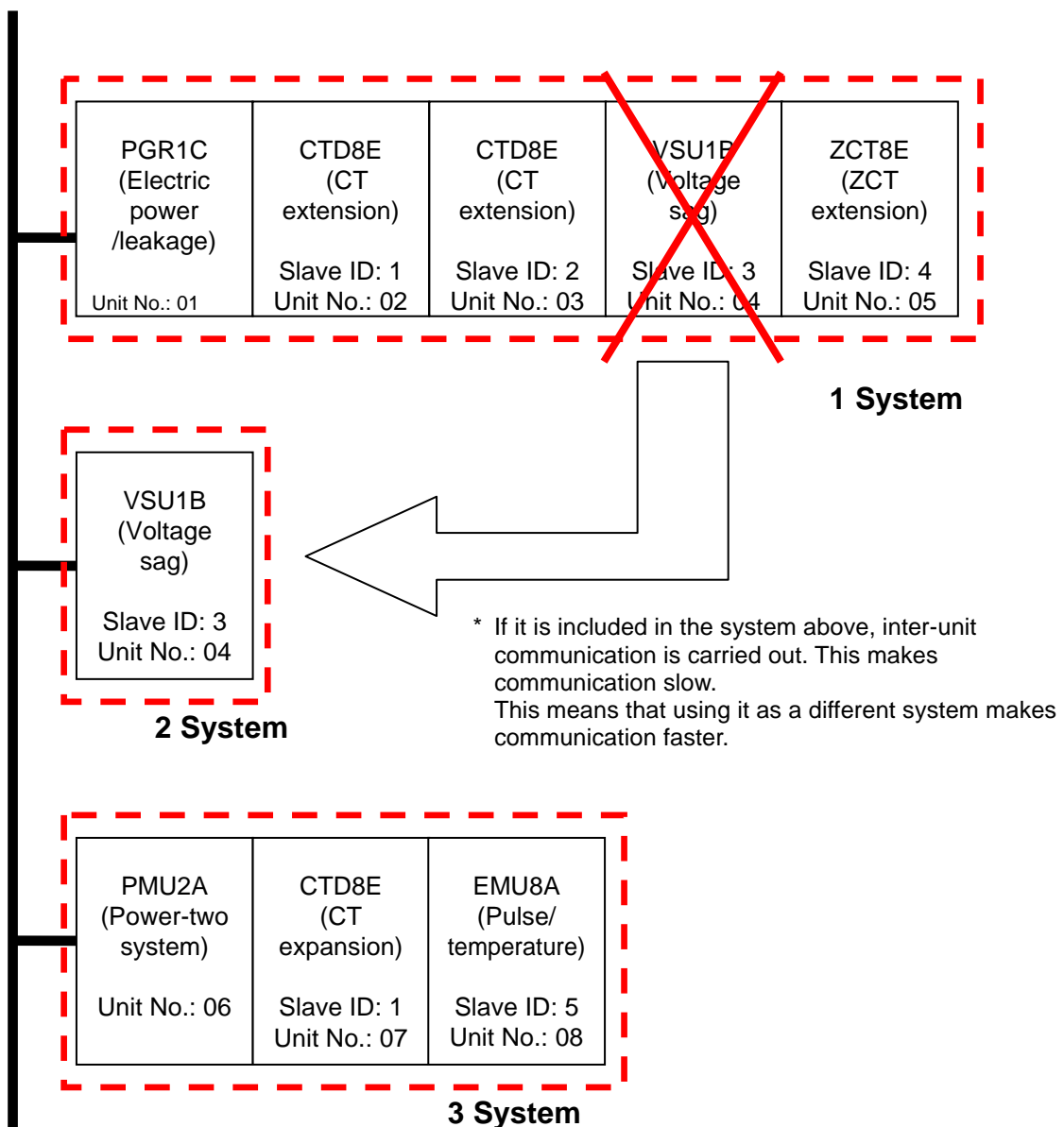
Model KE1 is a system containing a maximum of six units. Multiple-system configuration can be made via RS-485 communication.

The diagram below shows an example of the configuration consisting of the following multiple systems where masters are connected with the wire for RS-485 communication. The three systems are the configuration of the connection between power measurement and leakage detection in Model KE1, single unit configuration for voltage sag detection, and the configuration of the connection between energy classification and power measurement in Model KM1 series.

### ◆ Example of multiple-system configuration

Purpose of use : Classification of energy by equipment of single-phase 3-wire system line.  
Power measurements by single phase 3-wire system, 3-phase 3-wire system, and 3-phase 4-wire system  
3-phase 3-wire system earth leakage and instantaneous voltage drop monitoring.

### RS-485



- \* Set slave IDs in a way to avoid duplicates within the same system.
- \* Make sure the communication protocol matches across the entire systems.
- \* Set unit numbers in a way to avoid duplicates across the entire systems.
- \* Within a system where multiple units are connected, do not use RS-485 wiring for multiple connections.

## 1.4 Format standard

### ■ Format standard

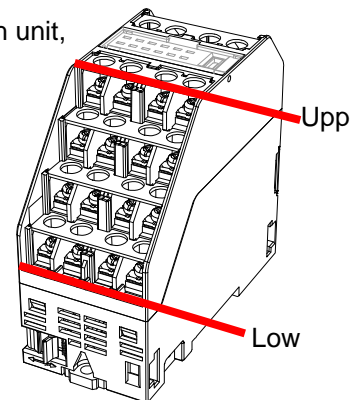
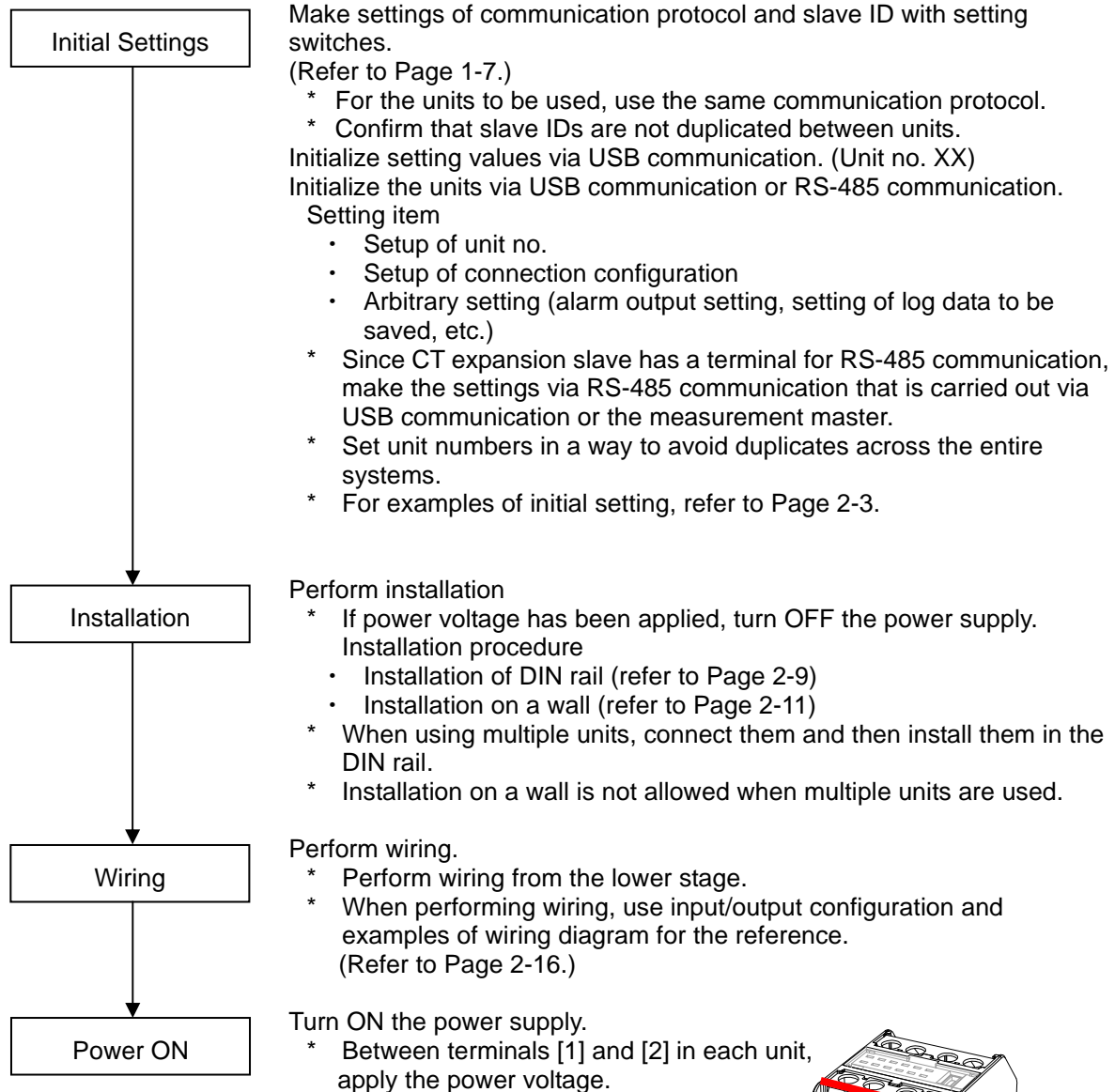
**K** □ **1** - □ □ □ □ □ - **FLK**  
 [1] [2] [3] [4] [5] [6] [7]

- |         |   |   |
|---------|---|---|
| [1] K   | : | Product of measurement monitor                  |
| [2] E   | : | Smart Measurement and Monitoring Instrument     |
| M       | : | Smart Power Monitor                             |
| E       | : | Smart Measurement and Monitoring Instrument     |
| [3] 1   | : | Series No.                                      |
| [4] □□□ | : | Unit type                                       |
|         |   | PGR Power/leakage monitor unit                  |
|         |   | PVS Power/voltage sag monitor unit              |
|         |   | VSU Voltage sag monitor unit                    |
|         |   | VAU Voltage/current monitor unit                |
|         |   | CTD CT Extension Unit                           |
|         |   | ZCT ZCT Extension Unit                          |
|         |   | DRT DeviceNet communication unit                |
|         |   | EMU Pulse/temperature input unit                |
| [5] □   | : | Number of input circuits                        |
| [6] □   | : | Blank: No output                                |
|         |   | A NPN transistor X 3 outputs                    |
|         |   | B 1a relay X 2 output                           |
|         |   | C 1a relay x 1 output + NPN transistor 1 output |
|         |   | E 1a relay x 1 output                           |
| [7] FLK | : | With communication function                     |

## Chapter 2. Preparation

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## 2.1 Flow before use



- \* For the setting, use KM1/KE1-Setting.  
For how to use KM1/KE1-Setting, refer to "KM1/KM1 User's Manual for Setting Tool" (GAMS-010).  
Download KM1/KE1-Setting and the manual at i-Web (<http://www.fa.omron.co.jp/>).

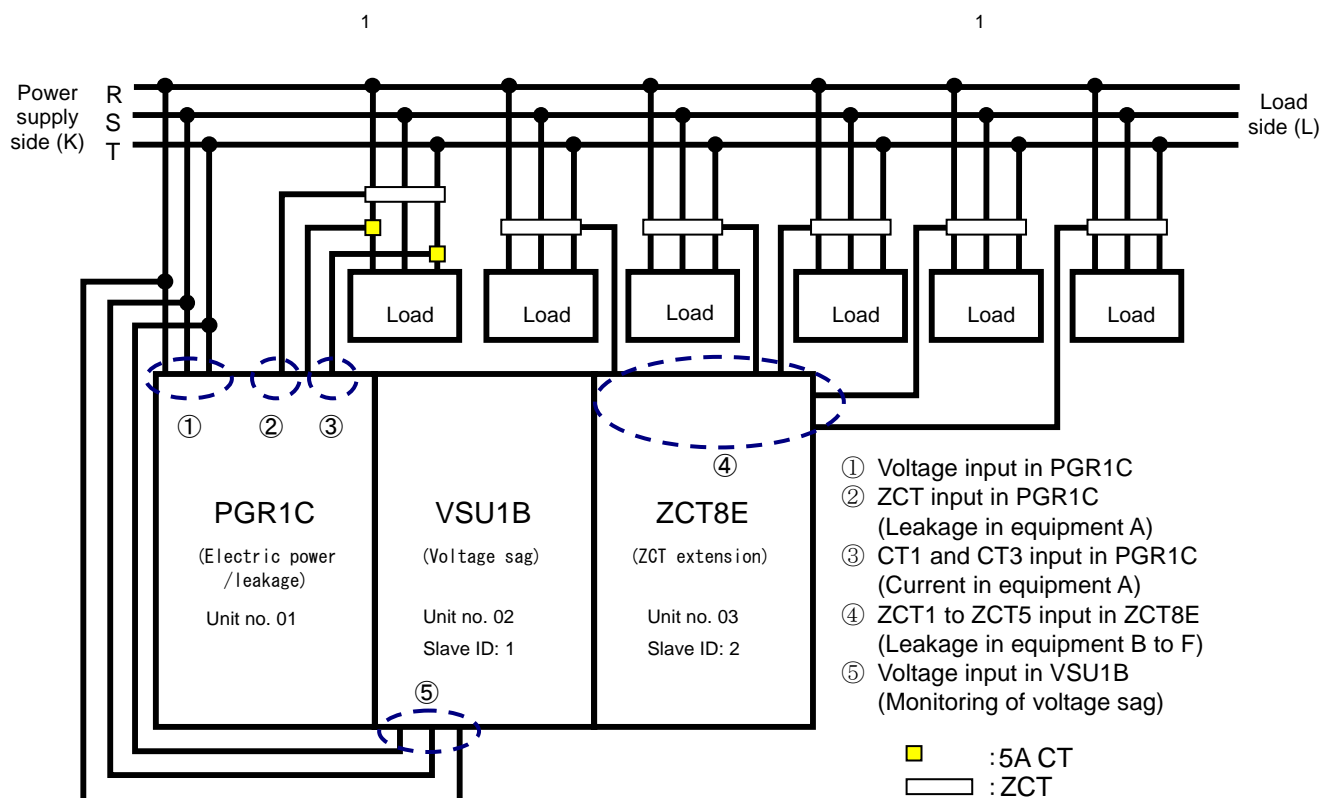
## ■ Setting example

- System Configuration : Master --- PGR1C (Electric power/leakage)  
Slave --- VSU1B (Voltage sag)  
ZCT8E (ZCT extension)
- Purpose : Measurement of power of 3-phase 3-wire line and monitoring of voltage sag  
Monitoring of leakage in pieces of equipment A to F connected to 3-phase 3-wire line
- Setting switch : Set the Pin no. 2 of DIP switch to OFF (CompoWay/F) across the entire system.  
Using the rotary switch, set the slave ID.  
CTD8E (CT expansion) --- 1 (Because the setting range of slave ID is from 1 to 4)
- Unit no. :  
CTD8E --- 03 (Because the setting range of unit no. is from 00 to 99.)

\* A unit no. is assigned by higher equipment (example: PC) to identify units from each other.

Connection configuration : H'11

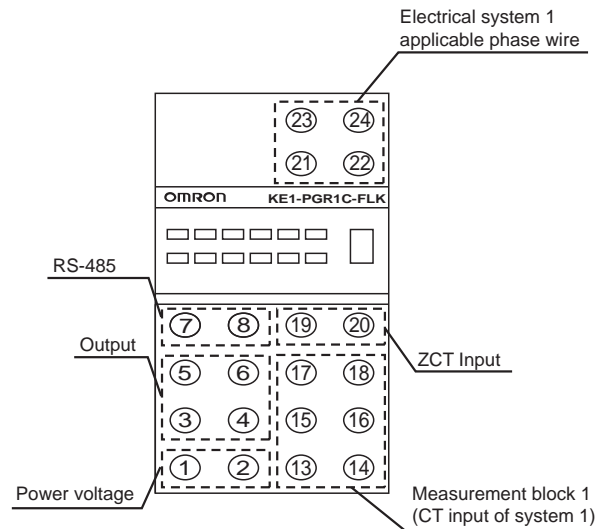
0	0	0	1	0	0	0	1
-	-	With/without slave ID 6	With/without slave ID 5	With/without slave ID 4	With/without slave ID 3	With/without slave ID 2	With/without slave ID 1



- Setting list of units

## PGR1C (Electric power/leakage)

Electrical system 1 applicable phase wire	: 3-phase 3-wire
Dedicated CT type for measuring block 1	: 5 A
Leakage comparison value	: 30 mA
Leakage operating time 1	: 0.5 s
Unit no.	: 01
Communication speed	: 9.6 kbps
Data bit length	: 7 bits
Stop bit length	: 2 bits
Vertical parity	: Even
Transmission wait time	: 20 ms

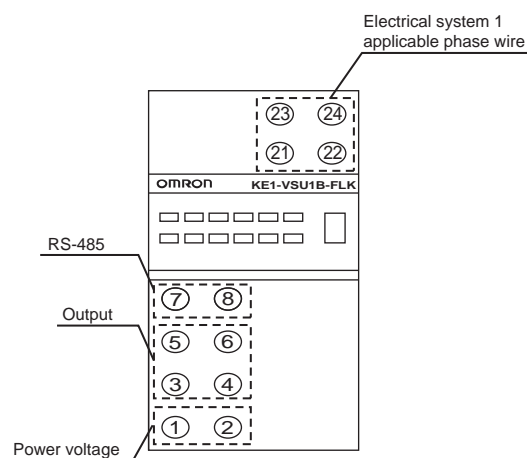




## VSU1B (Voltage sag)

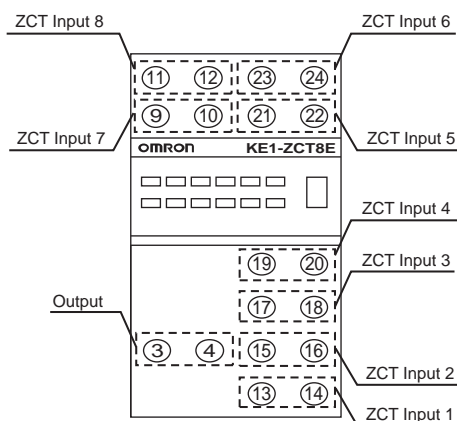
Phase and wire system where electrical system 1 is applied : 3-phase 3-wire

Voltage sag detection function 1	: Vrs (Monitoring of voltage between R and S)
Voltage sag detection function 2	: Vst (Monitoring of voltage between S and T)
Voltage sag detection function 3	: Vtr (Monitoring of voltage between T and R)
Voltage sag detection voltage 1	: 400V
Voltage sag detection voltage 2	: 400V
Voltage sag detection voltage 3	: 400V
Voltage sag duration 1	: 0.02s
Voltage sag duration 2	: 0.02s
Voltage sag duration 3	: 0.02a
Unit no.	: 02
Communication speed	: 9.6 kbps
Data bit length	: 7 bits
Stop bit length	: 2 bits
Vertical parity	: Even
Transmission wait time	: 20 ms



## ZCT8E (ZCT extension)

Leakage comparison value 1	: 30 mA
Leakage comparison value 2	: 30 mA
Leakage comparison value 3	: 30 mA
Leakage comparison value 4	: 30 mA
Leakage comparison value 5	: 30 mA
Leakage operating time 1	: 0.5 s
Leakage operating time 2	: 0.5 s
Leakage operating time 3	: 0.5 s
Leakage operating time 4	: 0.5 s
Leakage operating time 5	: 0.5 s
Unit no.	: 03

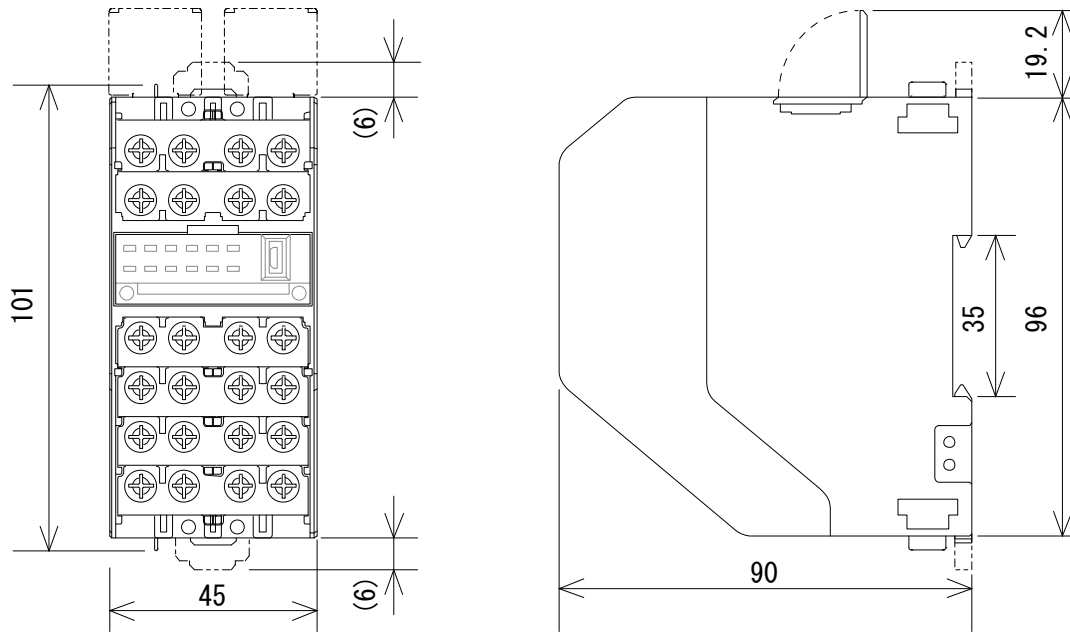


\* For the setting range for each item, refer to "List of parameters" on Page A-13.

## 2.2 Installation

### ■ External dimensions (unit: mm)

45 in width X 96 in height X 90 in depth (Protruding portion is not included)



\* Dimensions put in parentheses are applicable when DIN hook is pulled out.

## ■ Connection method

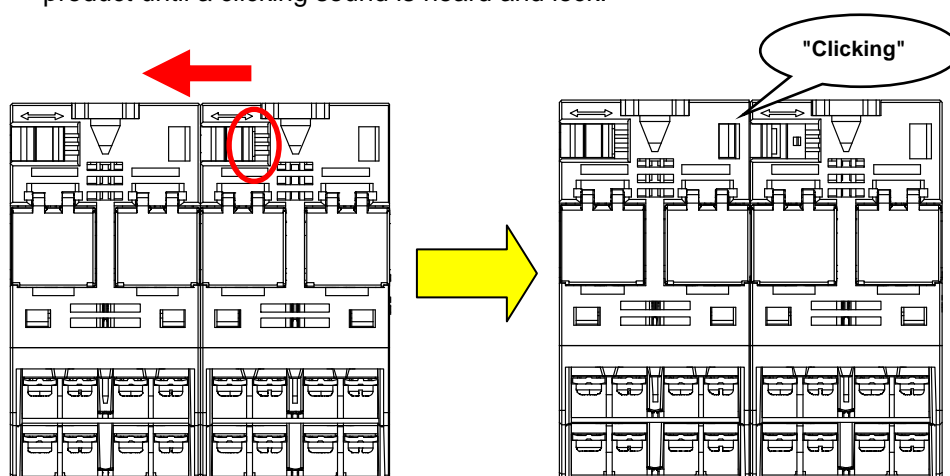
Using horizontally connecting hooks and connection connectors, connect adjacent units to each other.

### ● Horizontally connecting hook

This hook is used to securely fix units to each other on the DIN rail.

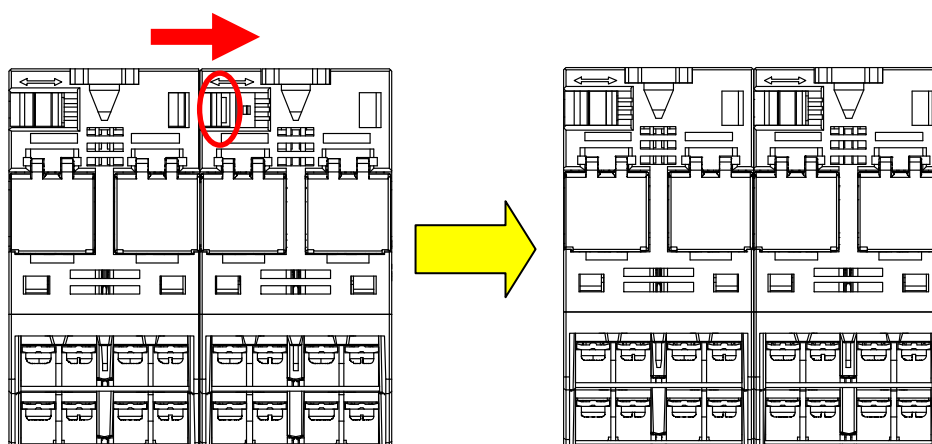
#### • Installation procedure

Slide the white, horizontally connecting hooks on top and at the bottom of the product until a clicking sound is heard and lock.



#### • Removal procedure

Pushing the protruding portion encircled, slide it in the direction opposite to that in which locking is done for installation.



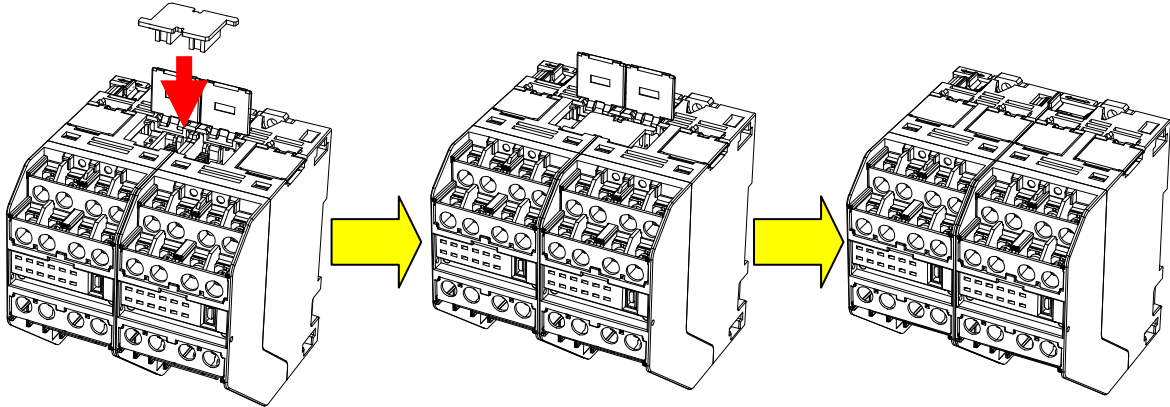
## • Connector

This connector is used to connect units to each other.

Inter-unit communication can be carried out to expand functions.

### • Installation procedure

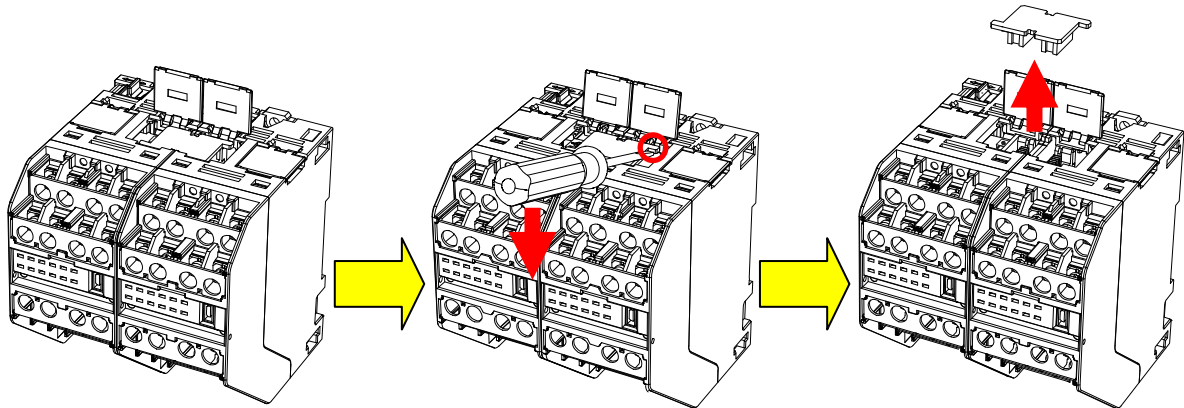
Lift the cover on top of the product and set the connection connector. Close the cover before use.



### • Removal procedure

Open the lid at the top of the product, and remove the connection connector by hooking a flat head screwdriver on the red circle portion shown in the figure.

\* Be careful not to make the flat head screwdriver contact the internal board.



\* 1 When multiple units are used within the system, be sure to install the connector by locking it with the horizontal connecting hook.

## ■ Installation procedure

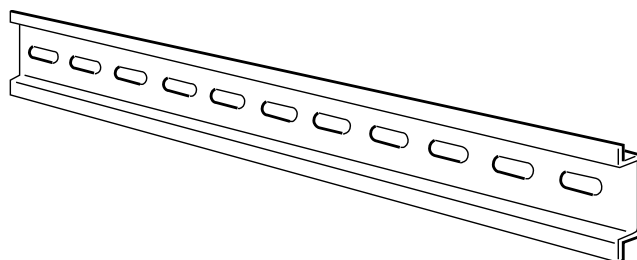
### • Installation of DIN rail

When installing Model KE1, use the DIN rail or screws.

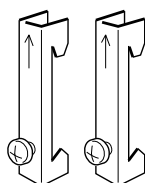
When using the DIN rail, fix it with three or more screws within the control panel.

### • Recommended DIN rail

Model	Dimensions	Manufacturer
Model PFP-100N	1,000 mm	OMRON
Model PFP-50N	500 mm	

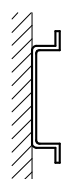


### • End plate Model PFP-M (2 pieces)



### • Installation direction

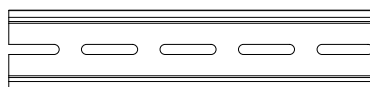
The installation direction of Model KE1 has been determined. As shown below, place the DIN rail vertical to the ground and install it in the horizontal direction.



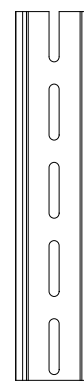
Vertical: ○



Horizontal: ×



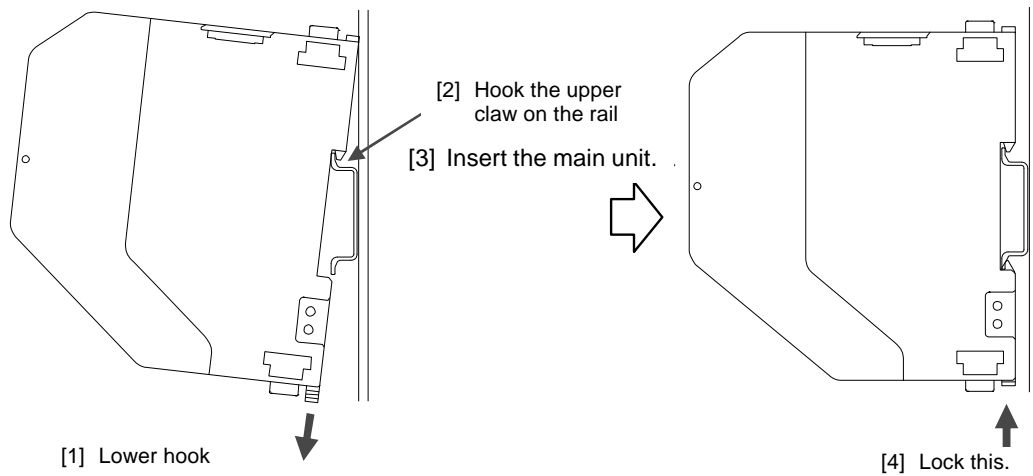
Lateral: ○



Longitudinal: X

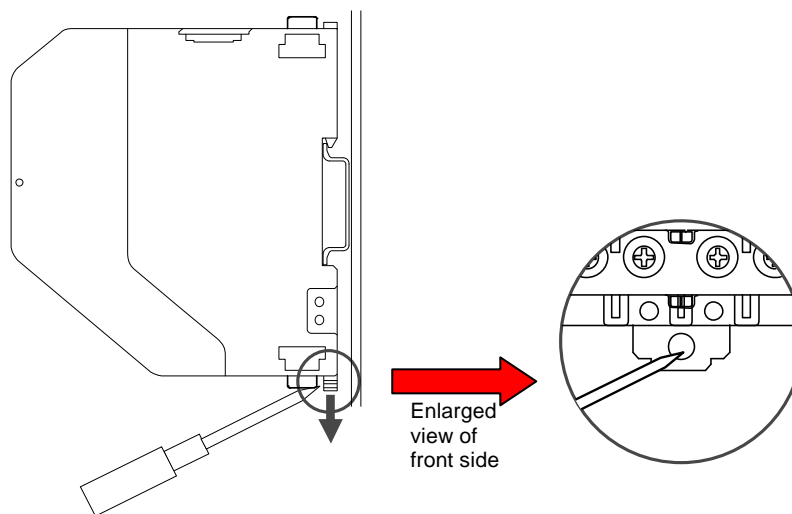
- Installation procedure

Lower the DIN hook, hook the upper claw on the DIN rail, and push it until the DIN hook can be locked. Then lock it by raising the hook.



- Removal procedure

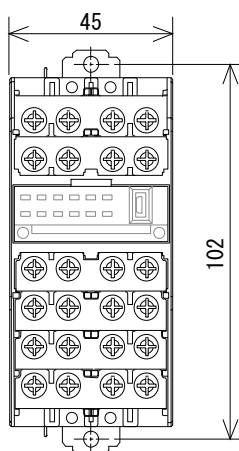
Pull the DIN hook out with a flat head screwdriver, etc., and then raise it from the lower side.



- Installation on a wall

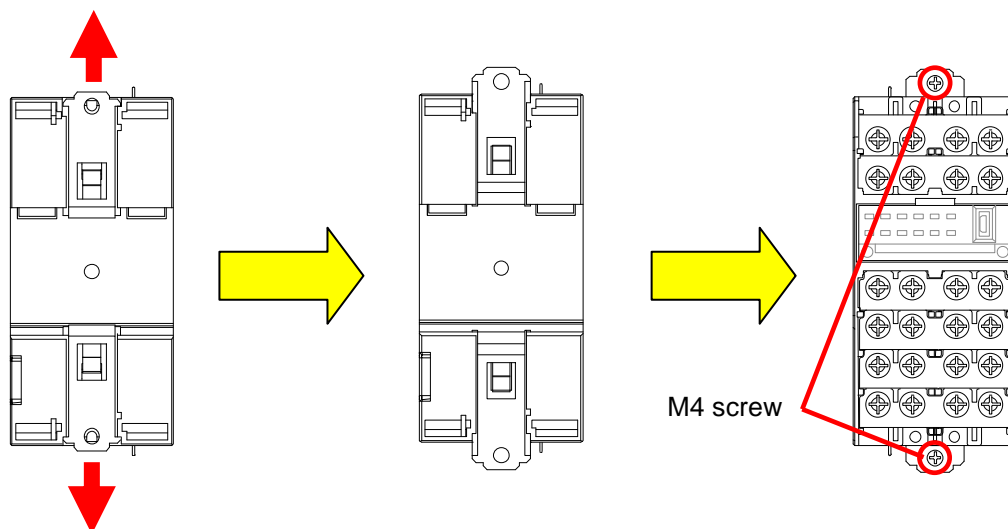
If the product is used as a single unit, it can be installed on a wall. When using multiple units, be sure to install them in the DIN rail.

- Installation procedure



- Installation procedure

Pull two DIN hooks on the back of the product to the outside until a clicking sound is heard. Put them in the DIN hook holes and install them with M4 screws.



## 2.3 Installation of dedicated CT, ZCT

The dedicated CT, ZCT is divided into the two types: split type and panel fixed (through) type.  
[Common]

- Measurement with single-phase 2-wire requires one dedicated CT, measurement with single-phase 3-wire or 3-phase 3-wire requires two dedicated CTs, and measurement with 3-phase 4-wire requires three dedicated CTs.
- The dedicated ZCT can be used for the measurement in single-phase 2-wire, single-phase 3-wire, 3-phase 3-wire, and 3-phase 4-wire.
- Use of dedicated CTs in a circuit requires all the CTs to have the same standard.
- The standard of the dedicated CTs to be used should match the settings of the dedicated CT of Model KE1.
- A dedicated CT has its polarity. Carry out wiring correctly between (K) and (L). For terminal positions, refer to Page 2-16 and later.
- Before making connections, confirm the directions of power supply side (K) and load side (L). Wrong direction prevents correct measurements.
- Securely close the terminal cover on the secondary side of dedicated CT.
- Do not ground the dedicated CT. Doing so causes a failure.
- Electric shocks may occur.  
For the primary side wire to be clamped in CT, be sure to use a covered electric wire of 600 V or more in basic insulation.  
When using a conductive object, such as bus bar, for clamping, ensure the basic insulation at least by, e.g., covering with an insulator.
- Avoid direct clamping in a line of 600 VAC or more.

[Split type]

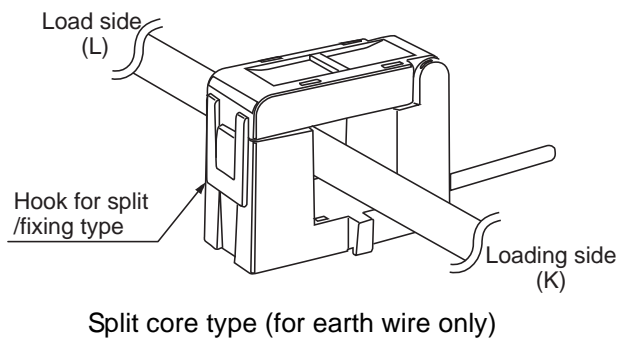
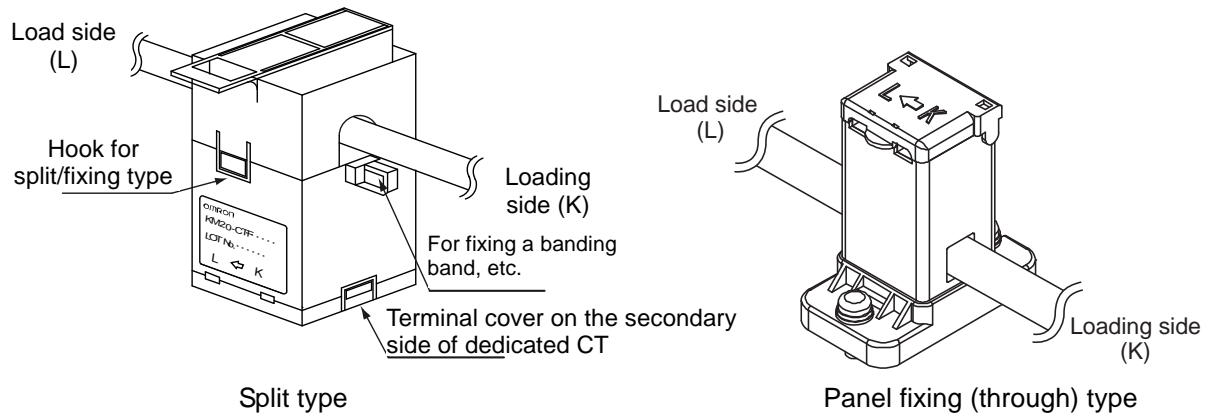
- Open the hook for the split/fixed type and clamp each phase. After clamping, securely perform fitting until a clicking sound is heard.

[Panel fixing (through) type]

- Securely fix the dedicated CT, ZCT to the panel, etc.

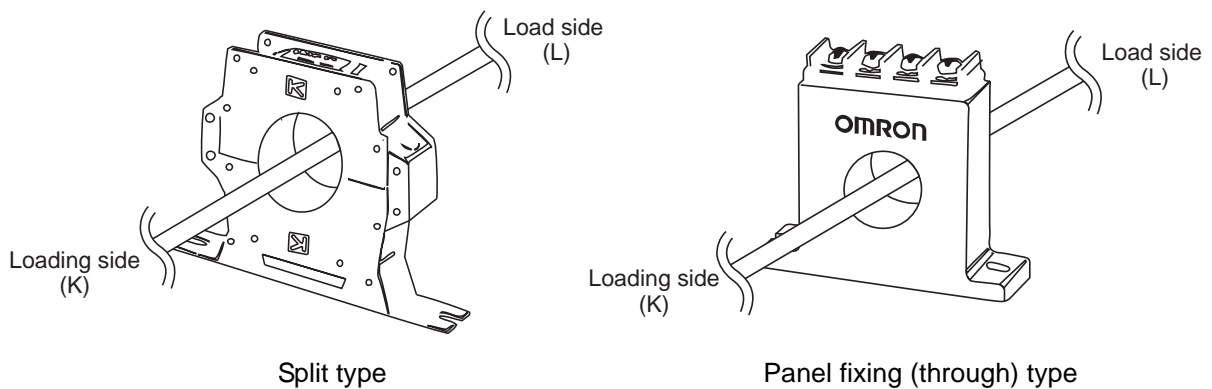


## 【CT】



\* Connect the split core type CT (for earth wire only) to the ZCT terminal, not the CT terminal, to use the CT as ZCT.

## 【ZCT】

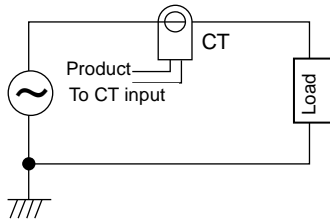


## ■ Wire connection and installation of dedicated CT, ZCT

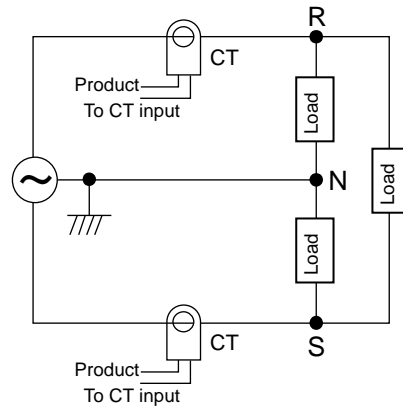
This section describes the wire connection for each phase wire and the installation of dedicated CT.

### ● Connection of dedicated CT

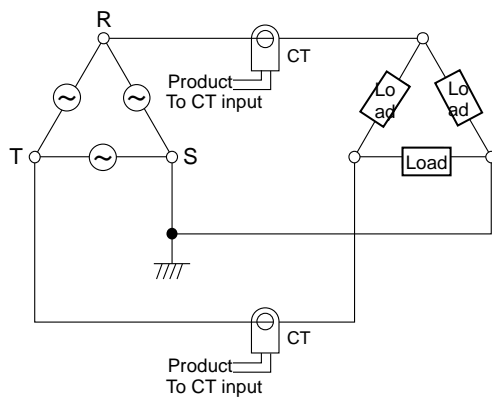
Single-phase 2-wire



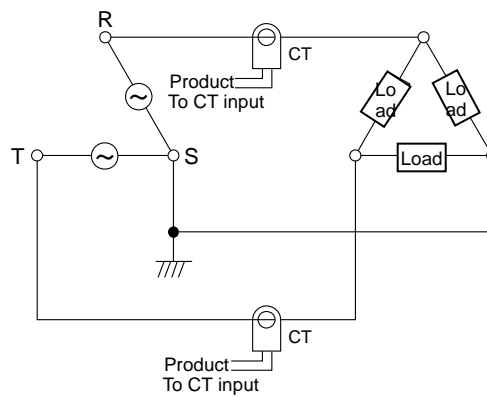
Single-phase 3-wire



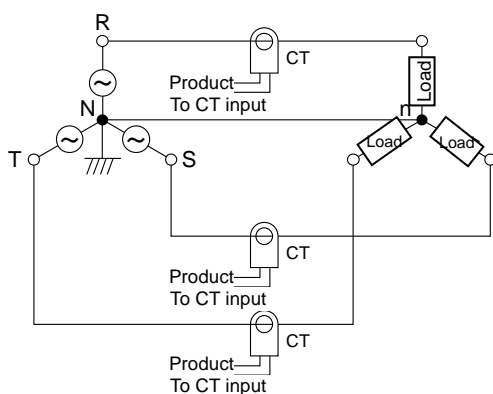
3-phase 3-wire ( $\Delta$  (delta) wire connection)



3-phase 3-wire (V wire connection)



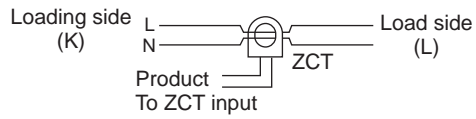
3-phase 4 wire (Y (star) wire connection)



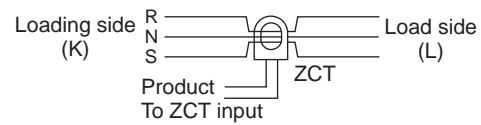
\* When installing the dedicated CT, set K and L at the power supply side and load side, respectively.

- Connection of dedicated ZCT

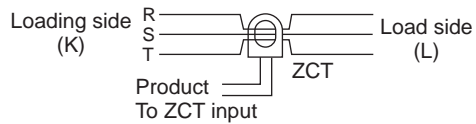
Single-phase 2-wire



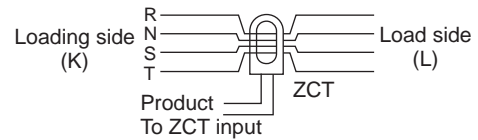
Single-phase 3-wire



3-phase 3-wire



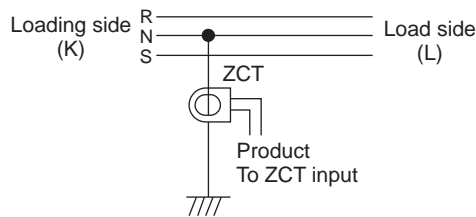
3-phase 4-wire



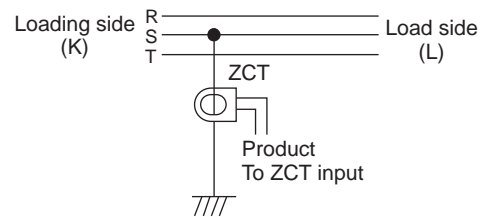
- \* When installing the dedicated ZCT, set K and L at the power supply side and load side, respectively.

- Connection of split core type CT for earth wire only

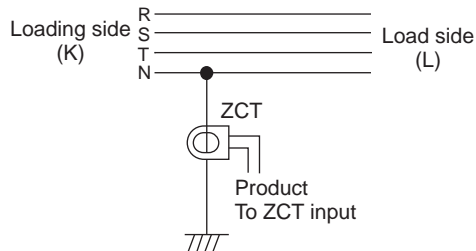
Single-phase 3-wire



3-phase 3-wire



3-phase 4-wire



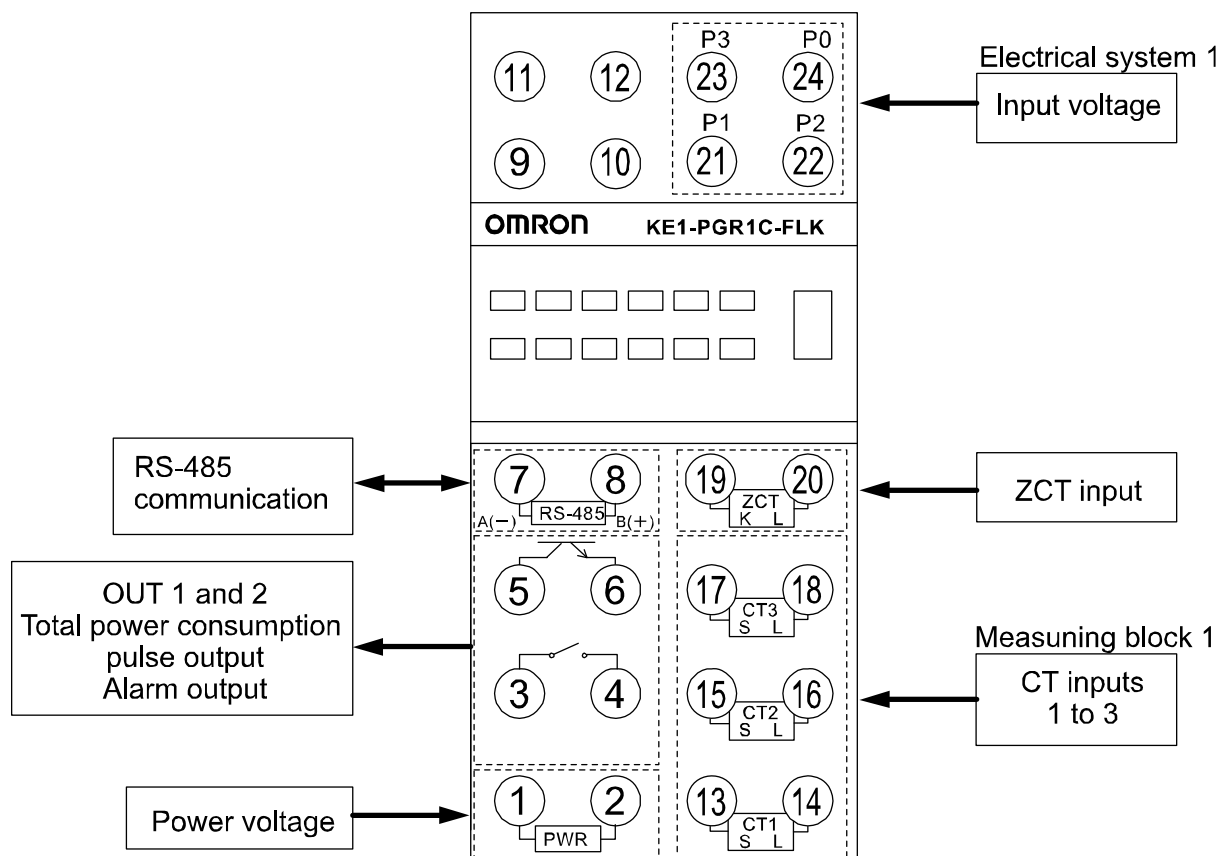
- \* Install the split core type CT for earth wire only so that K comes on the power supply side and L on the GND side.

## 2.4 Input/output configuration and example of wiring diagram

Terminal arrangements should be confirmed according to the numbers printed on the side face of the product and on the terminal block.

### ■ Model KE1-PGR1C-FLK

- Terminal arrangements and input/output configuration



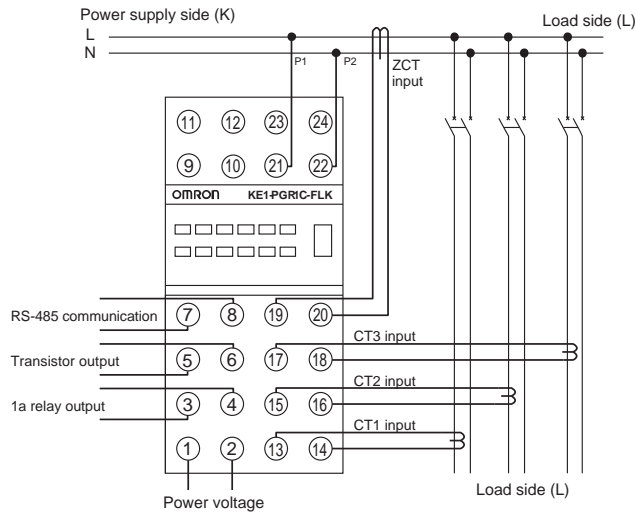
- Function of terminal

①	Power voltage	⑨	NC	⑰	CT-3S *
②	(AC100 to 240 V)	⑩	NC	⑱	CT-3L *
③	1a relay output	⑪	NC	⑲	ZCT-K
④		⑫	NC	⑳	ZCT-L
⑤	Transistor output	⑬	CT-1S *	㉑	Measurement voltage input P1
⑥	Transistor output COM	⑭	CT-1L *	㉒	Measurement voltage input P2
⑦	RS-485 A (-)	⑮	CT-2S *	㉓	Measurement voltage input P3
⑧	RS-485 B (+)	⑯	CT-2L *	㉔	Measurement voltage input P0

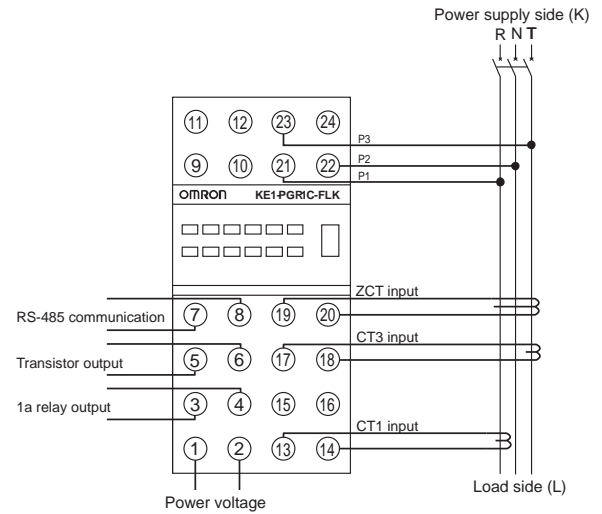
\* The capacity of CT-1 to CT-3 must be same.

- Example of wiring diagram

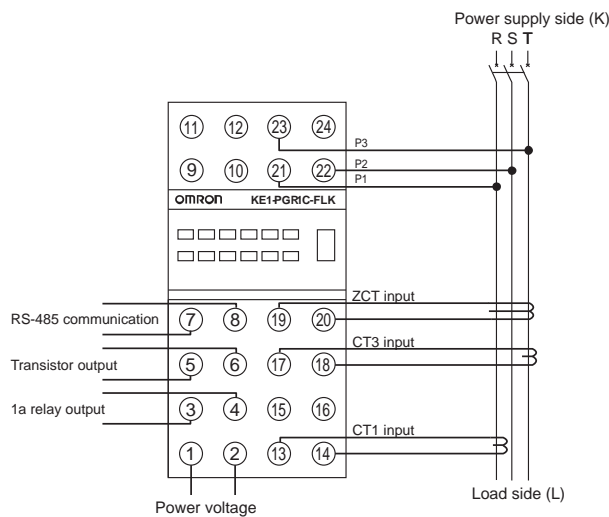
- Single-2 wire



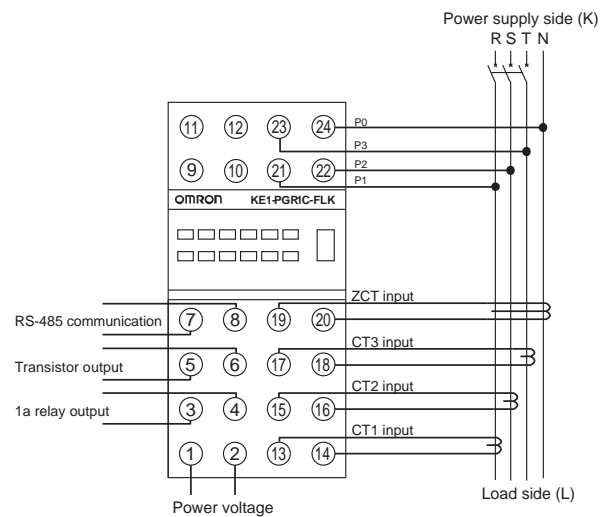
- Single-3 wire



- 3-phase 3-wire

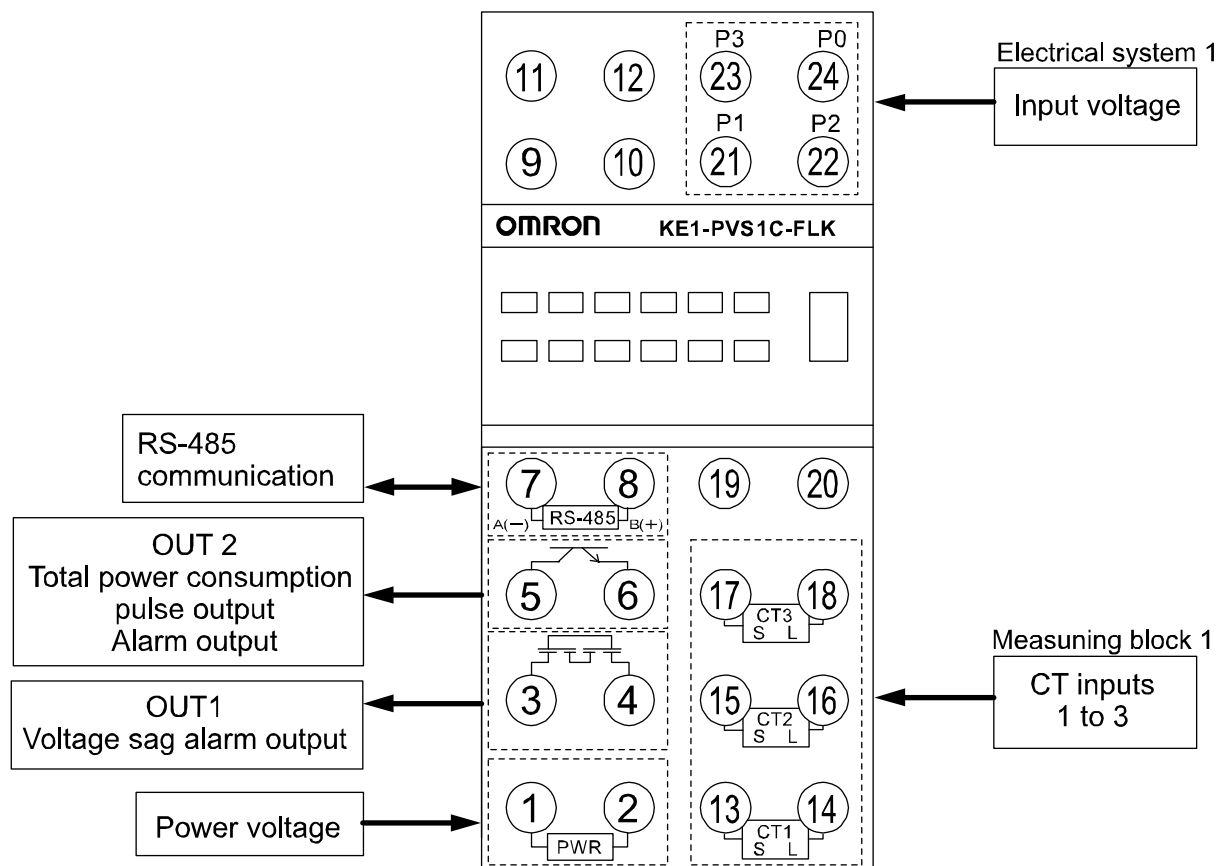


- 3-phase 4-wire



## ■ Model KE1-PVS1C-FLK

- Terminal arrangements and input/output configuration



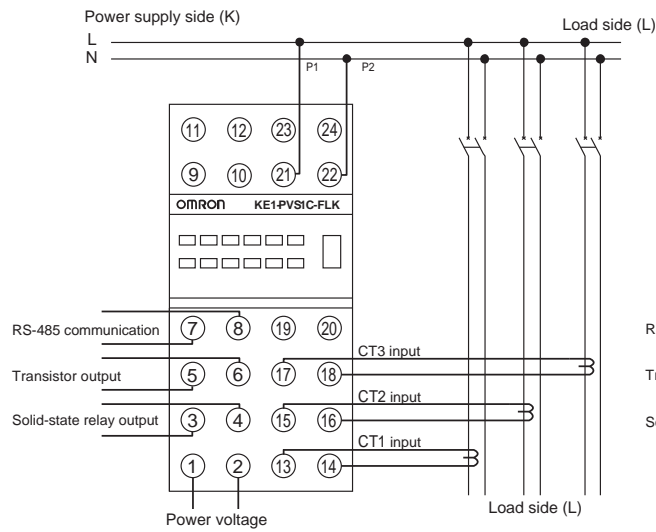
- Function of terminal

①	Power voltage (AC100 to 240 V)	⑨	NC	⑰	CT-3S *
②		⑩	NC	⑱	CT-3L *
③	Solid-state relay output	⑪	NC	⑲	NC
④		⑫	NC	⑳	NC
⑤	Transistor output	⑬	CT-1S *	㉑	Measurement voltage input P1
⑥	Transistor output COM	⑭	CT-1L *	㉒	Measurement voltage input P2
⑦	RS-485 A (-)	⑮	CT-2S *	㉓	Measurement voltage input P3
⑧	RS-485 B (+)	⑯	CT-2L *	㉔	Measurement voltage input P0

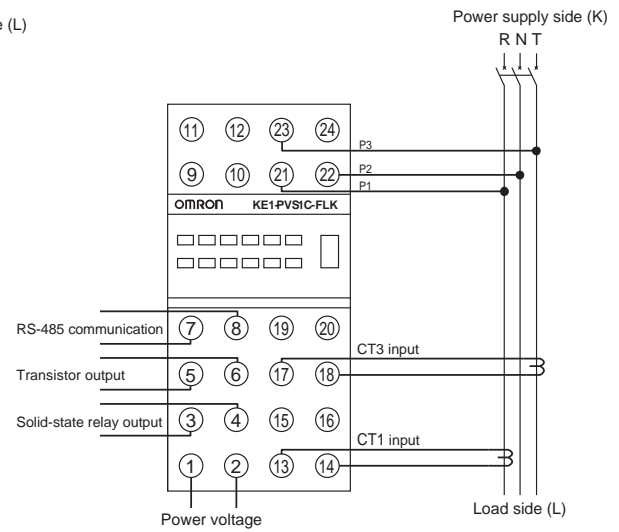
\* The capacity of CT-1 to CT-3 must be same.

- Example of wiring diagram

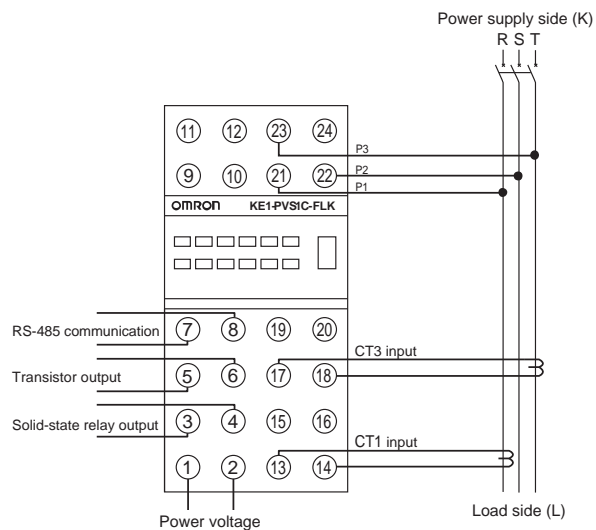
- Single-2 wire



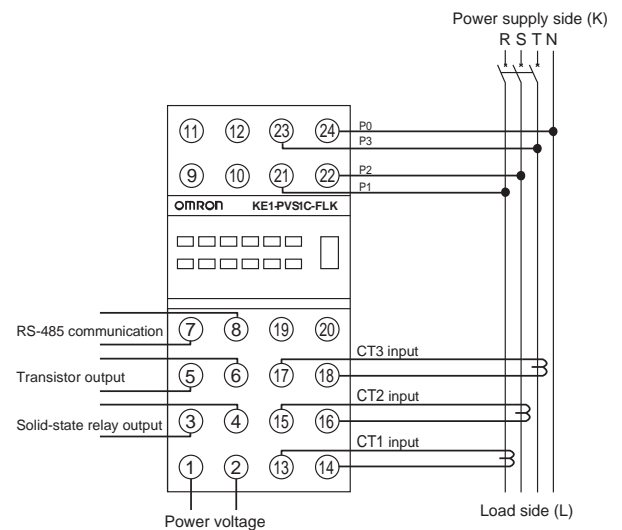
- Single-3 wire



- 3-phase 3-wire

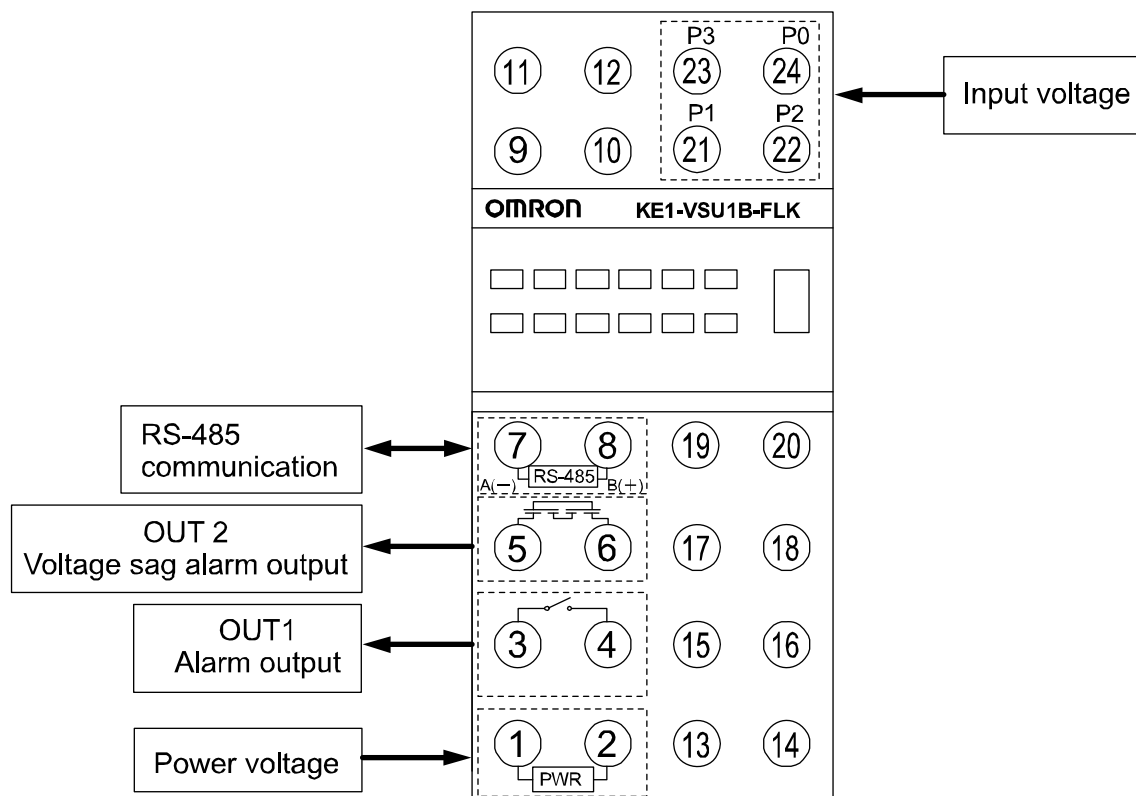


- 3-phase 4-wire



## ■ Model KE1-VSU1B-FLK

- Terminal arrangements and input/output configuration



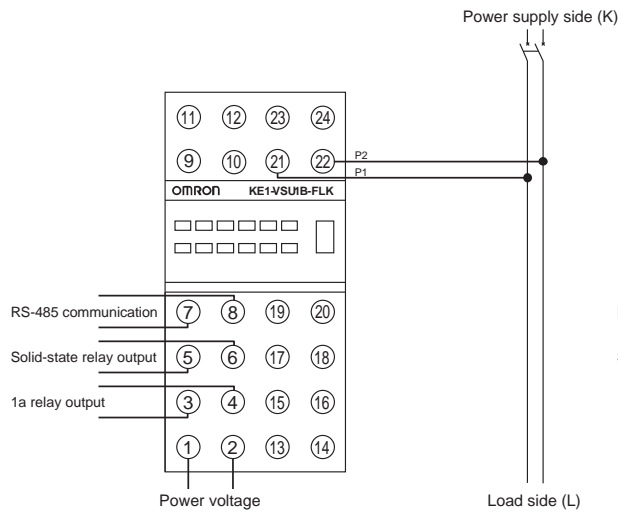
- Function of terminal

①	Power voltage (AC100 to 240 V)	⑨	NC	⑰	NC
②		⑩	NC	⑱	NC
③	1a relay output	⑪	NC	⑲	NC
④		⑫	NC	⑳	NC
⑤	Solid-state relay output	⑬	NC	㉑	Measurement voltage input P1
⑥		⑭	NC	㉒	Measurement voltage input P2
⑦	RS-485 A (-)	⑮	NC	㉓	Measurement voltage input P3
⑧	RS-485 B (+)	⑯	NC	㉔	Measurement voltage input P0

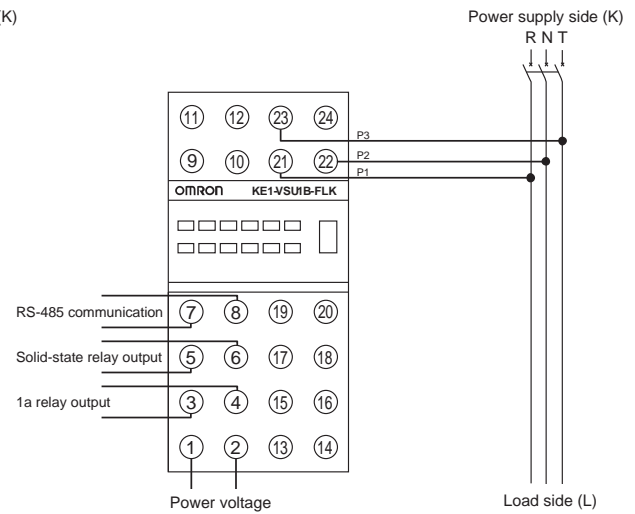


- Example of wiring diagram

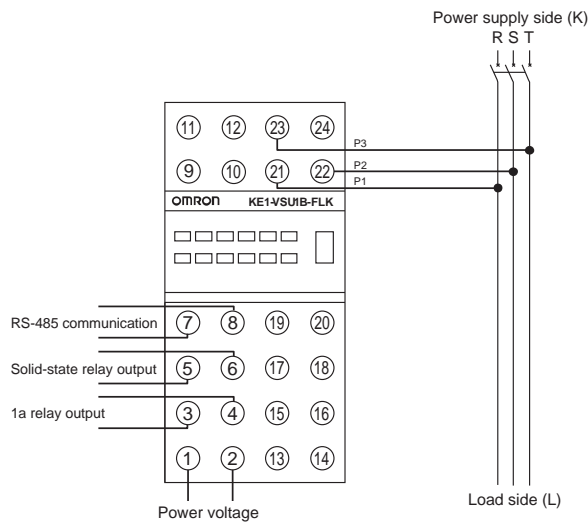
- Single-2 wire



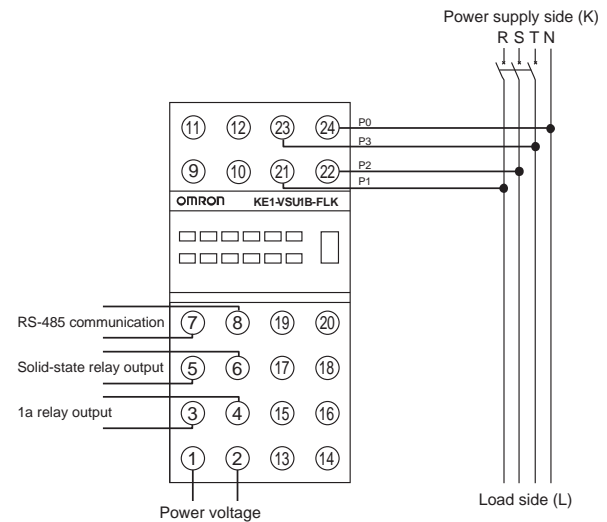
- Single-3 wire



- 3-phase 3-wire

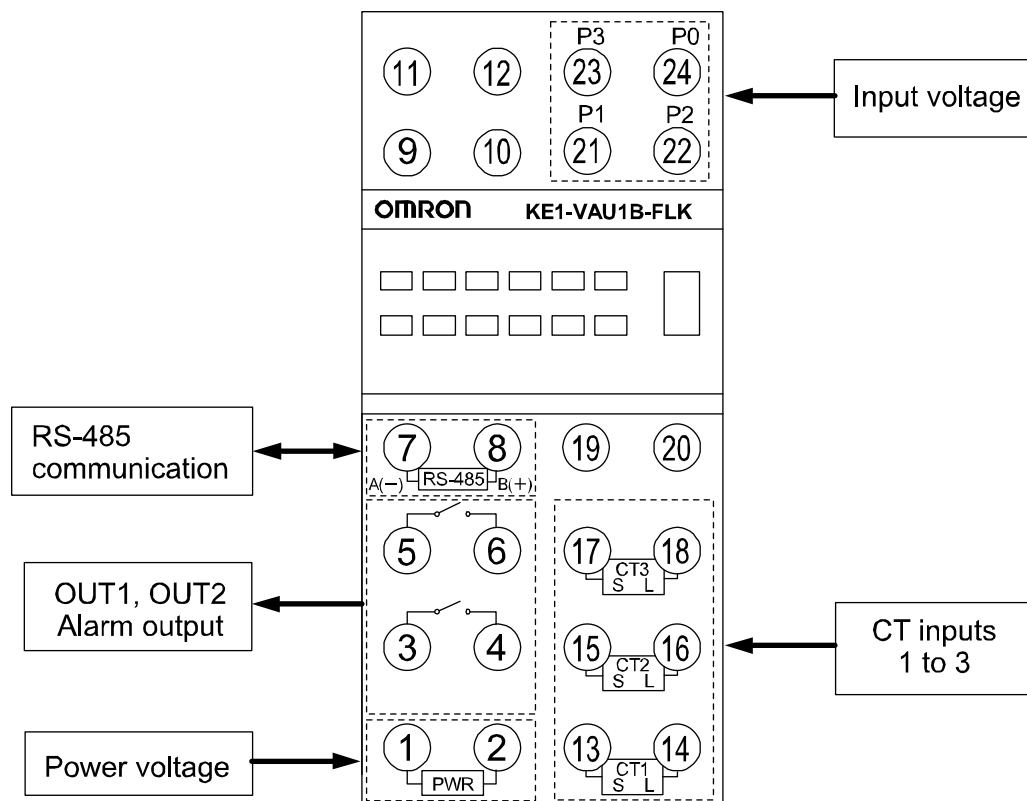


- 3-phase 4-wire



## ■ Model KE1-VAU1B-FLK

- Terminal arrangements and input/output configuration



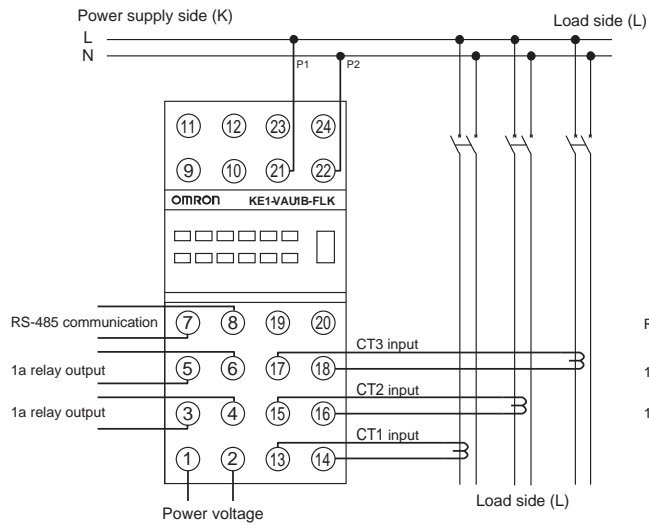
- Function of terminal

①	Power voltage	⑨	NC	⑰	CT-3S *
②	(AC100 to 240 V)	⑩	NC	⑱	CT-3L *
③	1a relay output 1	⑪	NC	⑲	NC
④		⑫	NC	⑳	NC
⑤	1a relay output2	⑬	CT-1S *	㉑	Measurement voltage input P1
⑥		⑭	CT-1L *	㉒	Measurement voltage input P2
⑦	RS-485 A (-)	⑮	CT-2S *	㉓	Measurement voltage input P3
⑧	RS-485 B (+)	⑯	CT-2L *	㉔	Measurement voltage input P0

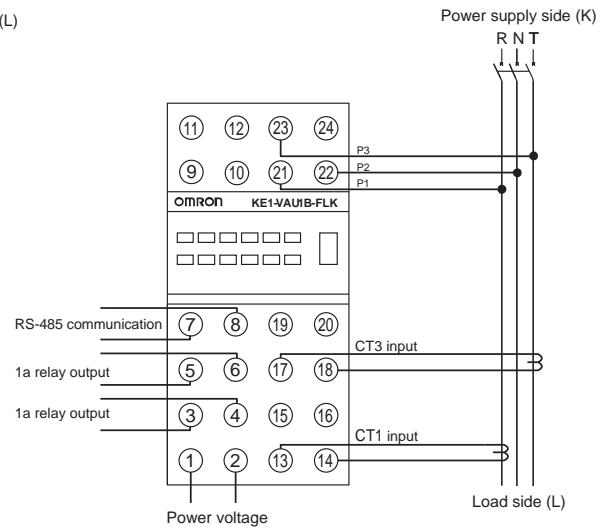
\* The capacity of CT-1 to CT-3 must be same.

- Example of wiring diagram

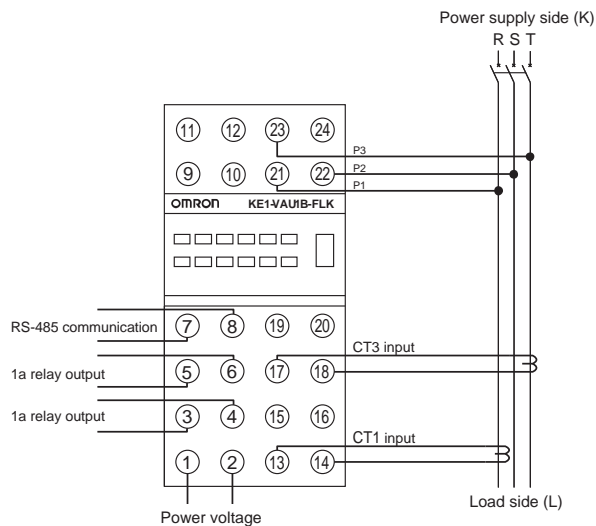
- Single-2 wire



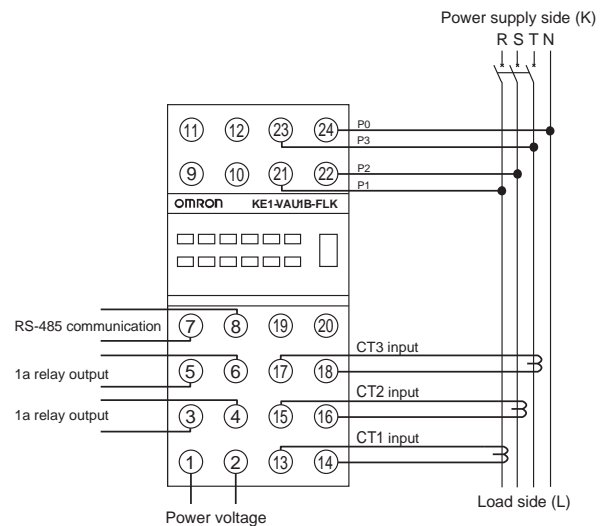
- Single-3 wire



- 3-phase 3-wire

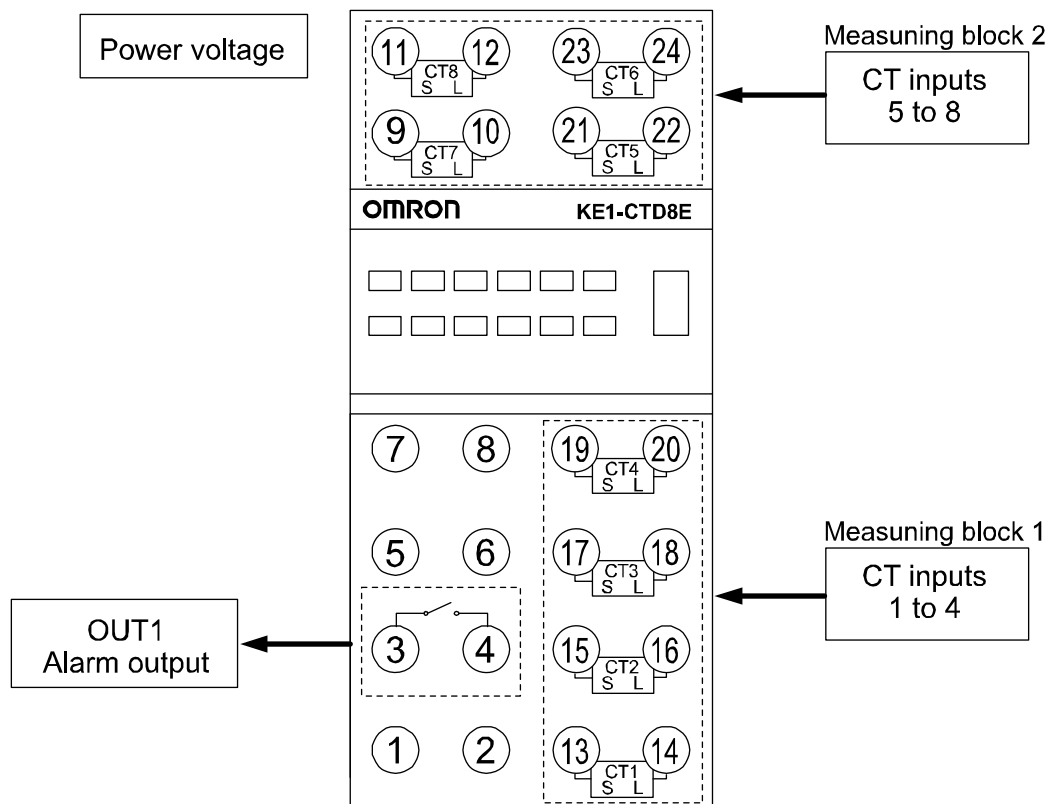


- 3-phase 4-wire



## ■ Model KE1-CTD8E

- Terminal arrangements and input/output configuration



- \* To measure electric power with CTD8E, assign the measurement blocks 1 and 2 to the system 1 (system 2) of the measurement master. The setting is made in KM1/KE1-Setting.
- \* The assignment to the system 2 is available only when the unit is connected to Model KM1-PMU2A-FLK in Model KM1 series.

### ● Function of terminal

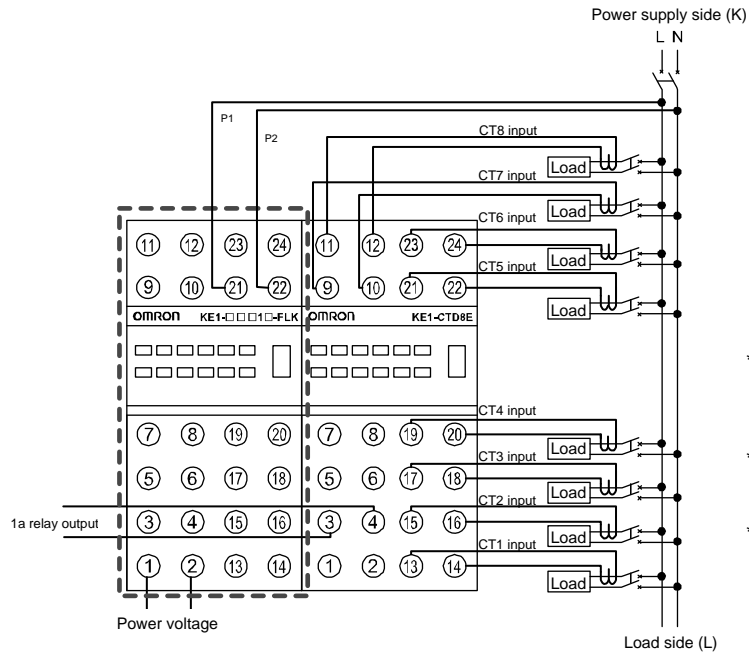
①	NC	⑨	CT-7S *	⑰	CT-3S *
②	NC	⑩	CT-7L *	⑱	CT-3L *
③	1a relay output	⑪	CT-8S *	⑲	CT-4S *
④		⑫	CT-8L *	⑳	CT-4L *
⑤	NC	⑬	CT-1S *	㉑	CT-5S *
⑥	NC	⑭	CT-1L *	㉒	CT-5L *
⑦	NC	⑮	CT-2S *	㉓	CT-6S *
⑧	NC	⑯	CT-2L *	㉔	CT-6L *

- \* The capacity of CT-1 to CT-4 must be same. The capacity of CT-5 to CT-8 must be same.

- Example of wiring diagram

## Single-phase 2-wire

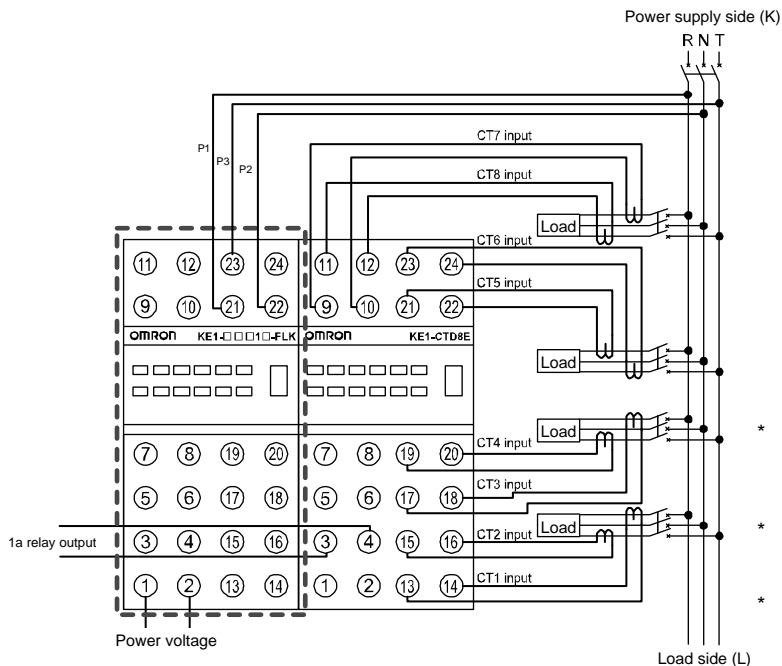
Example: For power measurement on 8 circuits



- \* Model KE1-CTD8E does not operate as a single unit. For the operation, be sure to connect it to the measurement master.
- \* The number CT inputs required differ depending on the line type.  
Single-phase 2-wire: CT1 input
- \* The number of circuits that can be measured in one Model KE1-CTD8E unit is as follows:  
Single-phase 2-wire: Up to 8 circuits

## Single-phase 3-wire

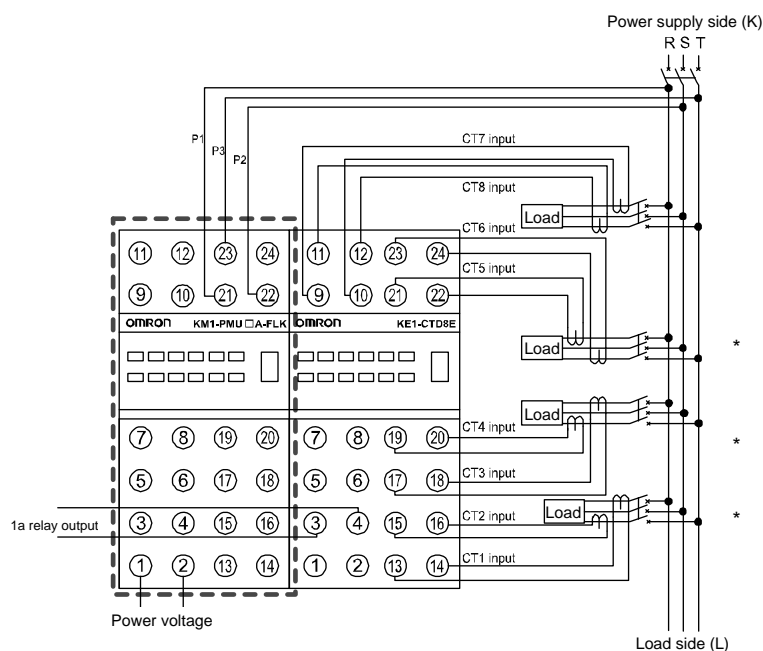
Example: For power measurement on 4 circuits



- \* Model KE1-CTD8E does not operate as a single unit. For the operation, be sure to connect it to the measurement master.
- \* The number CT inputs required differ depending on the line type.  
Single-phase 3-wire: CT2 input
- \* The number of circuits that can be measured in one Model KE1-CTD8E unit is as follows:  
Single-phase 3-wire: Up to 4 circuits

### 3-phase 3-wire

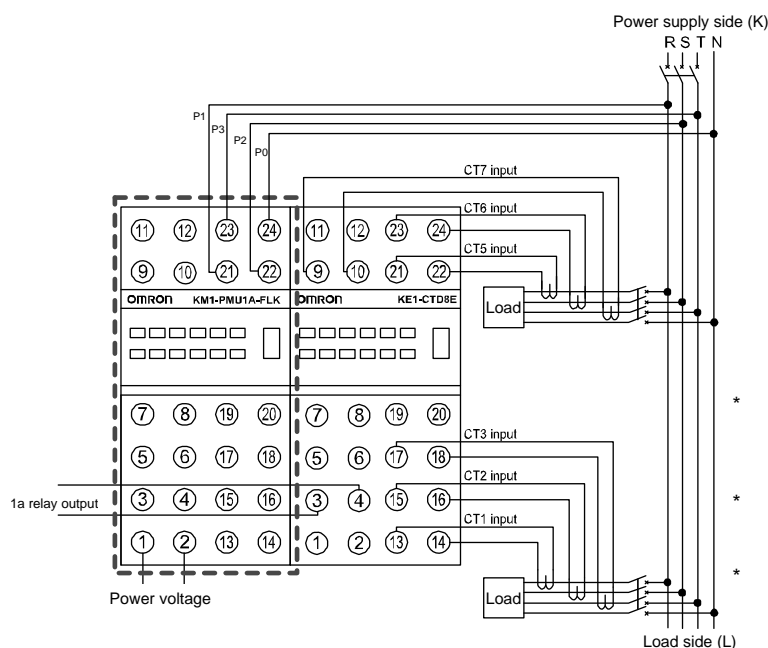
Example: For power measurement on 4 circuits



- \* Model KE1-CTD8E does not operate as a single unit. For the operation, be sure to connect it to the measurement master.
- \* The number CT inputs required differ depending on the line type.  
3-phase 3-wire: CT2 input
- \* The number of circuits that can be measured in one Model KE1-CTD8E unit is as follows:  
3-phase 3-wire: Up to 4 circuits

### 3-phase 4-wire

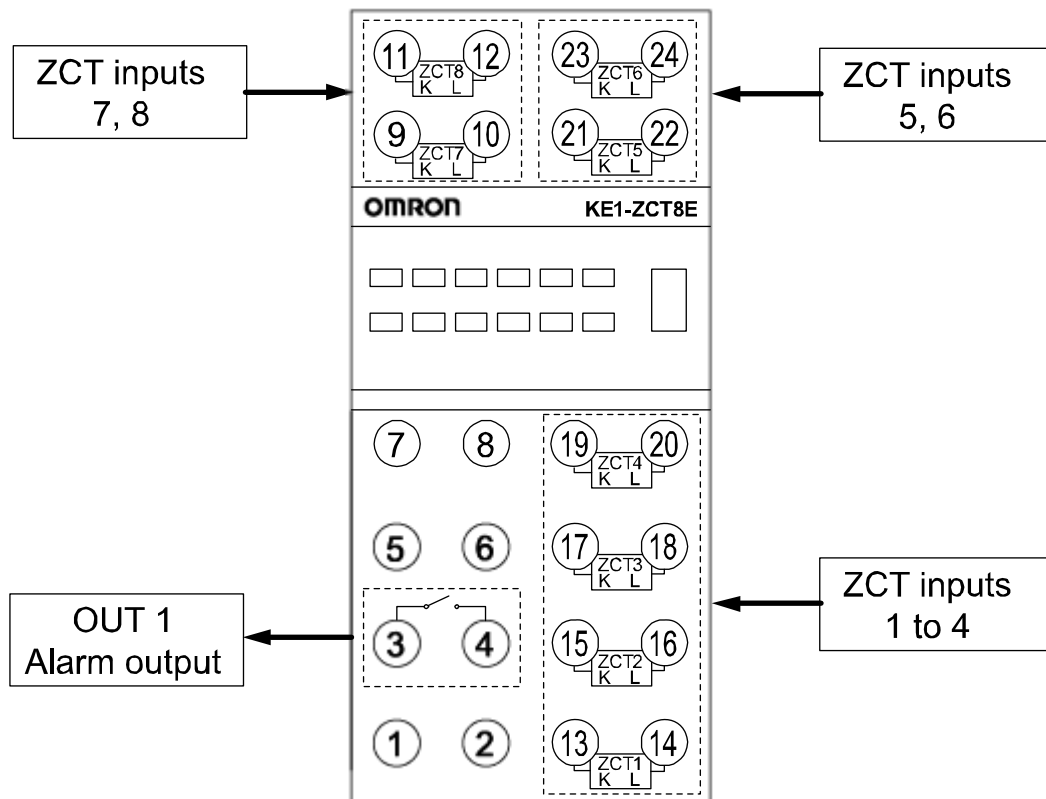
Example: For power measurement on 2 circuits



- \* Model KE1-CTD8E does not operate as a single unit. For the operation, be sure to connect it to the measurement master.
- \* The number CT inputs required differ depending on the line type.  
3-phase 4-wire: CT3 input
- \* The number of circuits that can be measured in one Model KE1-CTD8E unit is as follows:  
3-phase 4-wire: Up to 2 circuits

## ■ Model KE1-ZCT8E

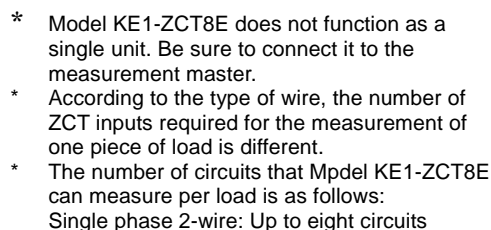
- Terminal arrangements and input/output configuration



- Function of terminal

①	NC	⑨	CT-7K *	⑰	CT-3K *
②	NC	⑩	CT-7L *	⑱	CT-3L *
③	1a relay output	⑪	CT-8K *	⑲	CT-4K *
④		⑫	CT-8L *	⑳	CT-4L *
⑤	NC	⑬	CT-1K *	㉑	CT-5K *
⑥	NC	⑭	CT-1L *	㉒	CT-5L *
⑦	NC	⑮	CT-2K *	㉓	CT-6K *
⑧	NC	⑯	CT-2L *	㉔	CT-6L *

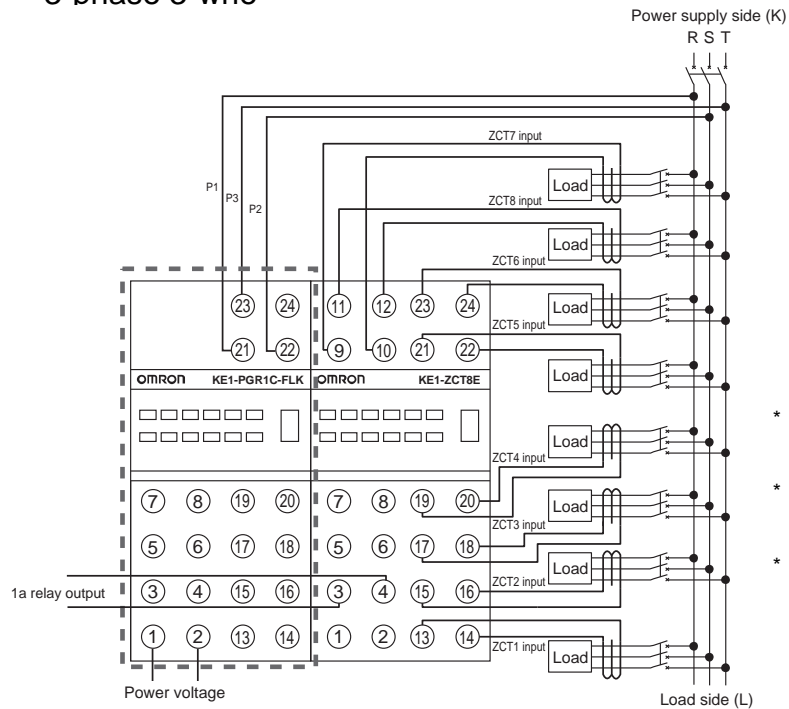
## Single-phase 2-wire



- \* Model KE1-ZCT8E does not function as a single unit. Be sure to connect it to the measurement master.
- \* According to the type of wire, the number of ZCT inputs required for the measurement of one piece of load is different.
- \* The number of circuits that Model KE1-ZCT8E can measure per load is as follows:  
Single phase 3-wire: Up to eight circuits

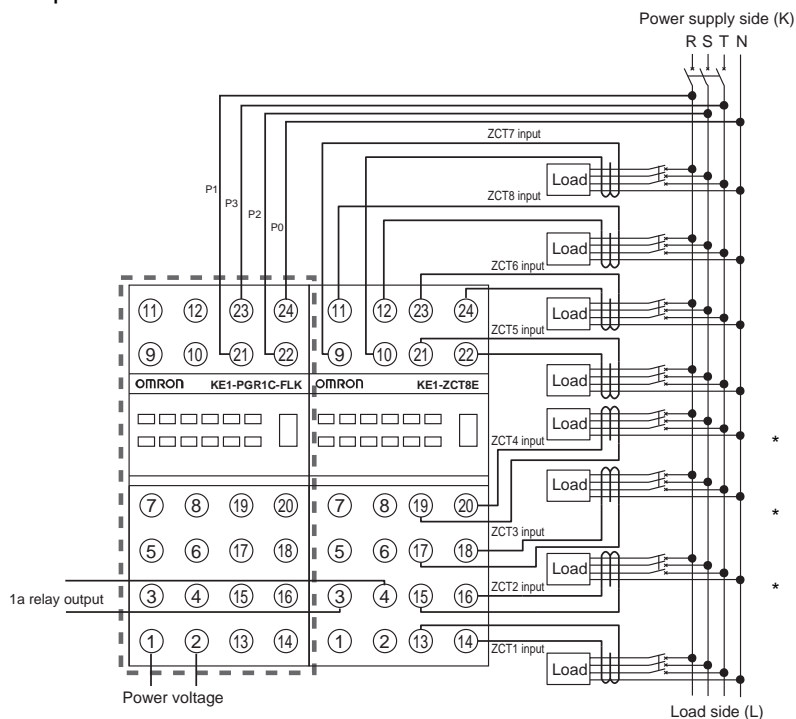


## 3-phase 3-wire



- \* Model KE1-ZCT8E does not function as a single unit. Be sure to connect it to the measurement master.
- \* According to the type of wire, the number of ZCT inputs required for the measurement of one piece of load is different.
- \* The number of circuits that Model KE1-ZCT8E can measure per load is as follows:  
3-phase 3-wire: Up to eight circuits

## 3-phase 4-wire

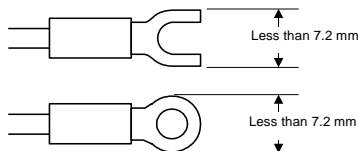


- \* Model KE1-ZCT8E does not function as a single unit. Be sure to connect it to the measurement master.
- \* According to the type of wire, the number of ZCT inputs required for the measurement of one piece of load is different.
- \* The number of circuits that Model KE1-ZCT8E can measure per load is as follows:  
3-phase 4-wire: Up to eight circuits

## 2.5 Wiring

### ■ Requests for wiring

- Do not change the terminal screws, but use existing screws.
- To prevent being affected by noise, wiring of signal line should be different from that of power line.
- Cable to be used for wiring terminals excepting CT should be twist pair AWG25 (whose cross-sectional area is 0.205 mm<sup>2</sup>) to AWG12 (whose cross-sectional area is 3.309 mm<sup>2</sup>).
- For circuits in use, select appropriate cables.
- When connecting dedicated CT, use the cable for dedicated CT (Model KM20-CTF-CB3: 3 m).  
When doing so, connect the shrinkable tube side to the dedicated CT.
- For RS-485 connection, the total cable length is up to 500 m.
- Do not ground the dedicated CT or RS-485 signal line. Doing so causes a failure.
- For the terminal section, carry out wiring by using a solderless terminal.
- Use wiring materials and crimp tools that are suitable for the solderless terminal.
- Tighten a terminal screw to the torque of 0.69 to 0.88 N·m.
- For a solderless terminal, use the M3.5 terminal whose shape is as follows.



### ■ Wiring

#### ● Power voltage

PGR1C (Electric power/leakage)	PVS1C (Electric power/voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

○: With terminal    ×: Without terminal

Connect between terminals [1] and [2].

The specifications are as follows.

Power voltage	Consumed power
AC100~240 V (50/60 Hz)	Measurement master : 10 VA or less for independent behavior. Functional slave: 10 VA or lower

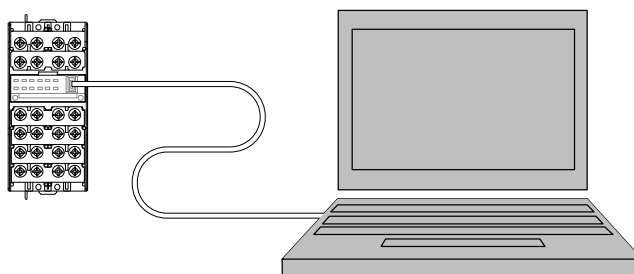
## • USB port

Connecting Model KE1 and a PC via a USB cable can make settings and read measurement values. In addition, supplying power from a PC via USB (driving USB bus power) can make settings only. For the functions available via a USB port, refer to the table below.

- \*1. For the USB cable, use mini-USB type B.
- \*2. If settings have been made via USB, remove the USB cable from the product, and then supply the power to it. When reading measurement values via USB communication, remove the USB cable once after the setting change, and then connect the product again.

	When one product is used	When multiple units are connected
Without power voltage	For all models, only settings can be made.	Only the measurement master can be set.
With power voltage	For all models, settings and reading of measurement values can be performed.	Connecting the measurement master can perform settings and reading of measurement values. Settings of the slave connected to the measurement master and reading of the measurement values can be performed.

- \*3. Connect the USB cable only when USB communication is required. If the USB cable is always connected, and the power supply to the product is turned ON/OFF due to instantaneous voltage drop, etc., the product cannot be started up normally to make measurements.
- \*4. Do not carry out RS-485 communication during USB communication. (Doing so may return a response.)



## • Input voltage

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With input X: Without input

Connect the wire between (21), (22), (23), and (24) terminals in the measurement master and slave units.

- \* When wiring, avoid error in the order of phases. An error will cause incorrect measurement.

[PMU1A (electric power)]

	Single phase 2-wire	Single phase 3-wire	3-phase 3-wire	3-phase 4-wire
P1 ②①	L	R	R	R
P2 ②②	N	N	S	S
P3 ②③	—	T	T	T
P0 ②④	—	—	—	N

- \* Indication of voltage: V(A)B: Indicates a voltage between [A] and [B].

Example: Vrs indicates a voltage between R and S.

## • CT input

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
CT/ZCT O/O	CT/ZCT O/x	CT/ZCT x/x	CT/ZCT O/x	CT/ZCT O/x	CT/ZCT x/O

O: With input X: Without input

[PGR1C (power/leakage), PVS1C (power/voltage sag), VAU1B (voltage/current)]

The connection terminal of the dedicated CT and the number of circuits to be measured in each phase and wire system are shown below.

	Single phase 2-wire	Single phase 3-wire	3-phase 3-wire	3-phase 4-wire
CT1([13]-[14])	L	R	R	R
CT2([15]-[16])	L	-	-	S
CT3([17]-[18])	L	T	T	T
Number of measurement circuits	3 circuits	1 circuit	1 circuit	1 circuit

[CTD8E (CT expansion)]

In this case, terminals [9], [10], [13], [15], [17], [19], [21], and [23] are specified as S, and terminals [10], [12], [14], [16], [18], [20], [22] and [24] as L.

	Single phase 2-wire	Single phase 3-wire	3-phase 3-wire	3-phase 4-wire
CT1([13]-[14])	L	R	R	R
CT2([15]-[16])	L	T	T	S
CT3([17]-[18])	L	R	R	T
CT4([19]-[20])	L	T	T	-
CT5([21]-[22])	L	R	R	R
CT6([23]-[24])	L	T	T	S
CT7([9]-[10])	L	R	R	T
CT8([11]-[12])	L	T	T	-
Number of measurement circuits	8 circuits	4 circuits	4 circuits	2 circuits

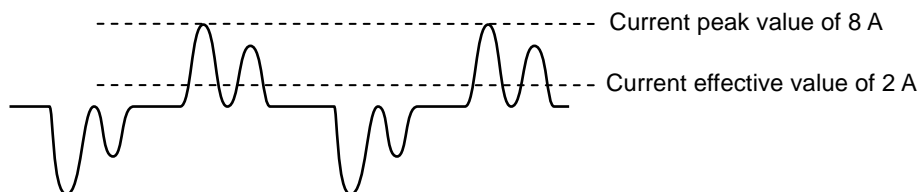
\* Measurement of power with CTD8E requires creating an association between a measurement block and voltage input system of a measurement master (Measurement block synchronization setting). For details, refer to page 3-3.

\* CT1 to CT4 are classified as measurement block 1 and CT5 to CT8 as measurement block 2.

\*1 Do not touch charging metal part of the dedicated CT terminal. Electric shocks may occur.

\*2 Do not ground the dedicated CT. Doing so causes a failure.

- \*3 When measuring electric power containing higher harmonics, such as inverter primary current, select a dedicated CT having allowance to standard load. For the current waveform (effective value of 2 A, and peak value of 8 A) as shown below, a dedicated CT of 50 A must be used. If 5ACT is used, saturation occurs, preventing obtaining correct measurement values. In general, entering a filter, AC reactor, etc., between the power supply and an inverter greatly changes the ratio of current and effective value of the inverter primary current. The ratio also changes depending on the capacitor, diode, etc.



Example of inverter primary current waveform

### • ZCT input

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	×	×	×	×	○

○: With input    ×: Without input

#### [PGR1C (power/leakage)]

When connecting the dedicated ZCT, connect a wire between the terminals [19] and [20]. In this case, the terminal [9], [11], [13], [15], [17], [19], [21] and [23] is treated as K and the terminal [10], [12], [14], [16], [18], [20], [22] and [24] as L.

#### [ZCT8E (ZCT extension)]

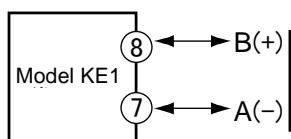
When connecting the dedicated ZCT, connect wires between the terminals [9] and [10], [11] and [12], [13] and [14], [15] and [17], [18] and [19] and [20], [21] and [22] and [23] and [24]. In this case, terminals [9] and [11] are treated as K and terminals [10] and [12] as L.

### • RS-485 communication

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

○: With terminal    ×: Without terminal

When using RS-485 communication functions, connect a communication cable between terminals [8] and [7].



A termination resistor must be connected to each end of the transmission path. Each termination resistor should be 120 Ω (1/2 W).

Communication connection diagram

- For the connection configuration, 1 : 1 or 1 : N is applicable. The number of connected units is as follows: when the protocol is CompoWay/F, 31 units, and when Modbus, up to 99 units. The total cable length is up to a maximum of 500 m. For the cable, use a twisted pair cable with shield (AWG24 (cross-sectional area of 0.205 mm<sup>2</sup>) to AWG14 (cross-sectional area of 2.081 mm<sup>2</sup>).
- \* Do not ground the RS-485 signal line. Doing so causes a failure.
- \* Do not carry out RS-485 communication during USB communication. (Doing so may return a response.)

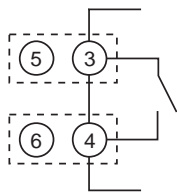
## • Output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	○	○

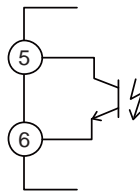
○: With output

To enable alarm output, connect wires in each unit as shown in the table and diagram below.

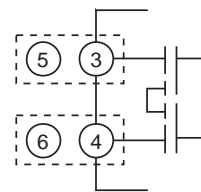
		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
OUT1	Between terminals ③—④	RY	SSR	RY	RY	RY	RY
OUT2	Between terminals ⑤—⑥	TR	TR	SSR	RY		



RY  
(Relay output)



TR  
(Transistor output)



SSR  
(Solid-state relay output)

\*1. SSR outputs voltage sag alarms only.

\*2. For information on the function setting of output terminal, refer to page 3-18. One relay output point exists.

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## 3.1 List of functions

		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/curr ent)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Applicable circuit	Single-phase 2-wire	○	○	○	○	○	○
	Single-phase 3-wire	○	○	○	○	○	○
	3-phase 3-wire	○	○	○	○	○	○
	3-phase 4-wire	○	○	○	○	○	○
Measurement function	Active power	○	○	×	×	○	×
	Leakage	○	×	×	×	×	○
	Current	○	○	×	○	○	×
	Voltage	○	○	○	○	×	×
	Power factor	○	○	×	×	○	×
	Reactive power	○	○	×	×	○	×
	Frequency	○	○	○	○	×	×
	Integrated active power	○	○	×	×	○	×
	Integrated regeneration power amount	○	○	×	×	○	×
	Integrated reactive power amount	○	○	×	×	○	×
Error detection function	Voltage sag (instantaneous voltage drop)	×	○	○	×	×	×
	Leakage	○	×	×	×	×	○
	Active power	○	○	×	×	○	×
	Over/under current	○	○	×	○	○	×
	Over/under voltage	○	○	○	○	×	×
	Power factor	○	○	×	×	○	×
	Reactive power	○	○	×	×	○	×
	Open phase (Fixed unbalance factor)	○	○	○	×	×	×
	Reverse phase	○	○	○	×	×	×
Additional function	CT signal detection	○	○	×	○	○	○
	Simple measurement	○	○	×	×	○	×
Target for log		Refer to Page A-18				×	×

○: With function

×: Without function



## 3.2 Basic functions

### ■ Applicable phase wire

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	○	×

○: With setting    ×: Without setting

- Set the phase wire to be measured.
- Setting range: Single-phase 2-wire, single-phase 3-wire, 3-phase 3-wire, and 3-phase 4-wire (initial value: 3-phase 3-wire)

\*1. CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

If CTD8E is connected to PGR1C that measures the circuits of 3-phase 3-wire, 3-phase 3-wire must be set as the phase and wire system applied to CTD8E.

### ■ Synchronization selection for measuring block

PGR1C (Electric power /leakage)	PGR1C (Electric power /leakage)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
×	×	×	×	○	×

○: With setting    ×: Without setting

- Set the voltage system synchronized with a measuring block.
- Setting range: System 1, system 2 (initial value: system 1)

The measuring blocks are divided into measuring block 1 and measuring block 2, which are assigned to system 1 and system 2, respectively, to perform power measurements. For PGR1C (Electric power/leakage) and PGR1C (Electric power/leakage), since their measuring blocks and voltage systems are fixed, the setting of synchronization selection for measuring block is not required.

### ■ Dedicated CT type

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

○: With setting    ×: Without setting

- Set the dedicated CTs to be used.
- The dedicated CTs are as follows.

Split type

CT Model	Standard
Model KM20-CTF-5A	5A
Model KM20-CTF-50A	50A
Model KM20-CTF-100A	100A
Model KM20-CTF-200A	200A
Model KM20-CTF-400A	400A
Model KM20-CTF-600A	600A

Panel fixed (through) type

CT Model	Standard
Model KM20-CTB-5A/50A	5A/50A

- Setting range: 5 A, 50 A, 100 A, 200 A, 400 A, 600 A (initial value: 100 A)
- \* When connecting CTD8E (CT extension) to "Model KM1-PMU2A-FLK" of KM1 series to measure two systems, set the type of dedicated CT for each block.

## ■ VT ratio

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	○	×

○: With function    ×: Without function

- Setting a VT ratio can measure a voltage higher than the standard by using general VT.
- Accuracy assurance is not applicable to general VT.
- Setting range: 001 to 99.99 (initial value: 1.00)
- \* The settings of CTD8E (CT expansion) should conform to those of the measurement master. In addition, CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

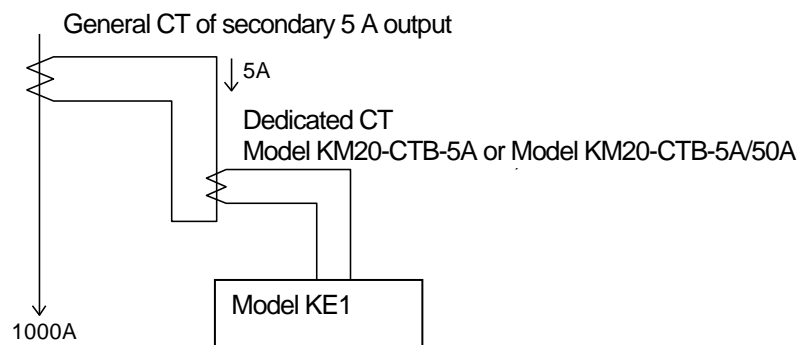
## ■ CT ratio

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

○: With function    ×: Without function

- Setting the CT ratio by using general CT can measure currents higher than the standard of dedicated CT.
- The CT ratio of general CT is set to make measurements by combining existing general CT.
- Accuracy assurance is not applicable to general CT.
- Setting range: 1 to 1000 (Initial value: 1)
- \* Set it to 1 when it is not used.
- \* CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

<When 5ACT is connected>



## ■ Low-cut function

- This function forcibly sets the current measurement value to 0 when the current value becomes less than (standard current of CT) X (setting ratio).
  - The ratio of an unmeasured load current to the standard current is set.
  - As a result, setting the current value to 0 can set the electric power to 0. Setting this function can cut current and power that are measured due to inductive noise in no-load condition. Set an optimum value.
- \*1. The low-cut function works only when all currents of a phase connected to dedicated CT becomes lower than or equal to the set current low-cut value.
- \*2. Effective values are used to judge low-cut. This means that, if the peak value is higher than the low-cut value, and the effective value is lower than the low-cut value, the low-cut function works.

### ● Low-cut current value

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

○: With function    ×: Without function

When the low-cut function works, the current and (active/reactive) power are fixed to 0, and the power factor is fixed to 1.

Setting range: 0.1 to 19.9% (Initial value: 0.6%)

- \* CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

### ● Leakage Low-cut current value

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	×	×	×	×	○

○: With function    ×: Without function

- Set a value for the low-cut function so that leakage (I<sub>o</sub>) values lower than that is regarded as 0 (zero).
- Setting range: 0.1 to 30.0 mA (Default: 1.0 mA)
- \* As leakage does not incorporate the concept of measurement blocks, the value set as the leakage low-cut current value is set as the leakage low-cut value of the whole unit.

### ● Average count

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	○	○

○: With function

- Average count is set to reduce dispersion in measurement values.
- When the average count is set to OFF, the instantaneous value updated every 100 ms is the latest value.
- The following measurement values are averaged: active power, current, voltage, power factor, and reactive power.
- Average value is calculated by the following formula.

$$\text{Value determined previously} \times \frac{(\text{Average count} - 1)}{\text{average count}} + \text{Value measured this time} \times \frac{1}{\text{Average count}} = \text{Value determined this time}$$

- Setting range: OFF, 2, 4, 8, 16, 32, 64, 128, 256, 512, and 1024 (Initial value: OFF)
- \* Over/under voltage, over/under current, and reverse phase alarm function are not affected.

## ■ Logging function

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With function    X: Without function

- Six data logging areas have been prepared. Each area can save 588 pieces of data (up to 6 items can be set.)
- Data logging cycle can be selected from among 5 minutes, 10 minutes, 30 minutes, 1 hour, 2 hours, 6 hours, 12 hours, and 24 hours, and is controlled by specifying 0:00 of the internal clock in the main unit as the starting point.

Example : When the logging function is set to 18:12, April 1, 2012 based on the time of the internal clock in the main unit.

Every 5 min : Saved at 18:15, April 1, 2012. Every 5 min after that  
 Every 10 min : Saved at 18:20, April 1, 2012. Every 10 min after that  
 Every 30 min : Saved at 18:30, April 1, 2012. Every 30 min after that  
 Every hour : Saved at 19:00, April 1, 2012. Every hour after that  
 Every 2 hours : Saved at 20:00, April 1, 2012. Every 2 hours after that  
 Every 6 hours : Saved at 0:00, April 2, 2012. Every 6 hours after that  
 Every 12 hours : Saved at 0:00, April 2, 2012. Every 12 hours after that  
 Every 24 hours : Saved at 0:00, April 2, 2012. Every 24 hours after that

- For logging, after measurement data within a logging cycle is saved, data is reset to start the measurement at the next cycle. For example, setting logging cycle of 5 min and voltage MAX accumulates voltage MAX values every 5 min.
- The number of days for which log data can be saved differs depending on logging cycles.
 

Every 5 min : 2 days + 1 hour  
 Every 10 min : 4 days + 2 hours  
 Every 30 min : 12 days + 6 hours  
 Every hour : 24 days + 12 hours  
 Every 2 hours : 49 days  
 Every 6 hours : 147 days  
 Every 12 hours : 294 days  
 Every 24 hours : 588 days
- For logging items that can be set, refer to Page A-15.

## ■ CT signal detection

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	○

O: With function    X: Without function

- When the CT, ZCT is connected, and the current whose measurement value is 2% of the standard current is supplied continuously for 10 or more seconds, the targeted LED lights.
- \* Even when the low-cut function forcibly sets the current measurement value to 0, CT signal detection turns LED ON, if the actually flowing current is more than 2% of the standard current.

## ■ Measurement function

### ● Active power

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

O: With measurement function X: Without measurement function

Measurement range: -99999999.9 to 99999999.9 W (minimum unit: 0.1 W)

The following active powers are measured: instantaneous value, maximum value, and minimum value.

The active power means a consumed power. Power that is generating electricity is referred to as regenerated power.

The logging function allows storing the max. and min. values. (Note 1)

**Note 1:** CTD8E (CT extension) cannot store the values with the logging function not provided.

### ● Integrated power amount

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

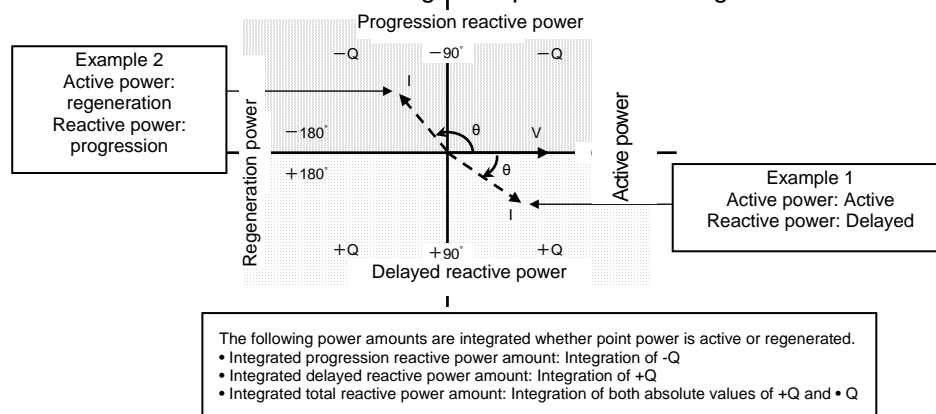
O: With measurement function X: Without measurement function

Measurement range: Excess of the measurement range of 0 to 999999999 Wh returns to 0 Wh, continuing the integration.

Power consumption (active power) and reverse power (regenerated power) are integrated separated from each other. After the conversion of VT and CT ratios, power is also integrated. Reactive power is also integrated. Via communication, integrated progression reactive power amount, integrated delayed reactive power amount and integrated total reactive power amount can be confirmed in units of varh. Each measurable amount is up to 999999999 varh. When each amount measured reaches 999999999 varh, it is reset to 0 varh. The reactive power amount to be integrated is divided into the three types: phase progression reactive power, phase delayed reactive power, and total reactive power of phase progression and phase delayed absolute values.

#### ◆ Definitions of phase progression and phase delayed of integrated reactive power amount

Whether the active power is active or regenerated, the integration progression reactive power amount is integrated in the case of phase progression, and integrated delayed reactive power amount is integrated in the case of phase delayed. In addition, for the integrated total reactive power amount, the absolute value of progression reactive power amount and the absolute value of delayed reactive power amount are integrated. The progression and delayed reactive power amounts are calculated according to the phase of the voltage based current.



## ● Current

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

O: With measurement function X: Without measurement function

Measurement range: 0.000 to 9999.999 A (minimum unit: 0.001 A)

The following currents are measured: instantaneous value, maximum value, and minimum value.  
S-phase current of 3-phase 3-wire is calculated based on R-phase and T-phase currents. N-phase current of single-phase 3-wire is calculated based on R-phase and T-phase currents.

\* The logging function allows storing the max. and min. values. (Note 1)

**Note 1:** CTD8E (CT extension) cannot store the values with the logging function not provided.

## ● Voltage

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With measurement function X: Without measurement function

Measurement range: 0.0 to 99999.9 V (minimum unit: 0.1 V)

The following voltages are measured: instantaneous value, maximum value, and minimum value.

\* The logging function allows storing the max. and min. values. (Note 1)

## ● Power factor

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

O: With measurement function X: Without measurement function

Measurement range: -1.00 to 0.00 to 1.00 (units of 0.01 (3 digits))

The following power factors are measured: instantaneous value, maximum value, and minimum value.  
When the low-cut function works, the power factor measurement value is fixed to 1.

\* The logging function allows storing the max. and min. values. (Note 1)

**Note 1:** CTD8E (CT extension) cannot store the values with the logging function not provided.

## ● Reactive power

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

O: With measurement function X: Without measurement function

Measurement range: -99999999.9 to 99999999.9 var (minimum unit: 0.1 var)

The following reactive power amounts are measured: instantaneous value, maximum value, and minimum value.

If the input current is less than the low-cut setting value, the reactive power value is forced to be 0 var.

\* The logging function allows storing the max. and min. values. (Note 1)

**Note 1:** CTD8E (CT extension) cannot store the values with the logging function not provided.

## ● Frequency

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

○: With measurement function    ×: Without measurement function

Measurement range: 45.0 to 65.0 Hz (minimum unit: 0.1 Hz)

## ● Leakage

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	×	×	×	×	○

○: With measurement function    ×: Without measurement function

Three types of values, instantaneous, max. and min. values of a leakage current are measured.  
Measurement range: 30 to 1,000 mA (Minimum unit of 1 mA)

\* The logging function allows storing the max. and min. values. (Note 1)

**Note 1:** CTD8E (CT extension) cannot store the values with the logging function not provided.

### 3-3 Voltage sag (instantaneous voltage drop) detection function

When voltage sag (instantaneous voltage drop) detection occurs, the voltage sag detection is reported with the lighting of ALM on the display and the signal output from the output terminal (Note 1). For the past eight voltage sags, voltage sag occurrence time and voltage measured around the occurrence are stored as voltage sag history.

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
×	○	○	×	×	×

O: With function    X: Without function

- Voltage sag detection is available with single-phase 2-wire/single-phase 3 wire/3-phase 3 wire/3-phase 4-wire systems and up to four detection conditions can be
- Availability of alarm output at the time of a voltage sag and storing of history data depend on whether the backup power supply of the product is available. For details, refer to page 3-11.  
(Backup of power supply indicates the state where power supply to the product is ensured by UPS or another device.)
- \* Voltage sag detection is unavailable for about 15 seconds after the power is turned on because the product is being started.
- \* To prevent incorrect detection, voltage sag detection is available when input voltage becomes 85 V or more after the power is turned on. However, only in the case of 3-phase 4-wire, voltage sag detection is available after input voltage becomes 49 V or more.
- \* As voltage sag history data is stored after the recovery from voltage sag, do not turn off the power until data storage is completed. (The same data may be saved twice.)

**Note 1:** The dedicated terminal is used for automatic output of data upon voltage sag detection. For information of the layout of the output terminals of each unit, refer to Chapter 2.4 (page 2-16).

#### ■ Object subject to monitoring of voltage sag

The object (voltage) subject to monitoring of sag in each phase and wire system is shown below.

	Single-phase 2-wire	Single-phase 3-wire	3-phase 3-wire	3-phase 4-wire
Phase voltage	×	○	×	○
Line-to-line voltage	○	×	○	×

O: With setting    X: Without setting



## ■ Setting of conditions for voltage sag detection

If a measured voltage continues to be lower than the sag detection voltage for the specified voltage sag duration or more, voltage sag is determined. Within 5 ms after the determination, ALM lights up and output from the output terminal is produced.

[Setting items]

Voltage sag backup:	OFF/ON	(Default: OFF)
Voltage sag detection function:	OFF, $V_{rs} \cdot V_{rn}$ , $V_{st} \cdot V_{sn}$ , $V_{tr} \cdot V_{tn}$	(Default: OFF)
Voltage sag detection voltage:	0.0 to 480.0 V	(Default: 80.0 V)
Voltage sag duration:	0.02 to 1.00 s	(Default: 0.02 s)

- If the power supply voltage is ensured by UPS or another device, set the voltage sag backup setting to ON.
- Voltage sag detection is determined by measured voltages without being affected by the VT ratio setting.
- \* Set each item in KM1/KE1-Setting.
- \* If sag detection voltage is set to 0 V, detection for 0 V may be unavailable due to the effect of surrounding environment. Setting a value within the rated input voltage range is recommended.
- \* When the voltage sag backup setting is set to OFF, the maximum setting of voltage sag duration is 0.2 s.  
If time longer than 0.2 s is set, the value is automatically overwritten with 0.2 s.

## ■ Voltage sag history

When voltage sag is detected, the following data is automatically stored as voltage sag history: Voltage sag occurrence time, voltage sag duration, root mean square (RMS) value (voltage), and AD value (voltage).

As the values measured around the occurrence of voltage sag are stored as root mean square value and AD value, voltage change at the occurrence of a voltage sag can be checked.

	Before voltage sag			After voltage sag	
	A/D value (Conversion into RMS value)	RMS value		A/D value (Conversion into RMS value)	RMS value
		Each waveform	Average of 10 waveforms		Each waveform
50 Hz	At intervals of about 0.63 ms 80 pieces About 0.05 s	At intervals of about 20.0 ms 64 pieces About 1.28 s	At intervals of about 200 ms 120 pieces About 24 s	At intervals of about 0.63 ms 80 pieces About 0.05 s	At intervals of about 20.0 ms 64 pieces About 1.28 s
60 Hz	At intervals of about 0.52 ms 80 pieces About 0.04 s	At intervals of about 16.7 ms 64 pieces About 1.06 s	At intervals of about 166 ms 120 pieces About 20 s	At intervals of about 0.52 ms 80 pieces About 0.04 s	At intervals of about 16.7 ms 64 pieces About 1.06 s

- Regarding the values measured before and after a voltage sag, the number of values to be stored changes according to frequency.
- The data of the past eight voltage sags can be stored as history. If more voltage sags occur, history data are deleted in chronological order to ensure storage space.
- \* If multiple voltages are monitored, A/D value is stored only for the first voltage sag.
- \* To calculate A/D value and RMS value before/after voltage sag, measured values are obtained on the basis of the timing at which internal voltage sag detection is determined. Accordingly, the number of measured values available before/after voltage sag may vary.

## ■ Operation at the time of power supply voltage sag (power failure)

If power supply voltage sag (power failure) occurs, storing of voltage sag history data and output from the output terminal depend on whether backup power supply is available.

Availability of backup power supply	State of measured voltage	State of power supply voltage		Storing of voltage sag history data	Output terminal operation
Backup power supply unavailable (*1) (Voltage sag backup setting: OFF)	Occurrence of voltage sag	Normal	→	Available	Output (1s)
	Occurrence of voltage sag	Occurrence of voltage sag	→	Available (*2)	(*3)
	Normal	Occurrence of voltage sag	→	Unavailable (*4)	Output unavailable (*4)
Backup power supply available (*1) (Voltage sag backup setting: ON)	Occurrence of voltage sag	No voltage sag with backup power supply	→	Available	Output (1s)

- \*1. Regardless of whether backup power supply is available, if voltage sag is detected, the product is automatically restarted to initialize itself after storing the voltage sag history data. Accordingly, consecutive voltage sags cannot be detected.
- \*2. Even when power supply voltage sags instantaneously, the voltage sag history data can be stored due to the electric double layer capacitor serving as a backup. However, if the electric double layer capacitor is not fully charged, the history data may not be stored properly. It takes about 3 minutes after the power is turned on to fully charge the capacitor.
- \*3. If the power supply voltage is 50 V or more, the state where an alarm is being output can continue 1 s at the longest. If the power supply voltage is 50 V or less, an alarm may not be output without the internal circuit operating.
- \*4. If only voltage sag of power supply voltage occurs with no voltage sag in measured voltage, this means that the condition is same as the one where the power is off. Therefore, neither storing of voltage sag history data nor output of a voltage sag alarm is available.

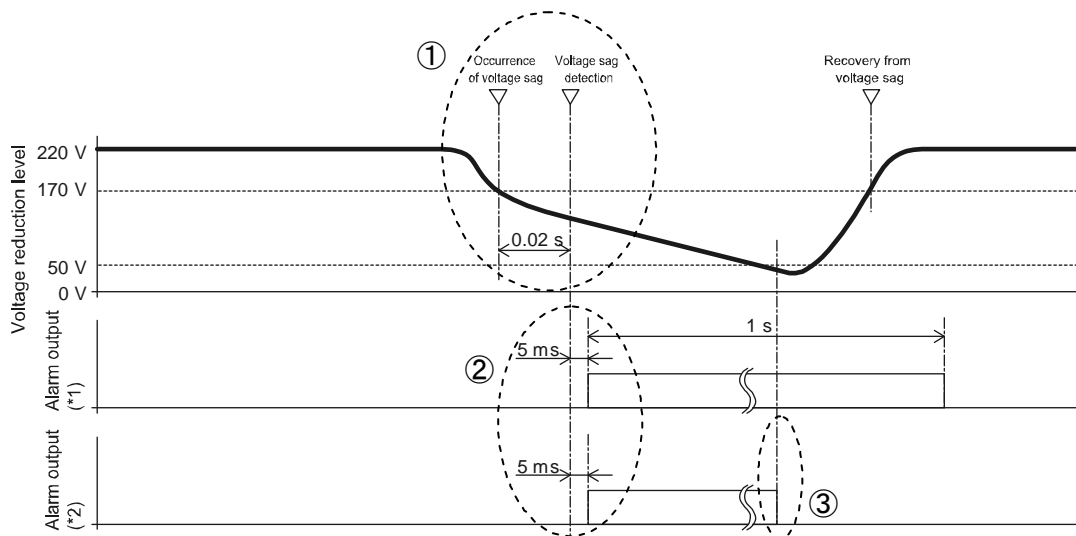
## ■ Examples of operations for voltage sag detection

The following diagrams ① to ③ show the examples of operations available when the voltage between R and S is subject to monitoring of voltage sag in 3-phase 3-wire system.

- ① The voltage (Vrs) between R and S in the 3-phase 3-wire system is lower than the voltage sag detection voltage (170 V). A voltage sag is determined when the voltage sag duration (0.02 s) is exceeded.
- ② A voltage sag alarm is output within 5 ms after the determination.
- ③ With voltage sag backup in the off state, if the power supply voltage becomes lower than 50 V, alarm output may be turned off less than 1 s.

### [Setting items]

Voltage sag backup : ON or OFF  
 Voltage sag detection function: Vrs  
 Voltage sag detection voltage: 170 V  
 Voltage sag duration: 0.02 s



Before voltage sag		After voltage sag	
A/D value (2.5 waveforms for conversion into RMS value) (80 pieces)		A/D value (2.5 waveforms for conversion into RMS value) (80 pieces)	
50 Hz: Intervals of about 0.63 ms (0.05 s)	60 Hz: Intervals of about 0.52 ms (0.04 s)	50 Hz: Intervals of about 0.63 ms (0.05 s)	60 Hz: Intervals of about 0.52 ms (0.04 s)
150.1 V		149.7V	
150.3 V		149.5V	
RMS value (64 pieces of each waveform)		RMS value (64 pieces of each waveform)	
50 Hz: Intervals of about 20 ms (1.28 s)	60 Hz: Intervals of about 16.7 ms (1.06 s)	50 Hz: Intervals of about 20 ms (1.28 s)	60 Hz: Intervals of about 16.7 ms (1.06 s)
150.0 V		149.9 V	
150.2 V		149.7 V	
RMS value (120 pieces of average of 10 waveforms)			
50 Hz: Intervals of about 200 ms (24 s)	60 Hz: Intervals of about 166 ms (20 s)		
150.0 V			
150.1 V			

\*1. Backup power supply available

\*2. Backup power supply unavailable

## 3.4 Leakage detection function

This function allows detecting electric leakage arising from insulation deterioration of electrical machinery and apparatus in a low voltage circuit.

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	×	×	×	×	○

O: With function X: Without function

- PGR1C (power/leakage) is capable of monitoring one circuit and ZCT8E (ZCT extension) eight circuits.
- The logging function allows storing max. and min. values. (PGR1C (power/leakage) only)

[Measurement range] 30 to 1000 mA (Minimum unit of 1 mA)

- \* As ZCT8E (ZCT extension) is not provided with the capability of the logging function, storing measured values is unavailable with the unit.

### ■ Detection function

If measurement continues to provide a value within a range specified as leakage comparison value for the duration longer than the leakage operating time, issuing an alarm is determined.

[Setting range]

Leakage comparison value: 30 to 1000 mA (Default: 30 mA)

Leakage operating time: 0.1 to 20.0 s (Default: 0.5 s)

- Leakage monitoring is available in single-phase 2-wire, single-phase 3-wire, 3-phase 3-wire, and 3-phase 4-wire systems.
- To allow signal output at the time of detecting a leakage, assign the function to an output terminal. For information on the output terminal function setting, refer to page 3-18.
- ZCT input allows Io of current to be measured.

### ■ Logging of measured value

- The logging function allows storing max. and min. values. It also allows storing an alarm history separately.

	Max. value	Min. value	Alarm history
PGR1C (Electric power/leakage)	○	○	○
ZCT8E (ZCT extension)	×	×	○

### ■ Available CT

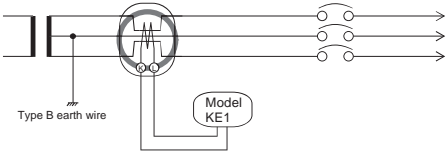
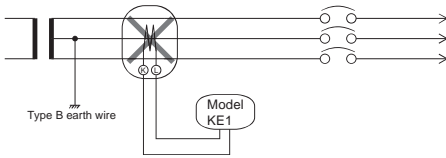
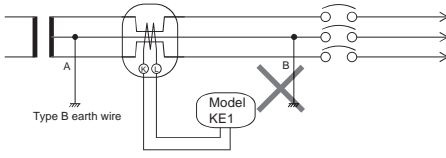
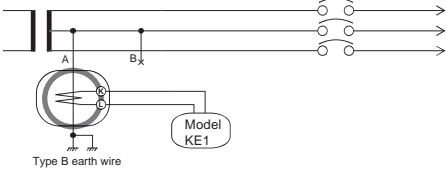
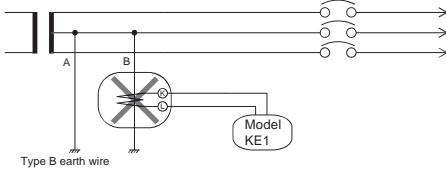
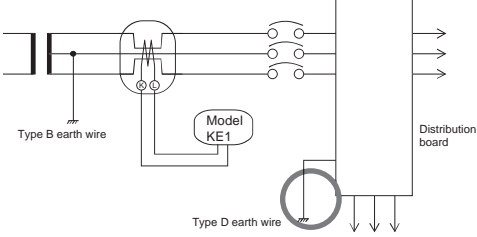
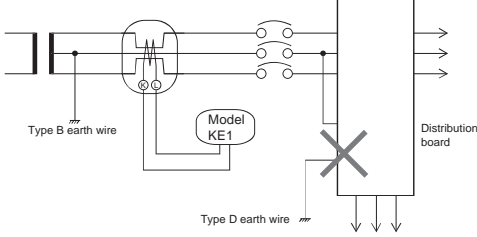
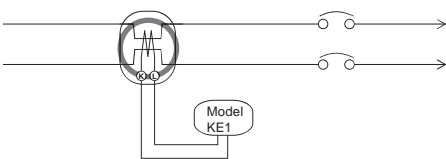
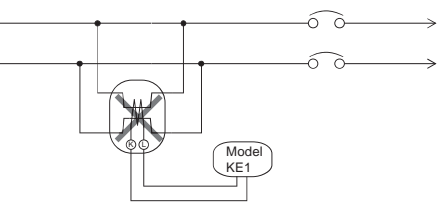
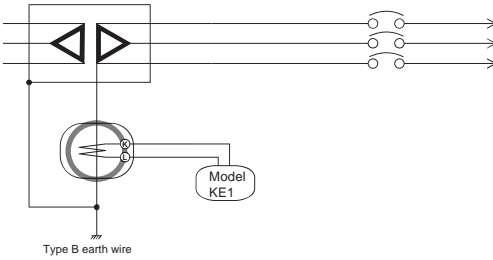
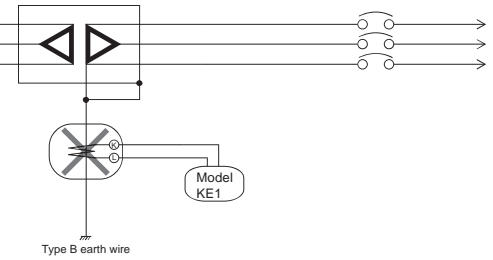
CT for earth wire only:	Model K6ER-CN22 (With cable)		
Split core type ZCT:	Model OTG-CN52	Model OTG-CN77	Model OTG-CN112
	Model OTG-CN36W		
Through type ZCT:	Model OTG-L21	Model OTG-L30	Model OTG-L42
	Model OTG-L68	Model OTG-L82	Model OTG-L156
	Model OTG-LA30W		

- \* Connect to the ZCT terminal of each unit.

### ■ Notes

- Do not use on the inverter secondary side.

## ■ Installation examples

<p><b>Example of correct installation</b></p> <p>Have all of 2-, wire 3- wire, or 4-wire run through the opening of ZCT in single-phase 2-wire, single phase 3-wire, 3-phase 3-wire, or 3-phase 4-wire systems</p> 	<p><b>Examples of incorrect installation</b></p> <p>Malfunction arises from the load current of the neutral line.</p>  <p>Malfunction arises from the load current diverted into Types A and B earth wires.</p> 
<p>To avoid malfunction caused by the load current of the neutral line, be sure to have the Type B earth wire run through the opening of ZCT.</p> 	<p>Malfunction arises from the diverted current between A and B due to the load current of the neutral conductor. ZCT may not work when a leakage occurs.</p> 
<p>Install Type D earth wire separately without connecting the distribution board and neutral line.</p> 	<p>If the distribution board and neutral line are connected, load current is diverted into the earth wire and malfunction occurs.</p> 
<p>Have cables run through ZCT properly.</p> 	<p>Correct leakage current value is not shown.</p> 
<p>Connect the voltage transformer case, cubicle case, iron angle, and frame that work as frame ground to the earth wire at a location closer to the earth compared to the installation location of ZCT.</p> 	<p>As a leakage of current directly returns to the earth of the voltage transformer and does not pass through the ZCT, ZCT does not work even when a leakage occurs.</p> 

## 3.5 Voltage/current monitoring function

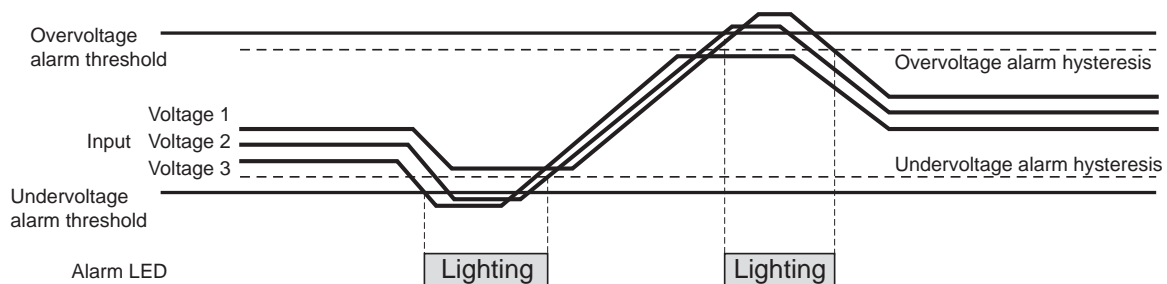
### ■ Overvoltage/undervoltage

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With function X: Without function

Set thresholds are used to monitor the status of voltage.

OR condition (threshold crossing in any one of the phases) is used to determine the issuing of an alarm. AND condition (no threshold crossing in all phases) is used to determine an alarm reset.



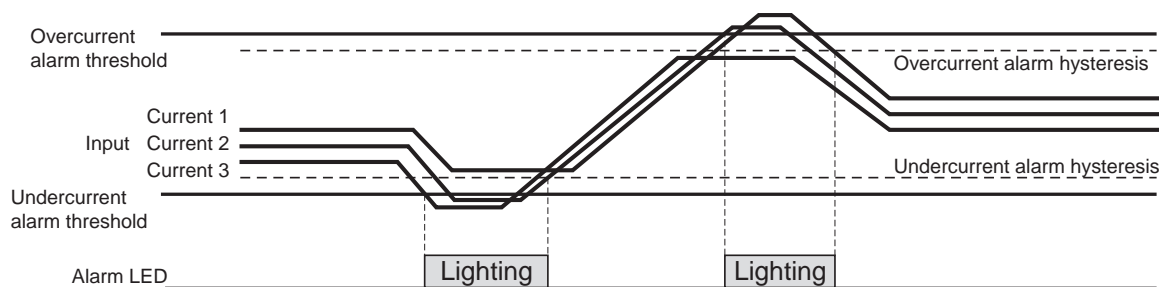
### ■ Overcurrent/undercurrent

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

O: With function X: Without function

Set thresholds are used to monitor the status of a current.

OR condition (threshold crossing in any one of the phases) is used to determine the issuing of an alarm. AND condition (no threshold crossing in all phases) is used to determine an alarm reset.

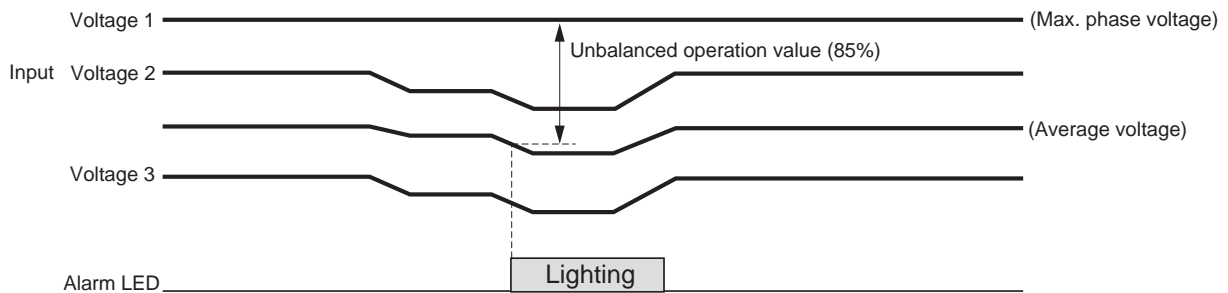


## ■ Open phase (Fixed unbalance factor)

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With function X: Without function

The occurrence of an open phase is determined when the calculation result of (max. difference between each phase voltage and average voltage)/average voltage is 85% of the max. phase voltage or less in 3-phase 3-wire or 3-phase 4-wire system.



## ■ Opposite phase

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With function X: Without function

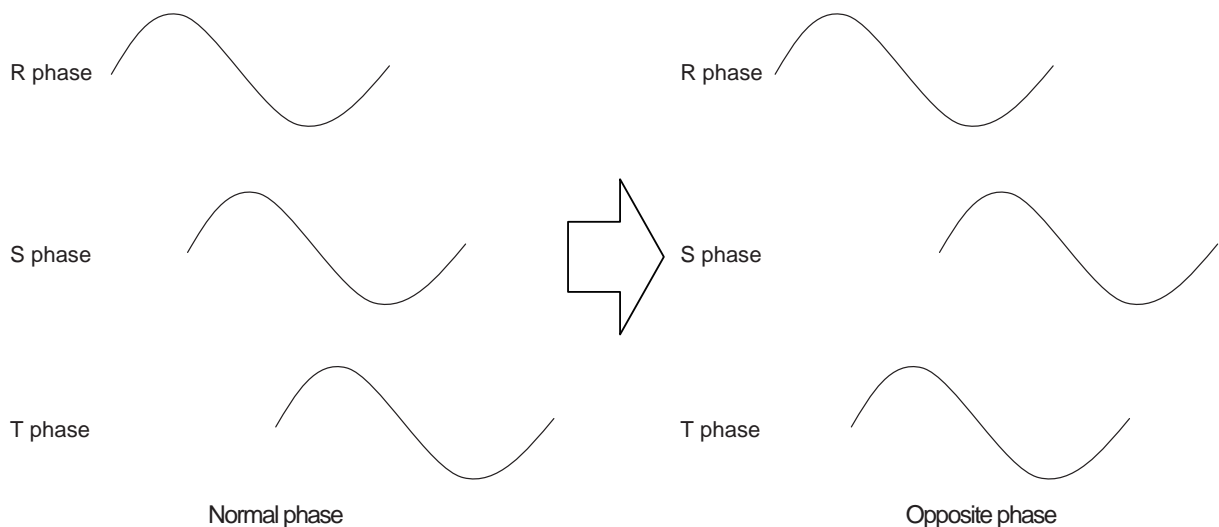
Opposite phase means the case where the phase sequence of voltage is not normal.

When the phase order is normal, phases R, S, and T are 0°, 120°, and 240°, respectively, with reference to phase R.

If the measured phase difference continues to show an incorrect relationship of angles for 0.1 s or more, the occurrence of an opposite phase is determined.

When an opposite phase is detected, check the equipment and wiring for any problem.

- \* Since phases other than the ones detected as normal phase are classified as opposite phase, opposite phase detection may be provided at the time of an open phase occurrence.



## 3.6 Output function

### ■ Output terminal 1/output terminal 2/output terminal 3 function setting

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	○	○

O: With setting

- An arbitrary output can be set at each of output terminal 1, output terminal 2, and output terminal 3. This setting can perform alarm outputs, pulse outputs, 3-STATE outputs, etc.

[Setting Items]

OFF, pulse output, open-phase output, opposite-phase output, measurement blocks 1/2, and alarm output (Default: OFF)

**Note.** PGR1C, PVS1C, VAU1B, and VAU1B are provided with two output terminals and CTD8E is provided with one output terminal.

### ■ Integrated power amount pulse output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	×	×

O: With function    X: Without function

Each time the integrated power amount reaches a set pulse output unit, pulse is output from the terminal set by the output pulse setting.

As the power amount increases, the integrated power amount increases, and pulse output cycles (intervals) become shorter. As the power amount decreases, the integrated power amount decreases, and pulse output cycles become longer.

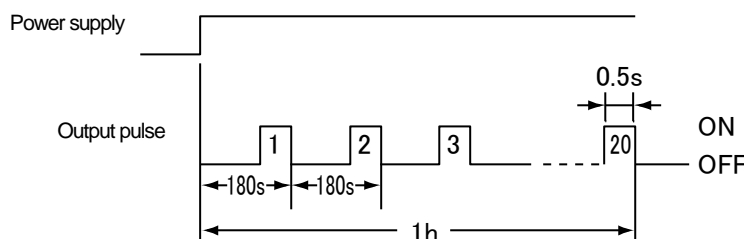
Output pulse cycles can be obtained by the following calculation formula.

Pulse output cycle [s] = 3600 [s]/(Power [W]/Pulse output unit [Wh])

The calculation method of pulse output cycles is described taking an example.

Example:

When input power is 200 k[W] and pulse output unit is 10 k[Wh] in 3-phase 3-wire, output pulse cycle =  $3600 \text{ [s]}/(200 \text{ k [W]}/10 \text{ k[Wh]}) = 180 \text{ [s]}$  is obtained. If the status with input voltage of 10 k[W] is continued for an hour, passage of an hour (3600 s) gives 10 k[Wh]. If an input of 200 k[W] sets the pulse output unit to 10 k[Wh],  $200 \text{ k[W]}/10 \text{ k[Wh]} = 20$  pulses are output for an hour, and the cycle is as follows:  $3600 \text{ [s]}/20 \text{ pulses} = 180 \text{ [s]}$ . For the output pulse, one pulse is output (ON) every 180 [s].



When the cycle is shorter than the pulse width, or when the next output is turned ON immediately after the output is turned OFF, OFF time of 100 ms is given.

If OFF time is short, count error may occur due to scan time such as PLC. Set an appropriate pulse output unit.



## ● Pulse output unit

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	×	×

O: With setting X: Without setting

Available when a pulse output is assigned to the output setting.

Any pulse output unit can be set.

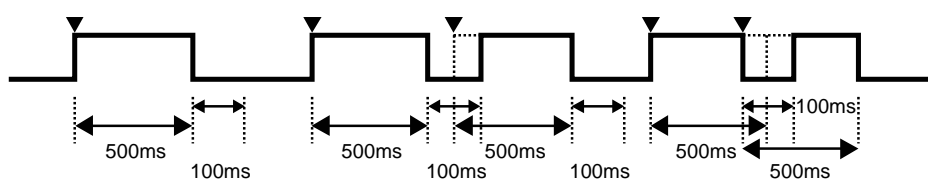
Setting range: 1 Wh, 10 Wh, 100 Wh, 1 kWh, 2 kWh, 5 kWh, 10 kWh, 20 kWh, 50 kWh, 100 kWh  
(Initial value: 100 Wh)

When the integrated power amount reaches the pulse output, power of the output unit is subtracted from the integrated power amount to perform pulse output.

The pulse output width is fixed to 500 ms. For 100 ms after the pulse output, next pulse output is forcibly turned OFF.

Overlap of pulses forcibly turns OFF the output for 100 ms to inhibit turning ON continuously.

Pulse output timing



\*1. ▼ indicates that the pulse output unit is reached.

\*2. The target circuit is selected by setting a pulse output circuit.

Setting range : Circuit 1, Circuit 2, Circuit 3, Circuit 4 (Initial value: Circuit 1)

	Circuit 1	Circuit 2	Circuit 3
Single-phase 2-wire	CT input 1	CT input 2	CT input 3
Single-phase 3-wire	CT input 1, 3		
3-phase 3-wire	CT input 1, 3		
3-phase 4-wire	CT input 1, 2, 3		

## ■ Voltage sag alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
×	○	○	×	×	×

O: With alarm X: Without alarm

If you set the voltage sag detection function to any one of the options other than OFF, voltage is monitored and an alarm is issued when a voltage sag is detected. Signals are output from the output terminal to which voltage sag alarm is assigned.

[Setting range]

Voltage sag detection function: OFF, Vrs · Vrn, Vst · Vsn, Vrt · Vtn (Default: OFF)

Voltage sag detection voltage: 0.0 to 480.0 V (Default: 80.0 V)

Voltage sag duration: 0.02 to 1.00 s (Default: 0.02 s)

Voltage sag backup: OFF, ON (Default: OFF)

\* For details on the voltage sag detection function, refer to Chapter 3.3.

\* For information on the locations of the output terminals used exclusively for voltage sag alarm, refer to Chapter 2.4.

## ■ Leakage alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	×	×	×	×	○

O: With alarm X: Without alarm

Selecting Leakage in the output terminal setting allows the output of leakage alarms from the output terminal.

[Setting range]

Leakage comparison value: 30 to 1000 mA (Default: 30 mA)

Leakage operating time 0.1 to 20.0 s (Default: 0.5 s)

\* For details on the leakage detection function, refer to Chapter 3.4.

## ■ Open phase (fixed unbalance factor) alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With alarm X: Without alarm

Turning on the open-phase detection function allows detecting an open phase and issuing an alarm. Selecting Open Phase in the output terminal function setting allows the output of open-phase alarms from the output terminal.

[Setting range] OFF, ON (Default: OFF)

- Open-phase alarm output is turned on when (max. difference between each phase voltage and average voltage)/average voltage is 85% or less under the condition of open-phase for 3-phase 3-wire or 3-phase 4-wire system.

\* For details on the open-phase detection function, refer to Chapter 3.5.

## ■ Opposite phase alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With alarm X: Without alarm

Turning on the opposite phase detection function allows monitoring the phase sequence of voltage and issuing an alarm when an abnormal condition is detected. Selecting Opposite Phase in the output terminal function setting allows the output of opposite-phase alarms from the output terminal.

[Setting range] OFF, ON (Default: OFF)

- \* For details on the opposite phase detection function, refer to Chapter 3.5.
- \* Since phases other than the ones detected as normal phase are classified as opposite phase, opposite phase detection may be provided at the time of an open phase occurrence.

## ■ Alarm output

- Alarm output upper/lower limit threshold, alarm output hysteresis, alarm output on-delay can be set.
  - Setting hysteresis can prevent frequently turning ON/OFF an alarm even when a measurement value varies near the alarm output judgment value.
  - On-delay is a function that keeps the output OFF for the specified hours and minutes. Set an optimum value.
  - Setting the upper limit threshold of each alarm to the maximum value turns the upper limit alarm function OFF, while setting the lower limit threshold to the minimum value turns the lower alarm function OFF. The setting should be made to use only either upper limit alarm or lower limit alarm.
- \* Do not use the alarm output function in cases related to safety, e.g., machine control, etc., because the function is assumed to detect errors and call attention by sounding a buzzer or lighting a lamp.

## ● Alarm history

Histories of alarms generated in the past can be confirmed via communication.

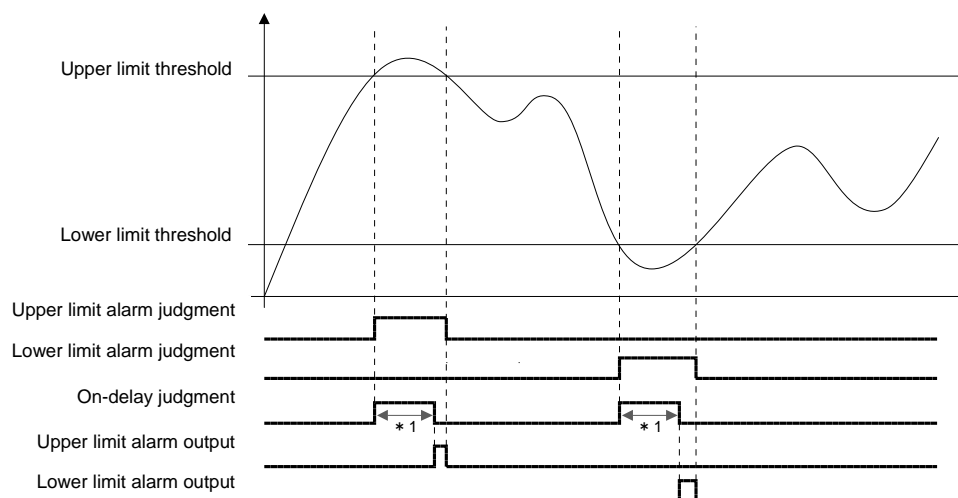
Histories of only 20 alarms generated in the past can be read. If the number of alarms generated exceeds 20, histories are deleted from the oldest one.

Alarm type, and time of alarm generation: The circuit in which an alarm was generated, and the time of generation are saved at first.

Alarm release time: Saved when all circuits to be judged have been alarm-released.

## ● Time chart of alarm output function

With on-delay setting, without hysteresis setting



\*1. Turn the alarm output OFF if the state remains OFF continuously in on-delay hour/minute and alarm judgment.

## ● Active input setting

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	○

O: With setting X: Without setting

Set the input (CT input/ZCT input) subject to monitoring in the alarm item setting and leakage alarm.

- Sets input that performs alarm judgment.
- Since 1 bit corresponds to 1 input, bits 0 to 7 correspond to inputs 1 to 8.
- Even if input whose bit is set to 0 (OFF) is a target for alarm, it is not judged as an alarm.
- The number of CT inputs per circuit differs depending on phase wire. In that case, if one of the CT inputs within the circuit is set to 1 (ON), it is judged as a target for alarm. For the inputs to be used, refer to the table below and Section 2.4 "Input/output configuration and example of wiring diagram."
- Setting range H'00000000 to H'000000FF (Initial value: H'000000FF)

	Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Input 8
PGR1C (Electric power/leakage)	CT input 1	CT input 2	CT input 3	ZCT input				
PVS1C (Electric power/voltage)	CT input 1	CT input 2	CT input 3					
VAU1B (Voltage/current)	CT input 1	CT input 2	CT input 3					
CTD8E (CT extension)	CT input 1	CT input 2	CT input 3	CT input 4	CT input 5	CT input 6	CT input 7	CT input 8
ZCT8E (ZCT extension)	ZCT input 1	ZCT input 2	ZCT input 3	ZCT input 4	ZCT input 5	ZCT input 6	ZCT input 7	ZCT input 8

## ● Active power alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

O: With alarm X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Active power upper limit alarm threshold : -120000000 to 120000000 W (Initial value: 1000 W)
- Active power upper limit alarm hysteresis : 0 to 24000000 W (Initial value: 100 W)
- Active power upper limit alarm on-delay : 0.5 to 10.0 s (Initial value: 0.5 s)
- Active power lower limit alarm threshold : -120000000 to 120000000 W (Initial value: 300 W)
- Active power lower limit alarm hysteresis : 0 to 24000000 W (Initial value: 100 W)
- Active power lower limit alarm on-delay : 0.5 to 10.0 s (Initial value: 0.5 s)

\*1. Setting a negative value can output an alarm against regenerated power.

\*2. CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

### ● Over current alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

O: With alarm X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Alarm judgment implements the OR operation in phases (when the value of a phase exceeds the over current alarm threshold). In addition, release of an alarm implements the AND operation (when the values of all phases are lower than over current alarm threshold and current alarm hysteresis).
- Over current alarm threshold : 0.0 to 6000.0 A (Initial value: 100.0 A)
- Over current alarm hysteresis : 0.0 to 1000.0 A (Initial value: 5.0 A)
- Over current alarm on-delay : 0.1 to 10.0 s (Initial value: 0.1 s)
- \* CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

### ● Under current alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	○	○	×

O: With alarm X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Alarm judgment implements the OR operation in phases (when the value of a phase is lower than the under current alarm threshold). In addition, release of an alarm implements the AND operation (when the values of all phases exceed under current alarm threshold and current alarm hysteresis).
- Under current alarm threshold : 0.0 to 6000.0 A (Initial value: 10.0 A)
- Under current alarm hysteresis : 0.0 to 1000.0 A (Initial value: 5.0 A)
- Under current alarm on-delay : 0.1 to 10.0 s (Initial value: 0.1 s)
- \* CTD8E (CT expansion) can perform the two-system measurement only when it is connected to PMU2A (power two-system).

### ● Over voltage alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With alarm X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Alarm judgment implements the OR operation in phases (when the value of a phase exceeds the over voltage alarm threshold). In addition, release of an alarm implements the AND operation (when the values of all phases are lower than over voltage alarm threshold and voltage alarm hysteresis).
- Over voltage alarm threshold : 0.0 to 12100.0 V (Initial value: 528.0 V)
- Over voltage alarm hysteresis : 0.0 to 2200.0 V (Initial value: 24.0 V)
- Over voltage alarm on-delay : 0.1 to 10.0 s (Initial value: 0.1 s)

## ● Under voltage alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

○: With alarm    X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Alarm judgment implements the OR operation in phases (when the value of a phase is lower than the under voltage alarm threshold). In addition, release of an alarm implements the AND operation (when the values of all phases exceed under voltage alarm threshold and voltage alarm hysteresis).
- Under voltage alarm threshold : 0.0 to 12100.0 V (Initial value: 85.0 V)
- Under voltage alarm hysteresis : 0.0 to 2200.0 V (Initial value: 24.0 V)
- Under voltage alarm on-delay : 0.1 to 10.0 s (Initial value: 0.1 s)

## ● Power factor alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

○: With alarm    X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Power factor alarm threshold : -1.00 to 1.00 (Initial value: 0.00)
- Power factor alarm hysteresis : 0.00 to 1.00 (Initial value: 0.05)
- Power factor alarm on-delay : 0.5 to 10.0 s (Initial value: 0.5 s)

\*1. CTD8E (CT expansion) can perform the two-system setting only when it is connected to PMU2A (power two-system).

## ● Reactive power alarm output

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

○: With alarm    X: Without alarm

- This function is available when output terminal function setting is selected as an alarm after the setting of alarm parameter setting and alarm output setting.
- Reactive power upper limit alarm threshold : -120000000 to 120000000 var (Initial value: 1000 var)
- Reactive power upper limit alarm hysteresis : 0 to 24000000 var (Initial value: 100 var)
- Reactive power upper limit alarm on-delay : 0.5 to 10.0 s (Initial value: 0.5 s)
- Reactive power lower limit alarm threshold : -120000000 to 120000000 var (Initial value: 300 var)
- Reactive power lower limit alarm hysteresis : 0 to 24000000 var (Initial value: 100 var)
- Reactive power lower limit alarm on-delay : 0.5 to 10.0 s (Initial value: 0.5 s)

\*1. CTD8E (CT expansion) can perform the two-system setting only when it is connected to PMU2A (power two-system).

## 3.7 Other functions

### ■ Simple measurement

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
×	×	×	×	○	×

O: With function X: Without function

This measurement allows roughly calculating electric power from the measured current value and any set voltage value and power factor.

This measurement is used when the wiring for voltage input is unavailable due to installation environment and wiring reasons. (Note 1)

[Setting range] OFF, ON (Default: OFF)

**Note 1:** The simple measurement function is unavailable when the measurement master of Model KE1 series is connected. The function is available when the measurement master of Model KM1 series is connected.

### ■ Electric energy conversion coefficient

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	×	×	○	×

O: With function X: Without function

Set a coefficient used to convert electric energy. For example, electric energy can be converted into CO2 emission or currency.

[Setting range] 0.000 to 9999.999 (Default: 1.000)

- The value equivalent to the electric energy can be obtained with the following formula.

$$\text{Equivalent value} = \text{Total electric energy} \times \text{Electric energy conversion coefficient}$$

- \* Measuring two systems with CTD8E (CT extension) requires the connection to PMU2A (Electric power two system).
- \* The method of calculating CO2 emission differs depending on each power business establishment and fiscal year. Set the electric energy conversion coefficient, referring to the web pages of power companies.
- \* To obtain the equivalent value in currency, set the electric energy conversion coefficient referring to the power charge per kWh on the web pages of power companies. When converting into foreign currency, set a conversion coefficient taking the exchange rate into account.

### ■ Time

PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
○	○	○	○	×	×

O: With function X: Without function

The product is connected to a PC to make settings by using higher-level software.

For details on the setting, refer to the manual for higher-level software.

The time can be set between 2012 and 2099.

Leap years in this period are also supported.

The accuracy is  $\pm 1.5$  min/month.

When a power failure (23°C) occurs, a backup is performed with an electric double layer capacitor for about 7 days.

## ■ Initialization

Initialization is available from KM1/KE1-Setting.

- Setting value initialization : Initializes setting values excepting time setting.
- MAX/MIN initialization : Initializes maximum and minimum values.
- Measurement history initialization : Initializes items to be logged.
- Alarm history initialization : Initializes alarm histories.
- Integrated power amount initialization : Initializes items to be backed up every 5 minutes.
- All initialization : Initializes all items excepting time setting.

	Setting value	MAX/MIN	Measurement history	Alarm history	Integrated power amount	All initialization
Measurement item	-	Initialization	-	-	-	Initialization
Integrated active power amount	-	-	-	-	Initialization	Initialization
Integrated regeneration power amount	-	-	-	-	Initialization	Initialization
Integration progression reactive power amount	-	-	-	-	Initialization	Initialization
Integrated delayed reactive power amount	-	-	-	-	Initialization	Initialization
Integrated total reactive power amount	-	-	-	-	Initialization	Initialization
Conversion value	-	-	-	-	Initialization	Initialization
Target for log	-	-	Initialization	-	-	Initialization
Voltage sag for log	-	-	Initialization	-	-	Initialization
Alarm history	-	-	-	Initialization	-	Initialization
Setting contents	Initialization	-	-	-	-	Initialization
Time setting	-	-	-	-	-	-

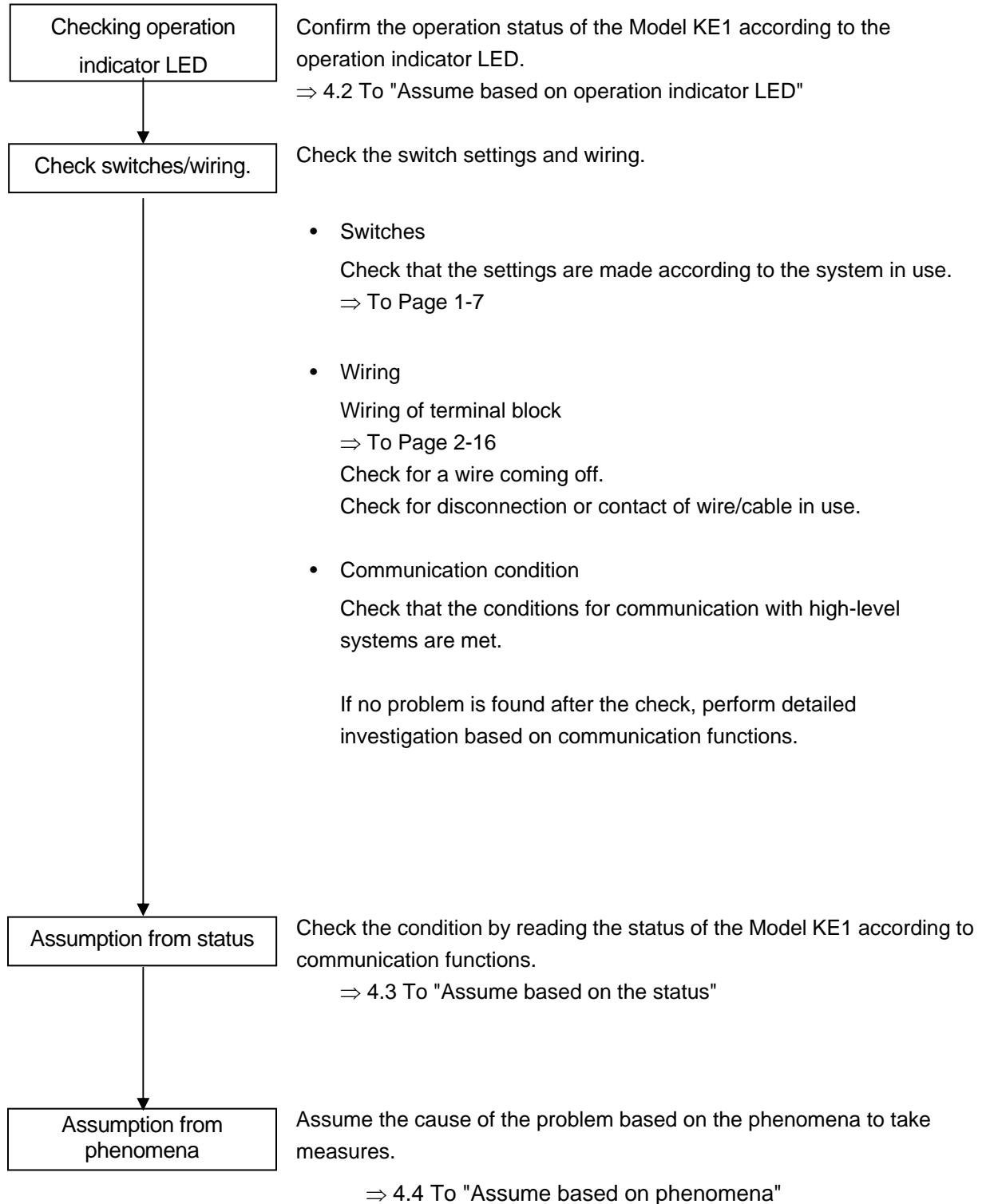


## Chapter 4. Troubleshooting

4.1	Flow of troubleshooting .....	4-2
4.2	Assume based on operation indicator LED .....	4-3
4.3	Assume based on the status .....	4-4
4.4	Assume based on phenomena .....	4-5

## 4.1 Flow of troubleshooting

If some problem occurs, check the sections according to the following items.



## 4.2 Assume based on operation indicator LED

If the power (PWR) lamp of the measurement master, CT expansion slave, or function slave is flashing, it indicates that an error has occurred.

Operation indicator LED				Assumable cause	Measures
PWR	CONN	ALM	COMM		
Lit 	Lit 	Lit 	Lit 	Immediately after power ON (All LEDs lit)	-
				Destruction of EEPROM data (All LEDs lit)	Repair is required. Contact the supplier you purchased the product from or our sales representative.
Lit 	Flashing 	Off 	Off 	Duplicates of slave ID, or out of range	Review the ID setting.
				Duplicates of unit no.	Review the unit no.
				Duplicates of the master	Review the master/slave.
				Over the allowable number of units connected	Check the number of units connected.
				Incompatibility in protocol of DIP switches	Check the settings of CompWay/F and Modbus and make the settings to match the protocol.
				Mismatch between the connection configuration and the ID of the connected slave	Make the ID of the connected slave match the connection configuration.
				Internal bus communication not allowed	Recheck the connection.
Lit 	Off 	Off 	Off 	Error in the unit connected	Check the error of the unit.
				Normal start-up (independent)	-
Lit 	Lit 	Off 	Off 	During measurement (independent)	-
				Normal start-up (multiple units)	-
Flashing 	Off 	Off 	Off 	During measurement (multiple units)	-
				EEPROM error	If the condition is not changed even by turning the power OFF, repair is required. Contact the supplier you purchased the product from or our sales representative.
				RAM error	
				RTC error	
Lit 	Lit/Off 	Off 	Lit 	Communication error	If the condition is not changed even by rechecking communication settings and wiring, repair is required. Contact the supplier you purchased the product from or our sales representative.
				RS-485/USB communication in progress	-
Lit 	Lit/Off 	Lit 	Off/Flashing 	Alarm output in progress	Since this is caused by functions of units, check the settings and then refer to Page 3-18.
Lit 	Lit/Off 	Flashing 	Off/Flashing 	Excess of over current	Return it to within the range of standard.
				Excess of over voltage	
				Frequency input error	

## 4.3 Assume based on the status

By reading the status through communication, you can confirm the condition of unit.

The status is made up of 32 bits: bit 1 indicating the occurrence and bit 0 indicating non-occurrence (mode of operation 1: stop; 0: operation). (For the status of each model, refer to "Model KM1/KE1 Communication Manual" (SGTE-719).)

Status name	Meaning	Measures
RAM error	Indicates a RAM error.	If the condition is not changed even by turning the power OFF, repair is required. Contact the supplier you purchased the product from or our sales representative.
EEPROM error	Indicates an EEPROM error.	
RTC error	Indicates an RTC error.	
Communication error	Indicates a communication error.	Set the clock again.
Operation Modes	Indicates the operation condition.	If the condition is not changed even by rechecking communication settings and wiring, repair is required. Contact the supplier you purchased the product from or our sales representative.
Voltage input over	Indicates that the measurement voltage is larger than the standard.	Return it to within the range of standard.
Current input over	Indicates that the measurement current is larger than the standard.	
Insufficient input voltage	Indicates that the measurement voltage is smaller than the standard.	
Frequency input error	Indicates that the measurement frequency is out of the range of standard.	
CT input <input type="checkbox"/>	Indicates that CT <input type="checkbox"/> has an input.	-
ZCT input <input type="checkbox"/>	Indicates that ZCT <input type="checkbox"/> has an input.	-
OUT <input type="checkbox"/>	Indicates that there is an output from OUT <input type="checkbox"/> .	-
Alarm 1	Indicates that one of the items set in the measuring block 1 item setting reaches the condition of alarm output.	-
Alarm 2	Indicates that one of the items set in the measuring block 2 item setting reaches the condition of alarm output.	-

## 4.4 Assume based on phenomena

### Before you think the product is malfunctioning

If Model KE1 does not operate normally, check applicable items listed below before making a request for repair.

If the product does not operate normally despite your check, we would like you to return the product to us via our sales division.

When	Phenomenon	Items to be checked	Action to be taken	Reference page
At time of initial connection to power	Operation indicator LEDs, OUT1, OUT2, and OUT3, light up.	Check that the lamp is flashing in conjunction with pulse output for measurement or alarm output.	If lamps, OUT1, OUT2, and OUT3, light up in conjunction with pulse output for measurement or alarm output, the product is normal.	-
	Voltage and current can be measured, but power cannot be measured correctly.	Check that the dedicated CT is not installed in the reverse direction.	If negative power is measured, all dedicated CTs may have been installed in the reverse direction. If the power close to 0 is measured, one of the two dedicated CTs may have been installed in the reverse direction.	2-12
	Large measurement error	Check that the wiring is correct.	Perform wiring correctly.	2-16
		Check that the type of the dedicated CT is correct.	Checking the type of your dedicated CT, set the dedicated CT of a correct type.	3-4
		Check that inputs are within the input range of the dedicated CT.	Checking the standard of the dedicated CT, supply current so that the dedicated CT can be within the range of the standard.	A-7
	Current becomes 0	Check that the current input value is higher than the current low-cut value.	Make settings so that the current low-cut value is lower than the current input value.	3-5
	Communication not allowed	Check that only the recommended communication converter (K3SC-10) is used.	Check that no error has occurred in the equipment connected.	-
		Check that the higher level systems (communication equipment) are normal.		-
		Check that settings for communication are correct.	Check that the communication setting is the same between the KM1 main unit and the communication converter.	-
		Check that the wiring is correct.	Perform wiring correctly.	2-16
		Check that the termination resistor has been installed.	Install termination resistors of 120 $\Omega$ (1/2 W) at the end of Model KM1 and in the communication converter.	2-34
		Check that the transmission distance is within the allowable maximum range.	Make connections in such a way that the maximum transmission distance for communication is 500 m or less.	-
		Check that the number of pieces of equipment connected to the same communication line is within the maximum number of connected units.	When CompoWay/F is selected for protocol, the maximum number of pieces of equipment connected must be 31 units in the KE/KM series. When Modbus, it must be 99 units or less in the KE/KM series (in either case, no base unit is included).	2-34
	Operation indicator LED PWR lights up, and CONN is flashing.	Check for duplicates of slave ID. Or, check that the setting is within the range.	Recheck the setting of slave ID.	-
		Check that the number of master units is one.	Check that the number of master units is one per system.	-
		Check that the number units connected is within the limit.	Check the maximum number of units connected.	-
		Check that the communication protocol is matched.	Recheck the setting of communication protocol.	2-3 2-31

When	Phenomenon	Items to be checked	Action to be taken	Reference page
When used	The primary current of the inverter cannot be measured correctly.	Check that the selected dedicated CT has some margin in the standard.	When the primary current of inverter is measured, the crest value is several times larger than the effective value. Therefore, use a dedicated CT having some margin in the standard.	A-7
	The date and time of the clock are initialized to April 1, 2012 at 0:0:0.	Check whether the RTC backup period has passed.	Set the clock all over again.	-
	Communication with the unit connected cannot be carried out.	Check that the specified connector has been used.	Use the specified connector.	2-9
		Check that the settings of the connection configuration are correct.	Match the setting of the slave ID of the connected unit with that of the connection configuration of the measurement master.	2-4
		Check that the power voltage has been applied to the functional slave.	Power voltage can be applied from the measurement master to CT expansion slaves only. Apply power voltage to the functional slave.	-
	Data backed up every 5 minutes or alarm histories for CTD8E (CT expansion) are not saved.	Check for errors in connections.	Connecting units to each other via the connector, match the setting of the slave ID with that of the connection configuration of the measurement master.	-
	Although communication with the unit connected can be carried out, CONN remains OFF.	-	Reset the entire system.	-

# Appendix

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# Product specifications

## Rating of main unit

Model		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)	
Applicable circuit		Single-phase 2-wire, single-phase 3-wire, 3-phase 3-wire, 3-phase 4-wire						
Max. number of CTs		3	3		3	8		
Selectabl CT (*1)		1	1		1	2 (*2)		
Max. number of ZCTs		1					8	
Power source	Standard power voltage	100~240 VAC 50/60 Hz						
	Permissible power voltage range	85 to 110% of the standard power voltage						
	Supply frequency fluctuation range	45~65Hz						
	Consumed power	10 VA or less for independent use, 14 VA for expansion		10 VA or less				
	Power failure compensation		Backup more than 1.2seconds					
Input	Standard input voltage	100 to 480 VAC single-phase 2-wire: line-to-line voltage 100/200 VAC single-phase 3-wire: phase voltage/line-to-line voltage 100 to 480 VAC 3-phase 3-wire: line-to-line voltage 58 to 277 VAC 3-phase 4-wire: Phase voltage						
	Standard input current (CT)	5A, 50 A, 100 A, 200A, 400A, 600A			5A, 50A, 100A, 200A, 400A, 600A			
	Standard input current (ZCT)	50A, 100A, 150A, 200A, 400A, 600A, 1000A					50A, 100A, 150A, 200A, 400A, 600A, 1000A	
	Standard input power	When 5ACT is used : 4 kW When 50ACT is used : 40 kW When 100ACT is used : 80 kW When 200ACT is used : 160 kW When 400ACT is used : 320 kW When 600ACT is used : 480 kW				When 5ACT is used : 4 kW When 50ACT is used : 40 kW When 100ACT is used : 80 kW When 200ACT is used : 160 kW When 400ACT is used : 320 kW When 600ACT is used : 480 kW		
	Standard input frequency	50Hz/60Hz						
	Supply frequency fluctuation range	45Hz~65Hz						
	Input current leakage	1000 mA					1000 mA	
	Permissible input voltage	110% of standard input voltage (continuous)						
	Permissible input current	120% of standard input current (continuous)			120% of standard input current (continuous)			
	Standard input load	Voltage input of 0.5 VA or less (excepting power supply section)						
		Current input of 0.5 VA or less (each input)				Current input of 0.5 VA or less (each input)		
Clock	Setting the time	2012 to 2099 (also supported in leap years during this period)						
	Clock accuracy	±1.5 min/month (at 23°C)						
	Clock backup retaining period	Backed up by the electric double layer capacitor for approximately 7 days (At 23°C with power not supplied after power is distributed for approximately 24 hours or more)						
Usage ambient temperature		-10 to +55°C (however there is to be no condensation or freezing)						
Storage temperature		-25 to 65°C (however there is to be no condensation or freezing)						
Storage ambient humidity		Relative humidity of 25 - 85%						
Storage humidity		Relative humidity of 25 - 85%						
Altitude		2000 m or less						
Installation environment		Over voltage category II, pollution level 2, measurement category II						
Applicable standards		IEC61010-2-030, EN61326-1						



## ■ Main part specifications

Model		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Item							
Accuracy (*1)	Voltage	±1.0% FS ±1 digit * However, intra Vtr voltage shall be ±2.0% FS ±1digit under the same conditions.					
	Current	±1.0% FS ±1 digit * However, S-phase current of 3-phase 3-wire and N-phase current shall be±2.0% FS ±1 digit under the same conditions.			±1.0% FS ±1 digit * However, S-phase current of 3-phase 3-wire and N-phase current shall be±2.0% FS ±1 digit under the same conditions.		
	Current leakage	30~200mA Min.: ±5%rdg±1digit 200~1000mA Max.: ±1%FS±1digit					30~200mA Min.: ±5%rdg±1digit 200~1000mA Max.: ±1%FS±1digit
	Electric power (Active power, reactive power)	Active power, reactive power ±2.0% FS ±1 digit (power factor)				Active power, reactive power ±2.0% FS ±1 digit (power factor)	
	Frequency	±0.3Hz±1digit					
	Power factor (*2)	±5.0% FS (Ambient temperature of 23°C, standard input, standard frequency, power factor = range of 0.5 to 1 to 0.5)				±5.0% FS (Ambient temperature of 23°C, standard input, standard frequency, power factor = range of 0.5 to 1 to 0.5)	
Influence by temperature		±1.0% FS (Ratio to measurement value at ambient temperature of 23°C, with standard input, standard frequency, and power factor of 1, within the working temperature range)					
Influence by frequency		±1.0% FS (Ratio to measurement value at ambient temperature of 23°C, with standard input, standard frequency, and power factor of 1, within the standard frequency range of ±5 Hz)					
Influence by higher harmonic wave		±0.5% FS (Error generated when the 2nd-, 3rd-, 5th-, 7th-, 9th-, 11th-, or 13th-order higher harmonic wave is superimposed over the basic wave at ambient temperature of 23°C with the content rates of 30% in current and 5% in voltage)					
Low-cut current setting value		Variable in units of 0.1% between 1.0-19.9% of the standard input			Variable in units of 0.1% between 1.0-19.9% of the standard input	Variable in units of 0.1% between 0.1-19.9% of the standard input	
Low-cut current leakage setting value		Variable in units of 0.1 mA between 0.1 to 30.0 mA					Variable in units of 0.1 mA between 0.1 to 30.0 mA
Sampling frequency		100 ms (with measurement voltage at 50 Hz), 83.3 ms (with measurement voltage at 60 Hz)					
Insulation resistance		Insulation resistance value of 20 MΩ (500 VDC)					
Voltage withstood		Common: 2000 V for 1 minute PGR1C: Place to which voltage is applied: Between all terminals and case simultaneously Between all power sources and all RS-485/transistor/relay outputs simultaneously Between all power sources and all current/voltage/leakage inputs simultaneously PVS1C: Between all current/voltage/leakage inputs and all RS-485/relay/transistor outputs simultaneously VSU1B: Between all power sources and all RS-485/relay outputs simultaneously Between all power sources and all voltage inputs simultaneously Between all voltage inputs and all RS-485/relay outputs simultaneously VAU1B: Between all power sources and all RS-485/relay outputs simultaneously Between all power sources and all current/voltage inputs simultaneously CTD8E: Between all current/voltage inputs and all RS-485/relay outputs simultaneously ZCT8E: Between all current inputs and all relay outputs simultaneously					
Vibration tolerance		Half amplitude of 0.35 mm, acceleration of 50 m/s <sup>2</sup> Frequency of 10 to 55 Hz, sweeping along three axes, 5 min x 10 times each					
Shocks withstood		150 m/ s <sup>2</sup> up/down, left/right, front/back in 6 directions, 3 times each					
Mass		Approximately 230 g					
Memory protection		EEPROM (non-volatile memory) Number of write times: :1 million times					
Combination		Connection to KM1-EMU8A-FLK can support 7 event input points and 1 temperature input point.					
Transistor output	Number of other points	1 open collector points (OUT2)					
	Output capacity	30 VDC ,30 mA					
	ON residual voltage	1.2 V or less					
	OFF time leakage current	100 μA or less					
	Integrated power amount pulse output	1 pulse output when the power amount in the set pulse output voltage is reached 1,10,100,1 k,2 k,5 k,10 k,20 k,50 k,100 k (W · h)					
	Alarm output	Outputs an alarm based on the set alarm output threshold					
	Return method	Automatic return only					

Model		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Relay output	Number of other points	1 a-contact point (OUT1)		1 a-contact point (OUT1)	2a-contact point (OUT1, OUT2)	1 a-contact point (OUT1)	
	Standard load	Resistance load 250 VAC 3 A 30 VDC 3 A Inductive load (cosφ=0.4,L/R=7 ms) 250 VAC 1 A 30 VDC 1 A		Resistance load 250 VAC 3 A 30 VDC 3 A Inductive load (cosφ=0.4,L/R=7 ms) 250 VAC 1 A 30 VDC 1 A	Resistance load 125 VAC 3 A 30 VDC 3 A		
	Mechanical life	10 million times or more		10 million times or more	5 million times or more		
	Electrical life	50,000 times or more (standard load, 1800 times/h in open-close frequency)		50,000 times or more (standard load, 1800 times/h in open-close frequency)	200,000 times or more (standard load, 1800 times/h in open-close frequency)		
	Failure rate P level	5 VDC 10 mA (in open-close frequency of 120 times/min)		5 VDC 10 mA (in open-close frequency of 120 times/min)			
	Alarm output	Turning output ON/OFF according to the setting value of alarm		Turning output ON/OFF according to the setting value of alarm			
	Return method	Automatic recovery only			Automatic recovery only		
Solid-state relay output	Number of output points		MOS FET 1 point (OUT1)	MOS FET 1 point (OUT2)			
	Max. load voltage		Peak 24 VAC/DC				
	Continuous load current		Peak 80 mA AC/DC				
	ON resistance		Max. 15 Ω				
	Open-circuit leakage current		Max. 1 nA				
	Alarm output		Output ON/OFF according to alarm setting				
	Recovery method		Automatic recovery only				
Communication	Protocol	Communication protocol switching, OFF: CompoWay/F ON: Modbus					
	Synchronous system	Refer to Model KM1/KE1 Communication Manual (SGTE-719).					
	Setup of unit no.	CompoWay/F:0-99, Modbus:1-99 * If switching operation switches the protocol to Modbus when the unit No. setting is set to 0, the unit no. setting value is automatically changed to 1.					
RS-485	Communication speed	9600bps, 19200bps, 38400bps					
	Transmission code	CompoWay/F: ASCII	Modbus : Binary				
	Data bit (*3)	CompoWay/F: 7 bit, 8 bit	Modbus : 8 bit				
	Stop bit (*3)	CompoWay/F: 1 bit, 2 bit	Modbus: 1 bit with parity, 2 bits without parity				
	Parity	No, Even, Odd					
	Maximum transmission distance	500 m					
	Maximum number of connected units	CompoWay/F: 31 units	Modbus: 99 units				
	Communication item	調歩同期					
USB		Conforms to USB Standard V1.1					
Retained during power failure		*4	*5	*6	*7	*8	*9
Number of connector insertion/removal times		25 times					

\*1 Conforms to JISC1111. Error in dedicated CT is not included. For ambient temperature of 23°C, standard input, standard frequency, and higher harmonic wave, the 2nd-, 3rd, 5th-, 7th-, 9th-, 11th-, and 13th orders are supported.

\*2. Calculation formula: Power factor = Active power/Apparent power  
Apparent power =  $\sqrt{(\text{Active power})^2 + (\text{Reactive power})^2}$

\*3 If the protocol is switched to Modbus, the setting value may be changed. When switching DIP switches, check the setting contents.

\*4 Setting data, Alarm history, Logging data and Backup data.

\*5 Setting data, Alarm history, Logging data, Backup data and Voltage sag history.

\*6 Setting data, Alarm history, Logging data, and Voltage sag history.

\*7 Setting data, Alarm history and Logging data.

\*8 Setting data and Alarm history.

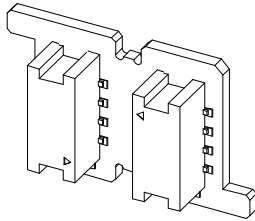
## Protection functions

Model		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Active power monitor	Operation setting range	Upper limit alarm: -120000000 to 120000000 W Lower limit alarm: -120000000 to 120000000 W				Upper limit alarm : -120000000 to 120000000 W Lower limit alarm : -120000000 to 120000000 W	
	Operation characteristics	±2.0%FS±1 digit				±2.0%FS±1 digit	
	Operation time	0.5 to 10.0 s				0.5 to 10.0 s	
	Operation time characteristics	±0.2 s				±0.2 s	
	Return power	Upper limit alarm : Upper limit alarm operation value 0 to 24000000 W Lower limit alarm : Lower limit alarm operation value 0 to 24000000 W				Upper limit alarm : Upper limit alarm operation value 0 to 24000000 W Lower limit alarm : Lower limit alarm operation value 0 to 24000000 W	
Current monitor	Operation setting range	Upper limit alarm : 0.0 to 6000.0 A Lower limit alarm : 0.0 to 6000.0 A			Upper limit alarm : 0.0 to 6000.0 A Lower limit alarm : 0.0 to 6000.0 A		
	Operation characteristics	±1.0%FS±1digit * S-phase current of 3-phase 3-wire and N-phase current of single-phase 3-wire shall be ±2.0% FS ±1 digit.			±1.0%FS±1digit * S-phase current of 3-phase 3-wire and N-phase current of single-phase 3-wire shall be ±2.0% FS ±1 digit.		
	Operation time	0.1 to 10.0 s			0.1 to 10.0 s		
	Operation time characteristics	±0.2 s			±0.2 s		
	Return current	Upper limit alarm : Upper limit alarm operation value 0.0 to 1000.0 A Lower limit alarm : Lower limit alarm operation value 0.0 to 1000.0 A			Upper limit alarm : Upper limit alarm operation value 0.0 to 1000.0 A Lower limit alarm : Lower limit alarm operation value 0.0 to 1000.0 A		
Voltage monitor	Operation setting range	Upper limit alarm : 0.0 to 12100.0 V Lower limit alarm : 0.0 to 12100.0 V					
	Operation characteristics	±1.0%FS±1 digit * However, intra Vtr voltage shall be ±2.0% FS ±1 digit under the same conditions.					
	Operation time	0.1 to 10.0 s					
	Operation time characteristics	±0.2 s					
	Return voltage	Upper limit alarm : Upper limit alarm operation value 0.0 to 2200.0 V Lower limit alarm : Lower limit alarm operation value 0.0 to 2200.0 V					
Power factor monitor	Operation setting range	-1.00~1.00					
	Operation characteristics	±5.0%FS (power factor = range of 0.5 to 1 to 0.5)				±5.0%FS (power factor = range of 0.5 to 1 to 0.5)	
	Operation time	0.5 to 10.0 s				0.5 to 10.0 s	
	Operation time characteristics	±0.2 s				±0.2 s	
	Return voltage	0.00 to 1.00				0.00 to 1.00	
Reactive power monitor	Operation setting range	Upper limit alarm : -120000000 to 120000000 var Lower limit alarm : -120000000 to 120000000 var				Upper limit alarm : -120000000 to 120000000 var Lower limit alarm : -120000000 to 120000000 var	
	Operation characteristics	±2.0%FS±1 digit				±2.0%FS±1 digit	
	Operation time	0.5 to 10.0 s				0.5 to 10.0 s	
	Operation time characteristics	±0.2 s				±0.2 s	
	Return voltage	Upper limit alarm : Upper limit alarm operation value 0 to 24000000var Lower limit alarm : Lower limit alarm operation value 0 to 24000000var				Upper limit alarm : Upper limit alarm operation value 0 to 24000000var Lower limit alarm : Lower limit alarm operation value 0 to 24000000var	

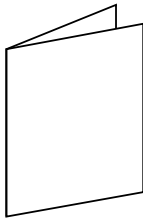
Model		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Item							
Leakage monitoring	Operation setting range	30 to 1,000 mA					30 to 1,000 mA
	Operation characteristics	±5% rdg (30 to 200 mA) ±1% FS (200 to 1,000 mA)					±5% rdg (30 to 200 mA) ±1% FS (200 to 1,000 mA)
	Operating time setting range	0.1 to 20.0 s					0.1 to 20.0 s
	Operation time characteristics	±0.2 s					±0.2 s
	Recovery condition	95% of operate value					95% of operate value
Voltage sag monitoring	Voltage sag detection voltage setting range		0.0 to 480.0 V				
	Tolerance of detected voltage		±2.5% FS				
	Duration setting range		Backup unavailable: 0.02 to 0.2 s Backup available: 0.02 to 1.00 s				
	Accuracy of relay output operating time		±5 ms				
Open-phase monitoring	Open-phase detection condition	In 3-phase voltage, (Max. difference between each phase voltage and average voltage/average voltage) x 100 · 85%					
	Operation characteristics	±1.0% FS ±1 digit * However, voltage between Vtr shall be ±2.0% FS ±1 digit under the same condition.					
	Operation time	0.1 s					
	Operation time characteristics	±0.2 s					
	Recovery condition	Unbalance factor of less than 13%					
Reverse phase monitor	Operation time	0.1s					
	Operation time characteristics	±0.2s					

## Accessories

- Connection connector (excepting measurement master)



- Instruction Manual (Japanese, English, Korean)



# Dedicated CT and ZCT

## ■ Specification

### 【CT】

Model Item	Split type					
	Model KM20-CTF-5A	Model KM20-CTF-50A	Model KM20-CTF-100A	Model KM20-CTF-200A	Model KM20-CTF-400A	Model KM20-CTF-600A
Primary standard current	5 A	50 A	100 A	200 A	400 A	600 A
Secondary standard current	1.67 mA	16.7 mA	33.3 mA	66.7 mA	66.7 mA	66.7 mA
Secondary coil	3,000 turns				6,000 turns	9,000 turns
Applicable frequency	10 Hz-5 kHz					
Insulation resistance	Between output terminal and case : 50 MΩ or higher (500 VDC mega)					
Voltage withstood	Between output terminal and case : 2000 VAC 1 min					
Protection element	7.5 V clamp element					
Permissible number of insertion/removal times	100 times					
Inner diameter	10 dia.		16 dia.	24 dia.	37 dia.	
Working temperature/ humidity range	-20 to + 60°C with 85% or less (without condensation)					
Storage temperature/ humidity range	-30 to + 65°C with 85% or less (without condensation)					

Item \ Model	Panel fixed (through) type
	Model KM20-CTB-5A/50A
Primary standard current	5 A/50 A
Secondary standard current	1.67 mA/16.7 mA
Secondary coil	3,000 turns
Applicable frequency	10 Hz to 5 kHz
Insulation resistance	Between output terminal and case : 50 MΩ or higher (500 VDC mega)
Voltage withstood	Between output terminal and case : 2000 VAC 1 min
Protection element	7.5 V clamp element
Inner diameter	10 dia.
Working temperature/humidity range	-20 to + 60°C with 85% or less (without condensation)
Storage temperature/humidity range	-30 to + 65°C with 85% or less (without condensation)

Item \ Model	Split core type for earth wire only
	Model K6ER-CN22
Primary standard current	2 A
Insulation resistance	Between core output lead wires: 100 MΩ or more
Voltage withstood	Between core output lead wires: 1000 VAC 50/60 Hz 1 min.
Inner diameter	22 dia.
Working temperature/humidity range	-10 to + 60°C with 25 to 85% (without condensation)
Storage temperature/humidity range	-20 to + 70°C with 25 to 85% (without condensation)

- \*1. Use the dedicated CT at a low voltage of 600 V or less.
- \*2. When clamping at a conductive object, such as bus bar, ensure the basic insulation at least by covering it with an insulator, etc.

## 【ZCT】

## • Split core type

Item \ Model	Indoor split core type			Outdoor split core type
	Model OTG-CN52	Model OTG-CN77	Model OTG-CN112	Model OTG-CN36W
Primary standard current	200 A	400 A	600 A	150 A
Insulation resistance	Between charging portion and earth: 100 M $\Omega$ or more (500 DCV megger)			
Voltage withstood	Between charging portion and earth: 2200 VAC 1 min.			
Inner diameter	52 dia.	77 dia.	112 dia.	36 dia.
Working temperature/ humidity range	-10 to + 60°C with 45 to 85% (without condensation)			
Storage temperature/ humidity range	-10 to + 60°C with 45 to 85% (without condensation)			

## • Through type

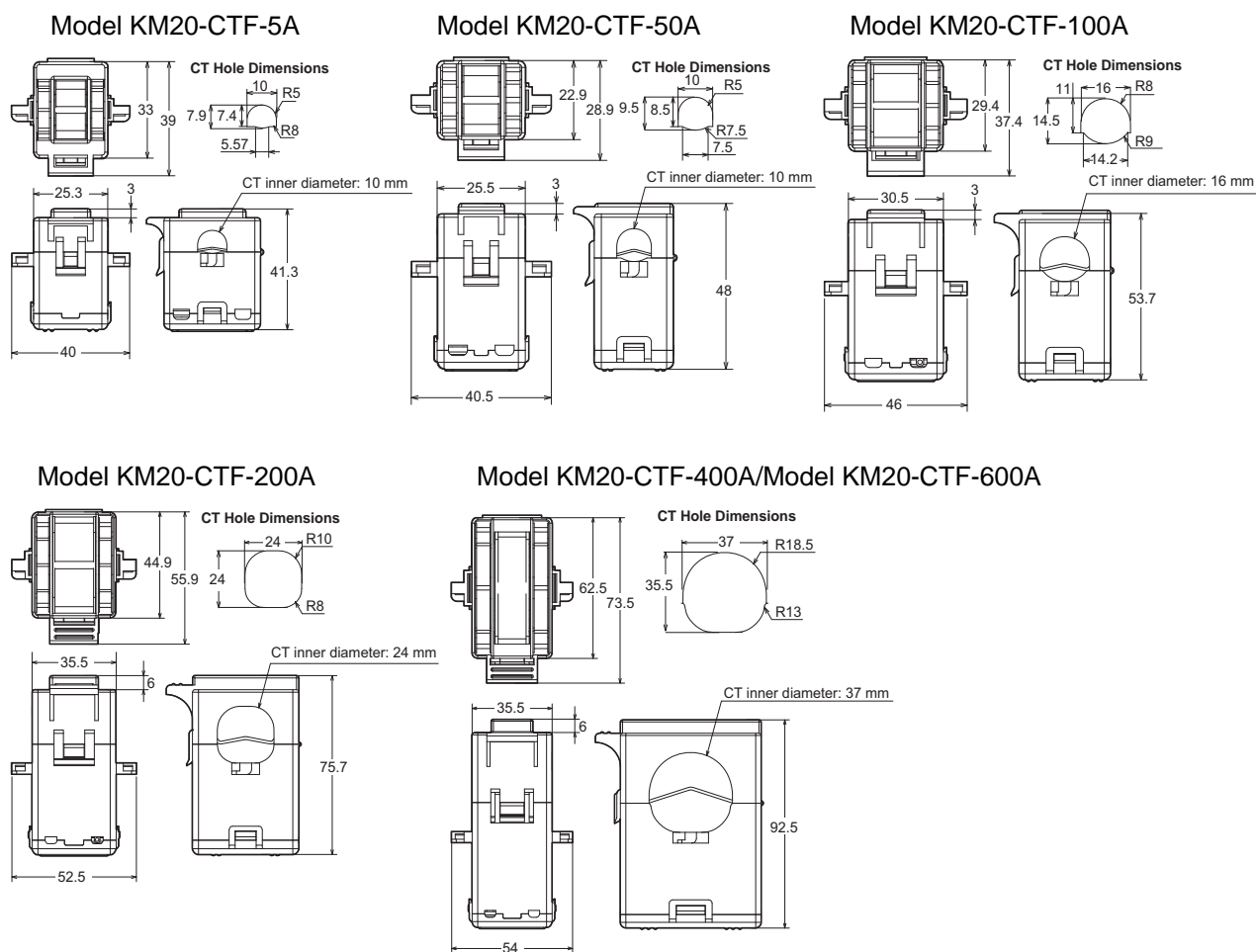
Item \ Model	Indoor through type						Outdoor through type
	Model OTG-L21	Model OTG-L30	Model OTG-L42	Model OTG-L68	Model OTG-L82	Model OTG-L156	Model OTG-LA30W
Primary standard current	50 A	100 A	200 A	400 A	600 A	1000 A	100 A
Insulation resistance	Between charging portion and earth: 100 M $\Omega$ or more (500 DCV megger)						
Voltage withstood	Between charging portion and earth: AC2200V 1min						
Inner diameter	21 dia.	30 dia.	42 dia.	68 dia.	82 dia.	156 dia.	30 dia.
Working temperature/ humidity range	-10 to + 60°C with 45 to 85% (without condensation)						
Storage temperature/ humidity range	-10 to + 60°C with 45 to 85% (without condensation)						

\*1. Use the dedicated ZCT in a low-voltage circuit of 600 V or below

\*2. When clamping at a conductive object, such as bus bar, ensure the basic insulation at least by covering it with an insulator, etc.

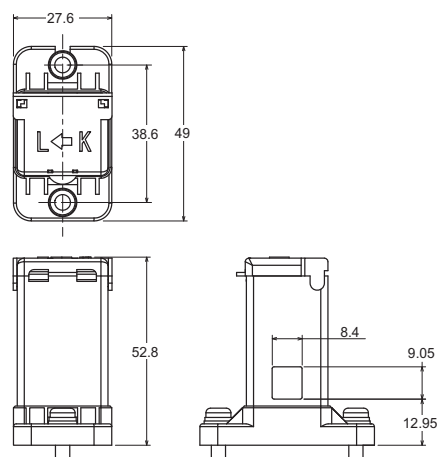
## ■ External dimensions (unit: mm)

### ● 【CT】 Split type



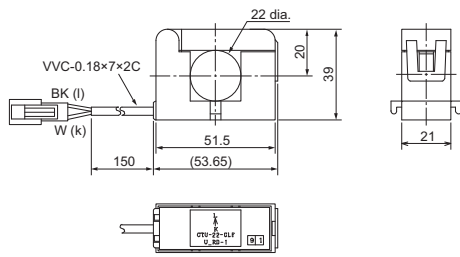
### ● 【CT】 Panel fixed (through) type

Model KM20-CTB-5A/50A

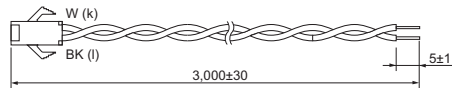


● 【CT】 Split core type for earth wire only

Model K6ER-CN22

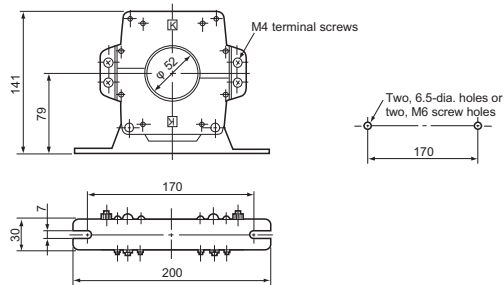


The following connection cable is included.

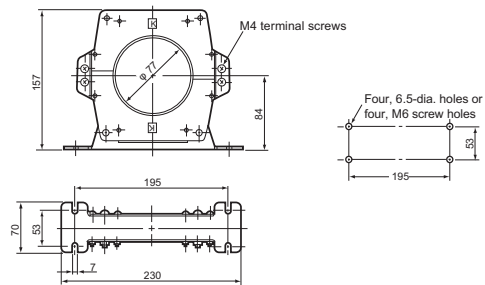


● 【ZCT】 Indoor split core type

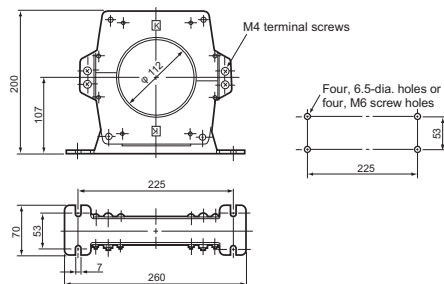
Model OTG-CN52



Model OTG-CN77

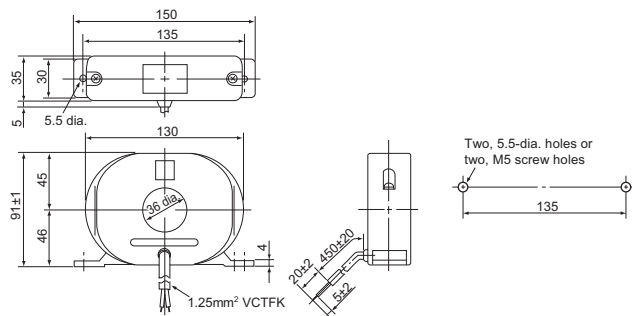


Model OTG-CN112



● 【ZCT】 Outdoor split core type

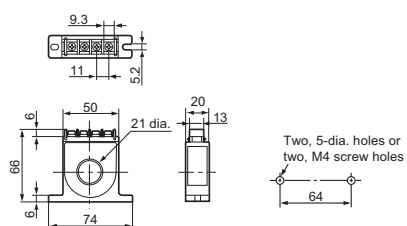
Model OTG-CN36W



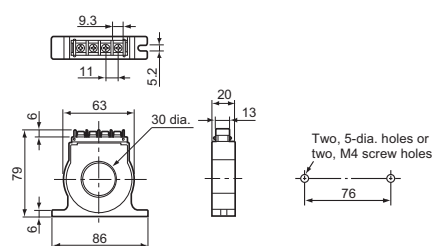


## ● 【ZCT】 Indoor through type

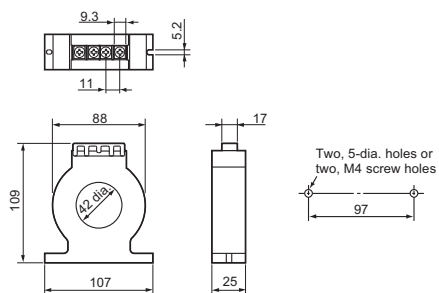
### Model OTG-L21



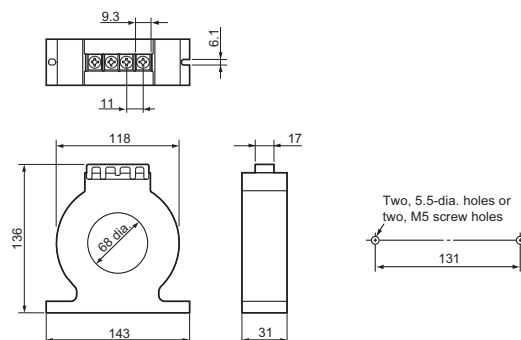
### Model OTG-L30



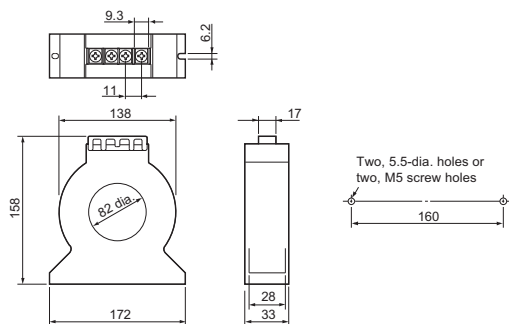
### Model OTG-L42



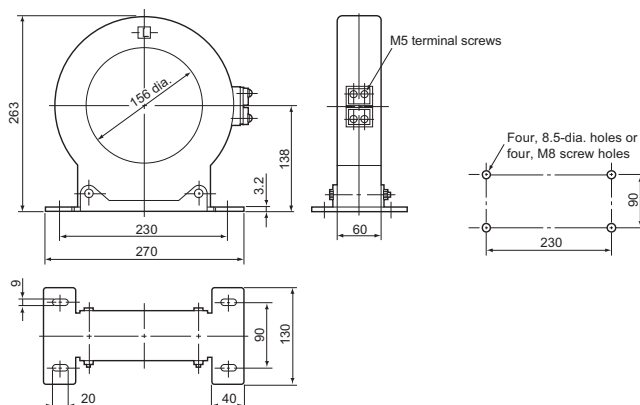
### Model OTG-L68



### Model OTG-L82

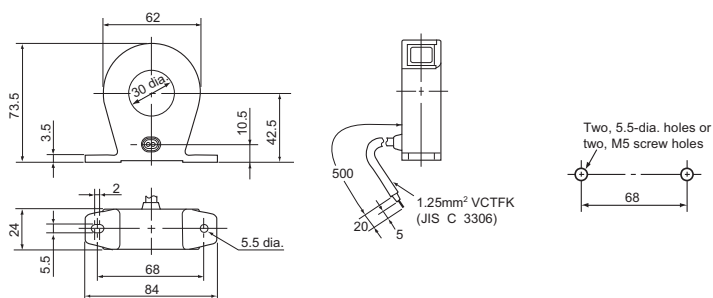


### Model OTG-L156



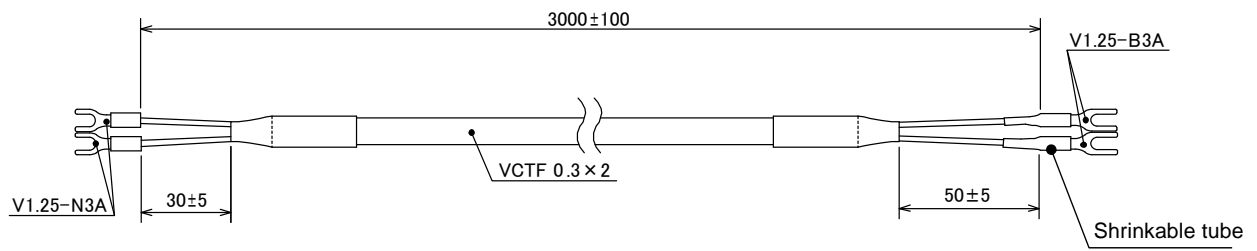
## ● 【ZCT】 Outdoor through type

### Model KM20-CTF-LA30W



## ● Outdoor slit core type

Model KM20-CTF-CB3 (Cable for dedicated CT)



- \* When installing the cable in dedicated CT, install the shrinkable tube side to the dedicated CT.
- \* This cable can be used for the dedicated ZCT.

# List of parameters

Setting item	Initial value	Setting range	PGR1C (Electric power/ leakage)	PVS1C (Electric power /voltage sag)	VSI1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Electrical system 1 applicable phase wire	2: 3-phase 3-wire	0: Single-phase 2-wire 1: Single-phase 3-wire 2: 3-phase 3-wire 3: 3-phase 4-wire	○	○	○	○	○	×
Synchronization selection for measuring block 1	0: Electrical system 1	0: Electrical system 1 1: Electrical system 2	×	×	×	×	○	×
Synchronization selection for measuring block 2			×	×	×	×	○	×
Dedicated CT type for measuring block 1	2: 100 A	0: 5 A 1: 50 A 2: 100 A 3: 200 A 4: 400 A 5: 600 A	○	○	×	○	○	×
Dedicated CT type for measuring block 2			×	×	×	×	○	×
Electrical system 1 VT ratio	1.00	0.01 to 99.99	○	○	○	○	○	×
Measuring block 1 CT ratio	1	1 to 1000	○	○	×	○	○	×
Measuring block 2 CT ratio			×	×	×	×	○	×
Low-cut current for measuring block 1	0.6%	0.1 to 19.9%	○	○	×	○	○	×
Low-cut current for measuring block 2			×	×	×	×	○	×
Low-cut current for leakage	1.0 mA	0.1 to 30mA	○	×	×	×	×	○
Average count	0: OFF	0: OFF 1: 2 times 2: 4 times 3: 8 times 4: 16 times 5: 32 times 6: 64 times 7: 128 times 8: 256 times 9: 512 times A: 1024 times	○	○	○	○	○	○
Pulse output unit	2: 100 Wh	0: 1 Wh 1: 10 Wh 2: 100 Wh 3: 1 kWh 4: 2 kWh 5: 5 kWh 6: 10 kWh 7: 20 kWh 8: 50 kWh 9: 100 kWh	○	○	×	×	×	×
Pulse output circuit	0: Circuit 1	0: Circuit 1 1: Circuit 2 2: Circuit 3 3: Circuit 4	○	○	×	×	×	×
Total power coefficient 1	1.000	0.000 to 9999.999	○	○	×	×	○	×
Phase loss detect function	0: OFF	0: OFF 1: ON	○	○	○	○	×	×
Phase sequence detect function	0: OFF	0: OFF 1: ON	○	○	○	○	×	×
Voltage sag backup	0: OFF	0: OFF 1: ON	×	○	○	×	×	×
Voltage sag detect function 1	0: OFF	0: OFF 1: Vrs, Vrn 2: Vst, Vsn 3: Vtr, Vtn	×	○	○	×	×	×
Voltage sag detect function 2			×	○	○	×	×	×
Voltage sag detect function 3			×	○	○	×	×	×
Voltage sag detect function 4			×	○	○	×	×	×
Voltage sag detect level 1	80.0 V	0.0 to 480.0 V	×	○	○	×	×	×
Voltage sag detect level 2			×	○	○	×	×	×
Voltage sag detect level 3			×	○	○	×	×	×
Voltage sag detect level 4			×	○	○	×	×	×
Voltage sag duration time 1	0.02 s	0.02 to 1.00 s	×	○	○	×	×	×
Voltage sag duration time 2			×	○	○	×	×	×
Voltage sag duration time 3			×	○	○	×	×	×
Voltage sag duration time 4			×	○	○	×	×	×

○: With function  
×: Without function

Setting item	Initial value	Setting range	PGR1C (Electric power/ leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Leakage current 1	30 mA	30 to 1000 mA	○	×	×	×	×	○
Leakage current 2			×	×	×	×	×	○
Leakage current 3			×	×	×	×	×	○
Leakage current 4			×	×	×	×	×	○
Leakage current 5			×	×	×	×	×	○
Leakage current 6			×	×	×	×	×	○
Leakage current 7			×	×	×	×	×	○
Leakage current 8			×	×	×	×	×	○
Leakage detection time 1	0.5 s	0.1 to 20.0 s	○	×	×	×	×	○
Leakage detection time 2			×	×	×	×	×	○
Leakage detection time 3			×	×	×	×	×	○
Leakage detection time 4			×	×	×	×	×	○
Leakage detection time 5			×	×	×	×	×	○
Leakage detection time 6			×	×	×	×	×	○
Leakage detection time 7			×	×	×	×	×	○
Leakage detection time 8			×	×	×	×	×	○
Output terminal 1 function setting	0: OFF	0: OFF 1: Measuring block 1 alarm 2: Measuring block 2 alarm 3: Earth leakage 4: Temperature 5: Phase-loss 6: Reverse phase 7: Pulse output 8: Measuring block 1 3-STATE HIGH 9: Measuring block 1 3-STATE MIDDLE A: Measuring block 1 3-STATE LOW B: Measuring block 2 3-STATE HIGH C: Measuring block 2 3-STATE MIDDLE D: Measuring block 2 3-STATE LOW	○	×	○	○	○	○
Output terminal 2 function setting	0: OFF		○	○	×	○	×	×
Output terminal 1 condition	0:N-O	0: N-O (Normally open)	○	×	○	○	○	○
Output terminal 2 condition		1:N-C (Normally closed)	○	○	×	○	×	×
Alarm parameter setting for measuring block 1	H'00000000	0bit: Over voltage alarm 1bit: Under voltage alarm 2bit: Over current alarm 3bit: Under current alarm 4bit: Active power upper limit alarm 5bit: Active power lower limit alarm 6bit: Reactive power upper limit alarm 7bit: Reactive power lower limit alarm 8bit: Power factor alarm 9bit to 31bit: Idle	○	○	○	○	○	×
Alarm parameter setting for measuring block 2			×	×	×	×	○	×
Alarm output setting for measuring block 1	H'00000000	0bit: Over voltage alarm 1bit: Under voltage alarm 2bit: Over current alarm 3bit: Under current alarm 4bit: Active power upper limit alarm 5bit: Active power lower limit alarm 6bit: Reactive power upper limit alarm 7bit: Reactive power lower limit alarm 8bit: Power factor alarm 9bit to 31bit: Idle	○	○	○	○	○	×
Alarm output setting for measuring block 2			×	×	×	×	○	×

○: With function  
×: Without function

Setting item	Initial value	Setting range	PGR1C (Electric power/ leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Active power upper limit alarm threshold for measuring block 1	1000 W	-120000000~120000000 W	○	○	×	×	○	×
Active power upper limit alarm hysteresis for measuring block 1	100 W	0~24000000 W	○	○	×	×	○	×
Active power upper limit alarm on-delay for measuring block 1	0.5 s	0.5~10.0 s	○	○	×	×	○	×
Active power lower limit alarm threshold for measuring block 1	300 W	-120000000~120000000 W	○	○	×	×	○	×
Active power lower limit alarm hysteresis for measuring block 1	100 W	0~24000000 W	○	○	×	×	○	×
Active power lower limit alarm on-delay for measuring block 1	0.5 s	0.5~10.0 s	○	○	×	×	○	×
Active power upper limit alarm threshold for measuring block 2	1000 W	-120000000~120000000 W	×	×	×	×	○	×
Active power upper limit alarm hysteresis for measuring block 2	100 W	0~24000000 W	×	×	×	×	○	×
Active power upper limit alarm on-delay for measuring block 2	0.5 s	0.5~10.0 s	×	×	×	×	○	×
Active power lower limit alarm threshold for measuring block 2	300 W	-120000000~120000000 W	×	×	×	×	○	×
Active power lower limit alarm hysteresis for measuring block 2	100 W	0~24000000 W	×	×	×	×	○	×
Active power lower limit alarm on-delay for measuring block 2	0.5 s	0.5~10.0 s	×	×	×	×	○	×
Over current alarm threshold for measuring block 1	100.0 A	0.0~6000.0 A	○	○	×	○	○	×
Over current alarm hysteresis for measuring block 1	5.0 A	0.0~1000.0 A	○	○	×	○	○	×
Over current alarm on-delay for measuring block 1	0.1 s	0.1~10.0 s	○	○	×	○	○	×
Under current alarm threshold for measuring block 1	10.0 A	0.0~6000.0 A	○	○	×	○	○	×
Under current alarm hysteresis for measuring block 1	5.0 A	0.0~1000.0 A	○	○	×	○	○	×
Under current alarm on-delay for measuring block 1	0.1 s	0.1~10.0 s	○	○	×	○	○	×
Over current alarm threshold for measuring block 2	100.0	0.0~6000.0 A	×	×	×	×	○	×
Over current alarm hysteresis for measuring block 2	5.0 A	0.0~1000.0 A	×	×	×	×	○	×
Over current alarm on-delay for measuring block 2	0.1 s	0.1~10.0 s	×	×	×	×	○	×
Under current alarm threshold for measuring block 2	10.0 A	0.0~6000.0 A	×	×	×	×	○	×
Under current alarm hysteresis for measuring block 2	5.0 A	0.0~1000.0 A	×	×	×	×	○	×
Under current alarm on-delay for measuring block 2	0.1 s	0.1~10.0 s	×	×	×	×	○	×
Over voltage alarm threshold for measuring block 1	528.0 V	0.0~12100.0 V	○	○	○	○	×	×
Over voltage alarm hysteresis for measuring block 1	24.0 V	0~2200.0 V	○	○	○	○	×	×
Over voltage alarm on-delay for measuring block 1	0.1 s	0.1~10.0 s	○	○	○	○	×	×
Under voltage alarm threshold for measuring block 1	85.0 V	0.0~12100.0 V	○	○	○	○	×	×
Under voltage alarm hysteresis for measuring block 1	24.0 V	0.0~2200.0 V	○	○	○	○	×	×
Under voltage alarm on-delay for measuring block 1	0.1 s	0.1~10.0 s	○	○	○	○	×	×

○: With function  
×: Without function

Setting item	Initial value	Setting range	PGR1C (Electric power/ leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Power factor alarm threshold for measuring block 1	0.00	-1.00~1.00	○	○	×	×	○	×
Power factor alarm hysteresis for measuring block 1	0.05	0.00~1.00	○	○	×	×	○	×
Power factor alarm on-delay for measuring block 1	0.5 s	0.5~10.0 s	○	○	×	×	○	×
Power factor alarm threshold for measuring block 2	0.00	-1.00~1.00	×	×	×	×	○	×
Power factor alarm hysteresis for measuring block 2	0.05	0.00~1.00	×	×	×	×	○	×
Power factor alarm on-delay for measuring block 2	0.5 s	0.5~10.0 s	×	×	×	×	○	×
Reactive power upper limit alarm threshold for measuring block 1	1000 var	-120000000~120000000 var	○	○	×	×	○	×
Reactive power upper limit alarm hysteresis for measuring block 1	100 var	0.0~240000000 var	○	○	×	×	○	×
Reactive power upper limit alarm on-delay for measuring block 1	0.5 s	0.5~10.0 s	○	○	×	×	○	×
Reactive power lower limit alarm threshold for measuring block 1	300 var	-120000000~200000000 var	○	○	×	×	○	×
Reactive power lower limit alarm hysteresis for measuring block 1	100 var	0.0~240000000 var	○	○	×	×	○	×
Reactive power lower limit alarm on-delay for measuring block 1	0.5 s	0.5~10.0 s	○	○	×	×	○	×
Reactive power upper limit alarm threshold for measuring block 2	1000 var	-120000000~120000000 var	×	×	×	×	○	×
Reactive power upper limit alarm hysteresis for measuring block 2	100 var	0~240000000 var	×	×	×	×	○	×
Reactive power upper limit alarm on-delay for measuring block 2	0.5 s	0.5~10.0 s	×	×	×	×	○	×
Reactive power lower limit alarm threshold for measuring block 2	300 var	-120000000~120000000 var	×	×	×	×	○	×
Reactive power lower limit alarm hysteresis for measuring block 2	100 var	0~240000000 var	×	×	×	×	○	×
Reactive power lower limit alarm on-delay for measuring block 2	0.5 s	0.5~10.0 s	×	×	×	×	○	×
Active input setting	H'000000FF	0bit: Input 1 1bit: Input 2 2bit: Input 3 3bit: Input 4 4bit: Input 5 5bit: Input 6 6bit: Input 7 7bit: Input 8	○	○	○	○	○	○
Unit no.	01	0~99	○	○	○	○	○	○
Communication speed	0: 9.6 kbps	0: 9.6 kbps 1: 19.2 kbps 2: 38.4 kbps	○	○	○	○	×	×
Data bit length	0: 7 bits	0: 7 bits 1: 8 bits	○	○	○	○	×	×
Stop bit length	1: 2 bits	0: 1 bit 1: 2 bits	○	○	○	○	×	×
Vertical parity	1: Even	0: No 1: Even 2: Odd	○	○	○	○	×	×
Transmission wait time	20 ms	0 to 99 ms	○	○	○	○	×	×
Connection configuration	H'00000000 (Not connected)	0 bit: Slave ID 1 connected/not connected 1 bit: Slave ID 2 connected/not connected 2 bit: Slave ID 3 connected/not connected 3 bit: Slave ID 4 connected/not connected 4 bit: Slave ID 5 connected/not connected 5 bit: Slave ID 6 connected/not connected	○	○	×	×	×	×

○: With function  
×: Without function

Setting item	Initial value	Setting range	PGR1C (Electric power/ leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/current)	CTD8E (CT extension)	ZCT8E (ZCT extension)
Data logging 1 item	Voltage MAX 1	Refer to Page A-18	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 2 item	Voltage MAX 2		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 3 item	Voltage MAX 3		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 4 item	Voltage MIN1		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 5 item	Voltage MIN 2		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 6 item	Voltage MIN 3		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 1 cycle	0: 5min	0: 5 min 1: 10 min 2: 30 min 3: 1 h 4: 2 h 5: 6 h 6: 12 h 7: 24 h	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 2 cycle	0: 5min		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 3 cycle	0: 5min		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 4 cycle	0: 5min		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 5 cycle	0: 5min		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Data logging 6 cycle	0: 5min		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Main unit attribute reading 1	Differs depending on the model.	Refer to Model KM1/KE1 Communication Manual (SGTE-719).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Main unit attribute reading 2			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Main unit attribute reading 3			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Main unit attribute reading 4			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Time information (month/day)	-	H'00YYMMDD YY: 2-digit year H'00 to H'63 (00 to 99) MM: 2-digit month H'00 to H'0C (01 to 12) YY: Date H'00 to H'1F (01 to 31)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×
Time information (hour/minute/second)	-	H'0000HHMMSS HH: Hour H'00 to H'17 (00 to 23) MM: Minute H'00 to H'3B (00 to 59) SS: Second H'00 to H'3B (00 to 59)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	×	×

○: With function  
×: Without function

# List of data logging items

Setting value	Data logging item	Targeted unit			
		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/ electric power)
0	Integrated active power amount 1	○	○	×	×
1	Integrated active power amount 2	○	○	×	×
2	Integrated active power amount 3	○	○	×	×
8	Total regenerated power amount 1	○	○	×	×
9	Total regenerated power amount 2	○	○	×	×
A	Total regenerated power amount 3	○	○	×	×
10	Integration progression reactive power amount 1	○	○	×	×
11	Integration progression reactive power amount 2	○	○	×	×
12	Integration progression reactive power amount 3	○	○	×	×
18	Integrated delayed reactive power amount 1	○	○	×	×
19	Integrated delayed reactive power amount 2	○	○	×	×
1A	Integrated delayed reactive power amount 3	○	○	×	×
20	Integrated total reactive power amount 1	○	○	×	×
21	Integrated total reactive power amount 2	○	○	×	×
22	Integrated total reactive power amount 3	○	○	×	×
28	Voltage MAX 1	○	○	○	○
29	Voltage MAX 2	○	○	○	○
2A	Voltage MAX 3	○	○	○	○
2E	Voltage MIN 1	○	○	○	○
2F	Voltage MIN 2	○	○	○	○
30	Voltage MIN 3	○	○	○	○
34	Current MAX 1	○	○	×	○
35	Current MAX 2	○	○	×	○

○ : With measuring function  
 × : Without measuring function



Setting value	Data logging item	Targeted unit			
		PGR1C (Electric power /leakage)	PVS1C (Electric power /voltage sag)	VSU1B (Voltage sag)	VAU1B (Voltage/ electric power)
40	Current MIN 1	○	○	×	○
41	Current MIN 2	○	○	×	○
42	Current MIN 3	○	○	×	○
4C	Active power MAX 1	○	○	×	×
4D	Active power MAX 2	○	○	×	×
4E	Active power MAX 3	○	○	×	×
54	Active power MIN 1	○	○	×	×
55	Active power MIN 2	○	○	×	×
56	Active power MIN 3	○	○	×	×
5C	Reactive power MAX 1	○	○	×	×
5D	Reactive power MAX 2	○	○	×	×
5E	Reactive power MAX 3	○	○	×	×
64	Reactive power NIN1	○	○	×	×
65	Reactive power NIN2	○	○	×	×
66	Reactive power NIN3	○	○	×	×
6C	Power factor MAX 1	○	○	×	×
6D	Power factor MAX 2	○	○	×	×
6E	Power factor MAX 3	○	○	×	×
74	Power factor MIN 1	○	○	×	×
75	Power factor MIN 2	○	○	×	×
76	Power factor MIN 3	○	○	×	×
A8	IoMAX1	○	×	×	×
B0	IoMIN1	○	×	×	×

○ : With measuring function  
 × : Without measuring function

# Model KM1/KE1 combination list

		Master			
		Model KM1-PMU1A-FLK (Electric power)	Model KM1-PMU2A-FLK (Power two-system)	Model KE1-PGR1C-FLK (Electric power/earth leakage)	Model KE1-PVS1C-FLK (Electric power/instantaneo us voltage drop)
Slave	Model KM1-EMU8A-FLK (Pulse/ temperature)	○	○	○	○
	Model KE1-VSU1B-FLK (Instantaneous voltage drop)	×	×	○	○
	Model KE1-VAU1B-FLK (Voltage/current)	×	×	○	○
	Model KE1-CTD8E (CT expansion)	×	×	○	○
	Model KE1-ZCT8E (ZCT expansion)	×	×	○	×
	Model KE1-DRT-FLK (DeviceNet communication)	○	○	○	○

O: Connection allowed  
X: Connection not allowed

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