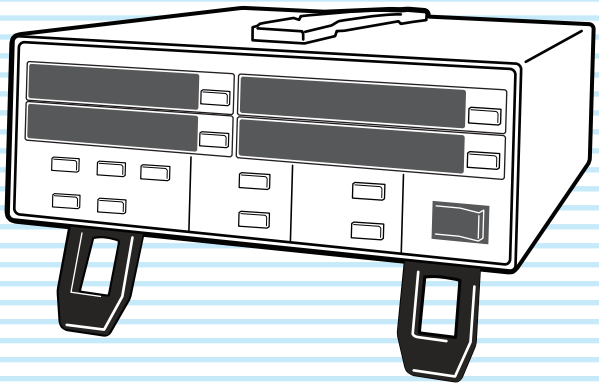
Part No. IB022853
Jul 2021

User's Manual

Digital Power Meter

KPM1000



Thank you for purchasing the KPM1000 Digital Power Meter.

Disposing of used Kikusui products in the EU

Under a law adopted by member nations of the European Union (EU), used electric and electronic products carrying the symbol below must be disposed of separately from general household waste.

This includes the power cords and other accessories bundled with the products. When disposing of a product subject to these regulations, please follow the guidance of your local authority, or inquire with your Kikusui distributor/agent where you purchased the product.

The symbol applies only to EU member nations.

Disposal outside the EU

When disposing of an electric or electronic product in a country that is not an EU member, please contact your local authority and ask for the correct method of disposal.

About the operation manuals

There are two operation manuals for the KPM1000: the User's Manual (this manual) and the Communication Interface Manual.

The manuals are intended for users of the KPM1000 and their instructors. Explanations are given under the presumption that the reader has knowledge of measuring instruments.

- User's manual (this manual)
  This manual is intended for first-time users of the KPM1000. It gives an overview of the KPM1000, connecting procedures, safety precautions, etc. Please read this manual before you operate the product.
- Communication interface manual
  This manual explains how to control the KPM1000 remotely using SCPI commands.
  The interface manual is written for readers with sufficient basic knowledge of how to control measuring instruments using a PC.
- Quick start
  The quick reference briefly explains the KPM1000 panel, a connection example, and the basic operation of the KPM1000.
- Safety information
  This gives general safety precautions. Keep them in mind and make sure to observe them.

Every effort has been made to ensure the accuracy of this manual. However, if you have any questions or find any errors or omissions, please contact your Kikusui agent or distributor.

If you find any misplaced or missing pages in this manual, it will be replaced. If the manual gets lost or soiled, a new copy can be provided for a fee. In either case, please contact your Kikusui agent or distributor, and provide the "Kikusui Part No." given on the cover.

After you have finished reading this manual, store it so that you can use it for reference at any time.

You can download the most recent version of these manuals from the Kikusui Electronics Corporation website (www.kikusui.co.jp/en/download/).

Product firmware versions that this manual covers

This manual applies to products with firmware versions 1.0x.

When contacting your Kikusui agent or distributor about the product, please provide them with:

The model (marked on the front panel).
The firmware version (see p.17).
The serial number (displayed on the rear panel).

How to read this manual

This manual is designed to be read from beginning to end. We recommend that you read it thoroughly before using this product for the first time.

Copyrights

Notations Used in This Manual

- In this manual, the KPM1000 Digital Power Meter is also referred to as the KPM1000.
- The term "PC" is used to refer generally to both personal computers and workstations.
- The operation of holding down the SHIFT key and pressing a key that has blue characters is written as (SHIFT+key name).
- The following markings are used in the explanations in the text.

⚠WARNING

Indicates a potentially hazardous situation which, if ignored, could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which, if ignored, may result in damage to the product or other property.

NOTE

Indicates information that you should know.

DESCRIPTION

Explanation of terminology or operation principle.

See

Indicates a reference to detailed information.

Product Overview

- Designed for use with single-phase systems
- Highly accurate measurements
  The voltage, current, and power measurements have an accuracy of ±(0.1 % of reading + 0.1 % of range). Because the KPM1000 has crest factor 6, waveforms that have a small RMS value but a large peak value can be measured with high accuracy.
- The KPM1000 can perform standby power measurements in compliance with the IEC62301 Ed. 1.0 standard.
  The power accuracy specifications comply with IEC62301 (Household electrical appliances—Measurement of standby power). The KPM1000 can perform standby power consumption measurements as defined in ErP directive Lot6. The minimum power range is 0.75 W, which enables you to perform measurements with a resolution of 10 mW or greater as required by the standard.
- Display of four items
  You can display four measurement items simultaneously. This reduces the amount of time you spend switching between measurement items. The 7-segment display is easy to see even from far away.
- Safety plugs
  Safety plugs are used to connect wires to the voltage input terminal. The terminal has been designed to ensure safety when it is being wired. It is a different shape from the current input terminal.
- Remote interface
  The RS232C interface is installed as standard. The GPIB and USB (TMC) interfaces are available as factory options.

Checking the Package Contents

When you receive the product, check that all accessories are included and that the accessories have not been damaged during transportation. If any of the accessories are damaged or missing, contact your Kikusui agent or distributor.

We recommend that you save all packing materials, in case the product needs to be transported at a later date.

Accessories


or

or


Rated voltage:
125 Vac
PLUG: NEMA5-15
Length :
approx. 2.5 m
[85-AA-0004]

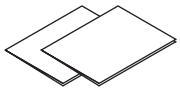
Rated voltage:
250 Vac
PLUG: CEE7/7
Length :
approx. 2.5 m
[85-10-1070]

Rated voltage:
250 Vac
PLUG: GB1002
Length :
approx. 2.5 m
[85-10-0791]

☐ Power cord (1)

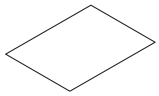
Red: [99-05-0050]
black: [89-05-0060]

☐ Safety plug (1 each)

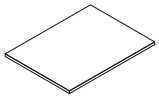


English (1)
Japanese(1)

☐ Quick start



☐ Packing list (1)



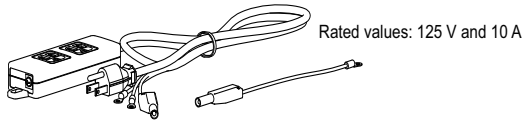
☐ Safety information (1)

☐ CD-ROM (1)

Options

The KPM1000 has the following options. For information, contact your Kikusui agent or distributor. The GPIB and USB interfaces are available as factory options.

- AC outlet cable (OT01-KPM)



The AC outlet cable enables you to measure the EUT just by connecting it to the outlet. This makes it easy to wire the measurement circuit.

- Test leads 100CM (TL40)

Red and black, one each (length: 1 m)
600 V CATIII to 1000 V CATII, 32 A, 2.5 mm^2

- Safety plugs (screw connection type; TL41)

Red and black, one each
1000 V CATII, max. 32 A

- Safety plugs (solder connection type; TL42)

Red and black, one each
1000 V CATII, max. 32 A

- Safety plugs (clamp connection type; TL43)

Red and black, one each
600 V CATII, max. 10 A

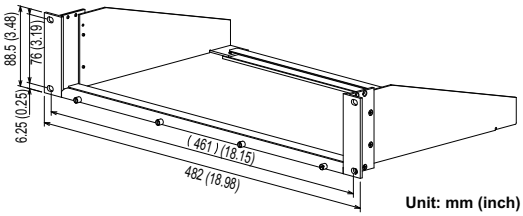
- Alligator clips (TL44)

Red and black, one each
1000 V CATII, max. 32 A

- Fork terminal adapters (TL45)

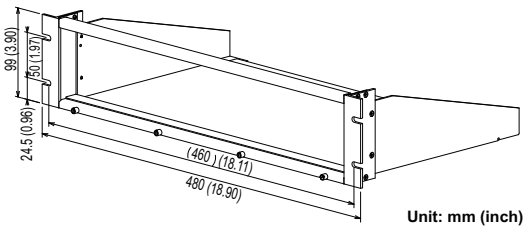
Red and black, one each
1000 V CATII, 20 A

- EIA rack mount adapter (KRA2)
  2U inch rack



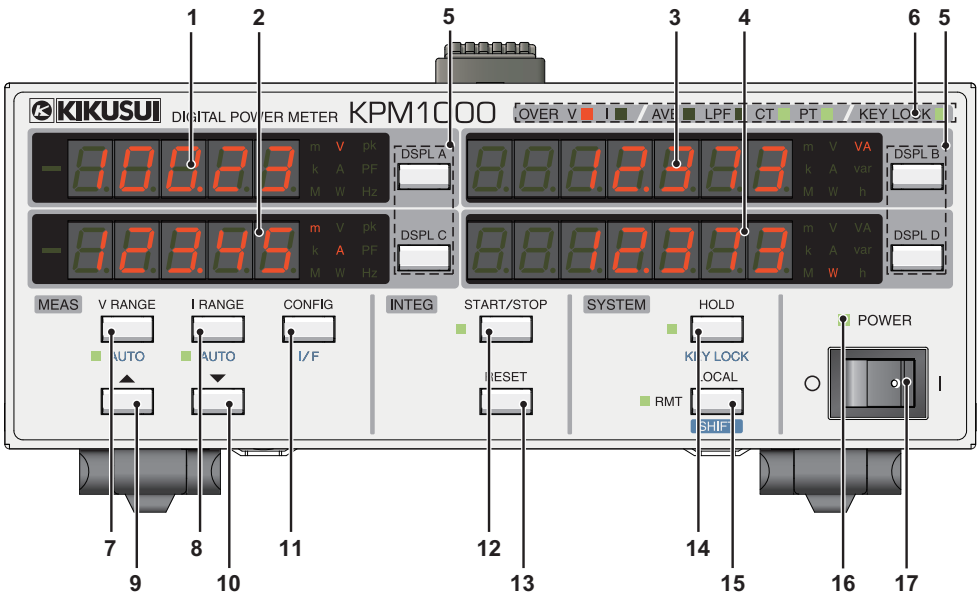
Unit: mm (inch)

- JIS rack mount adapter (KRA100)
  2U milli rack



Unit: mm (inch)

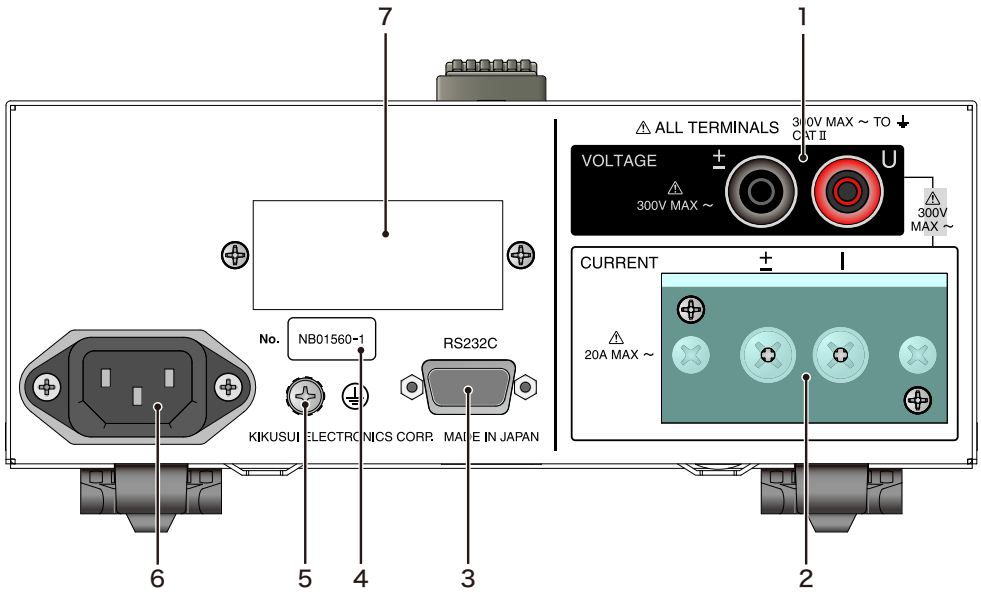
Front panel



No.	Name		Function	See
1	Displays	A	This displays the measured values. V, A, W, pk, PF, or Hz can be displayed as the unit.	p.19
2		C		
3		B	This displays the measured values. V, A, W, VA, var, or h can be displayed as the unit.	
4		D	Depending on the display item, a symbol may be shown on the left side of the display.	
5	Display switches	DSPL A key	This is used to switch the item that is shown on display A.	p.22
		DSPL B key	This is used to switch the item that is shown on display B, select the voltage or current range, and select the item on the configuration menu.	p.22 p.25 p.28
		DSPL C key	This is used to switch the item that is shown on display C and select the item on the configuration menu.	p.22 p.28
		DSPL D key	This is used to switch the item that is shown on display D, select the range, and select the item on the configuration menu.	p.22 p.25 p.28
6	Status indicators	OVER V	A voltage peak over-range has occurred.	p.24
		OVER I	A current peak over-range has occurred.	
		AVE	Averaging is on.	
		LPF	The low pass filter is in use.	
		CT	The CT ratio scaling is enabled.	
		PT	The PT ratio scaling is enabled.	
		KEY LOCK	The keys are locked.	
7	Voltage range	V RANGE key	This is used to set the voltage range.	p.25
	SHIFT+	AUTO key	This is used to select the auto voltage range. When the auto range feature is enabled, the AUTO LED lights.	
8	Current range	I RANGE key	This is used to set the current range.	
	SHIFT+	AUTO key	This is used to select the auto current range. When the auto range feature is enabled, the AUTO LED lights.	
9	Up key	▲ key	This is used to set the ranges and parameters. Pressing this key increases the value.	
10	Down key	▼ key	This is used to set the ranges and parameters. Pressing this key decreases the value.	

No.	Name		Function	See
11	Configuration	CONFIG key	This is used to set the configuration settings on the configuration menu.	p.29
	SHIFT+	I/F key	This is used to set the configuration settings on the remote interface menu.	p.30
12	Integration	START/STOP key	This is used to start and stop integration. During integration, the LED is lit. When integration is paused, the LED blinks.	p.33
13	Reset	RESET key	This is used to clear integration.	
14	Display hold	HOLD key	This is used to hold (stop the updating of) the displayed measured values. When values are held, the LED lights.	p.26
	SHIFT+	KEY LOCK key	This is used to lock the keys. When keys are locked, the LED lights.	p.27
15	Local	LOCAL key	If you press this key when the KPM1000 is in remote mode, the RMT LED turns off, and the KPM1000 switches to local mode.	p.27
	SHIFT	SHIFT key	This is used to perform the secondary key functions that are written in blue characters. In local mode, hold down SHIFT, and then press a key that has blue characters.	-
16	Power indicator		When the POWER switch is on, this lights.	-
17	POWER switch		Flip the switch to the (I) side to turn the power on. Flip it to the (O) side to turn the power off.	p.17

Rear panel



No.	Name		Function	See
1	VOLTAGE	U, ±	Voltage input terminals	p.12
2	CURRENT	I, ±	Current input terminals	p.11
3	RS232C		RS232C port for controlling the KPM1000 remotely	Below
4	Serial number	No.	Product serial number	-
5	⏚		Protective conductor terminal	p.8
6	AC inlet	AC INPUT	Power inlet	p.8
7	Factory option remote interface	USB	USB port for controlling the KPM1000 remotely	Below
		GPIB	GPIB connector for controlling the KPM1000 remotely	Below

For details on remote control, see the Communication Interface Manual.

1 Installation and Preparation

This chapter describes how to unpack and prepare this product before you use it.

Connecting the power cord

Check whether the AC power line is compatible with the input rating of the product. The product can receive a nominal line voltage in the range of 100 VAC to 240 VAC at 50 Hz or 60 Hz.

⚠WARNING **Possible electric shock.**

This product is a piece of equipment that conforms to IEC Safety Class I (equipment that has a protective conductor terminal). Be sure to earth ground the product to prevent electric shock. Connect the ground terminal to earth ground.

NOTE

- Use the supplied power cord to connect to the AC line.
  If the supplied power cord cannot be used because the rated voltage or the plug shape is incompatible, have a qualified engineer replace the power cord with an appropriate power cord that is 3 m or less in length. If obtaining a power cord is difficult, contact your Kikusui agent or distributor.
- The power cord with a plug can be used to disconnect the product from the AC line in an emergency. Connect the plug to an easily accessible power outlet so that the plug can be removed from the outlet at any time. Be sure to provide adequate clearance around the power outlet.
- Do not use the supplied power cord as the power cord for other devices.

1. **Check that the POWER switch is turned off (◯).**
2. **Connect the power cord to the AC INPUT inlet on the rear panel.**
3. **Connect the power cord plug to a properly grounded outlet.**
4. **In case that the measurement exceeds 7 A (rms), securely connect a cable to the ⏚ (protective conductor terminal) for earth ground on the rear panel. Use a cable which maximum current rating is above the current to measure.**

Wiring the measurement circuit

This section will explain how to wire the KPM1000, AC power supply, and load.
This product is designed for use with alternating current. It cannot measure current that has a DC component. If you try to measure an object that produces asymmetrical current waveforms (half-wave rectified or full-wave rectified waveforms)—for example, a hair dryer—errors will occur.

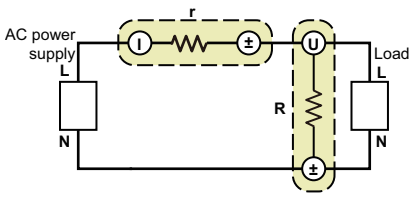
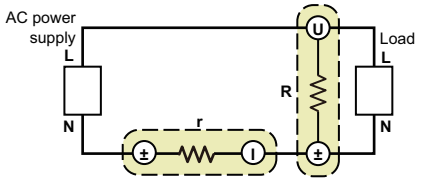
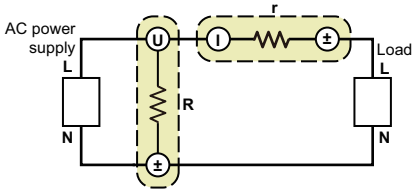
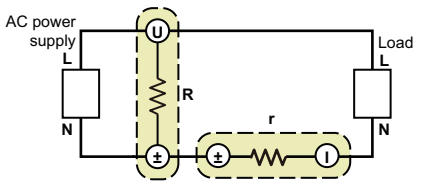
⚠WARNING **Possible electric shock. Before you connect the KPM1000 to an AC power supply, (1) turn the KPM1000 off, and remove the power cord from the outlet, or (2) turn off the distribution switch that is connected to the power cord.**

NOTE

IEC standard measurement category CAT II

- Applies to measurements on circuits directly connected to a low-voltage installation. This category applies to measurements on circuits of equipment on the primary side of a transformer. Such pieces of equipment have a power cord connected to a power outlet. Examples are household appliances and portable tools.
- This product cannot be used to perform measurements in building installations. For example, this category applies to distribution boards, circuit breakers, and wiring systems in a fixed installation, and to stationary motors with a permanent connection to a fixed installation. This product cannot be used to perform measurements on these objects.

To construct the measurement circuit, you can connect the voltage input terminal to the load or connect the current input terminal to the load. The effect of input impedance may become large depending on the measured voltage or measured current. Select a measurement circuit that will minimize the input impedance.
You can connect the current input terminal to the L side or the N side. Normally connect the current input terminal to the L side, but by connecting the terminal to the N side, you can reduce the amount of error caused by the influence of common-mode voltage.
In the following table, “r” is the KPM1000’s current input terminal (input resistance: 2 mΩ). “R” is the KPM1000’s voltage input terminal (input resistance: 6 MΩ).

	Connecting the current input terminal to the L side	Connecting the current input terminal to the N side
Connecting the voltage input terminal to the load		
Connecting the current input terminal to the load		

We will explain the power loss that occurs during power measurements through two examples: (1) a measurement of 100 V and 50 mA and (2) a measurement of 100 V and 20 A.

Measurement circuit	Power loss that occurs during power measurement	
	Measurement of 100 V and 50 mA	Measurement of 100 V and 20 A
Connecting the voltage input terminal to the load	$(100\ V)^2 / 6\ M\Omega = 0.00167\ VA$	
Connecting the current input terminal to the load	$(50\ mA)^2 \times 2\ m\Omega = 0.005\ mVA$	$(20\ A)^2 \times 2\ m\Omega = 0.08\ VA$

From the above table, we can see that in the measurement of 100 V and 50 mA, connecting the current input terminal to the load results in smaller power loss, which provides the most accurate measurements. In the measurement of 100 V and 20 A, connecting the voltage input terminal to the load results in smaller power loss, which provides the most accurate measurements.

Connecting the current input terminal

■ Input terminal specifications

- The maximum allowable current is 24 Arms. You cannot use the input terminal for values that exceed the maximum value.
- The maximum isolation voltage is 300 V. You cannot use the input terminal for values that exceed the maximum value.
- The maximum voltage between the voltage input terminals is 300 V. You cannot use the input terminal for values that exceed the maximum value.
- The voltage input terminal input impedance is approximately 6 MΩ. The current input terminal input impedance is approximately 2 mΩ.

■ Wires to use

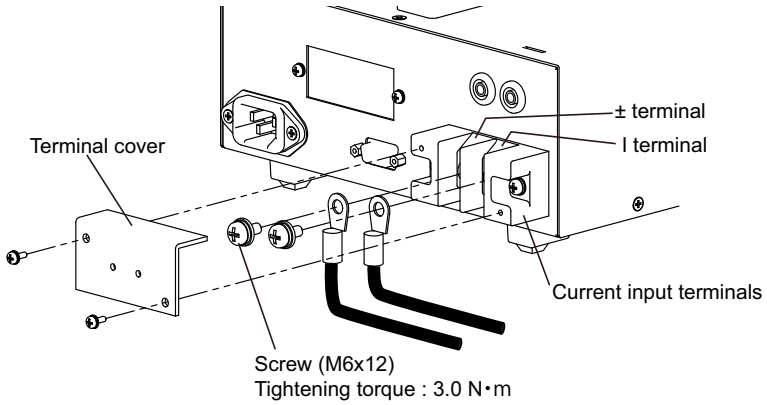
Select the wires to match the input current of the measured item (load). To provide some outlines for the wires that you can select from, the following chart presents the nominal cross-sectional area and allowable current of various wires. Use wires whose withstand voltage is more than sufficient for the maximum rated input voltage.

Nominal cross-sectional area (mm^2)	AWG	Reference cross-sectional area (mm^2)	Allowable current A (Ta = 30 °C)[1]
0.9	18	0.82	17
1.25	16	1.31	19
2	14	2.08	27
3.5	12	3.31	37
5.5	10	5.26	49

1 Excerpt from Japanese laws related to electrical equipment.

■ Connecting the wires

- The current input terminal has polarity (terminal I and ± terminal). Use these terminals as is necessary depending on the measurement circuit.
- Terminate the wires with crimping terminals.
- Use crimping terminals that have a 6 mm diameter screw mounting hole and are compatible with the wires.
- Connect the wires to the current input terminal.
- To prevent electric shock, be sure to attach the terminal cover.



Connecting the voltage input terminal

WARNING **Possible electric shock. The voltage input terminal is designed to be used with safety plugs. Do not use connectors that have bare conductive parts (such as banana plugs) to connect wires to the voltage input terminal.**

■ Input terminal specifications

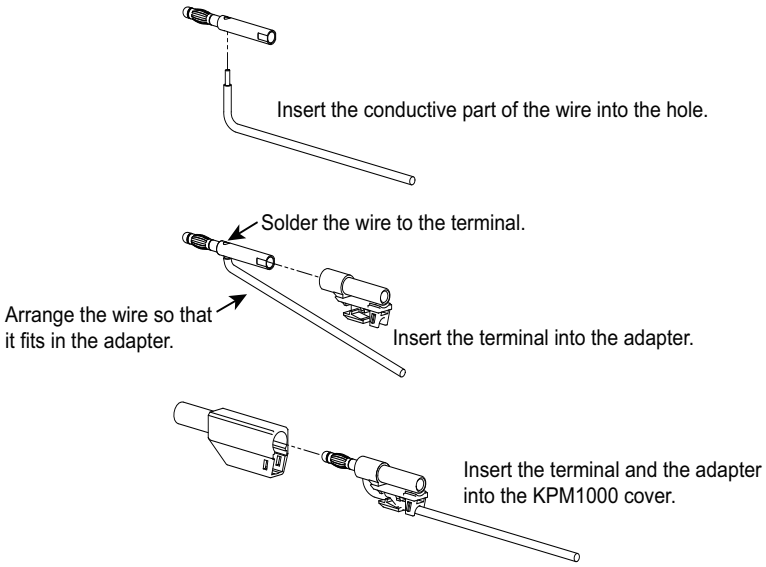
- The maximum allowable voltage is 360 Vrms. You cannot use the input terminal for values that exceed the maximum value.
- The maximum voltage between the current input terminals is 300 V. You cannot use the input terminal for values that exceed the maximum value.

■ Wires to use

Use wires whose nominal cross-sectional area is between 0.75 mm^2 and 2.5 mm^2 and whose external diameter is 3.9 mm or less. Use wires whose withstand voltage is more than sufficient for the maximum rated input voltage.

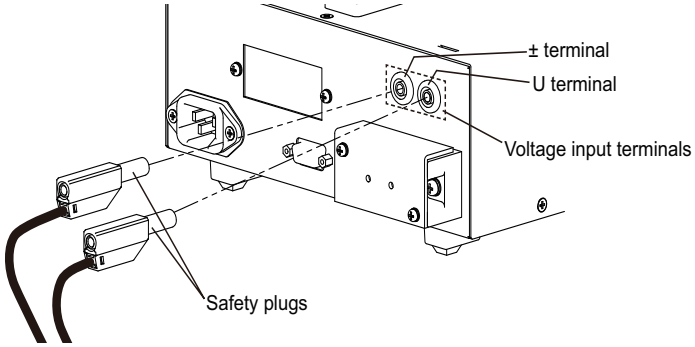
■ Connecting wires to the safety plugs

Use safety plugs to connect the wires to the voltage input terminal. To use the included safety plugs, first connect the wires to the safety plugs, and then connect the safety plugs to the KPM1000.



■ Connecting the wires

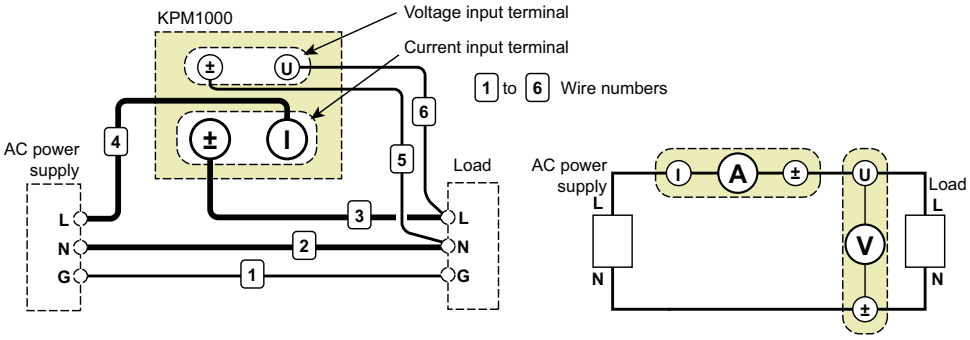
- The voltage input terminal has polarity (terminal U and ± terminal). Use these terminals as is necessary depending on the measurement circuit.
- Connect wires with safety plugs to the voltage input terminal.



Connecting the voltage input terminal to the load

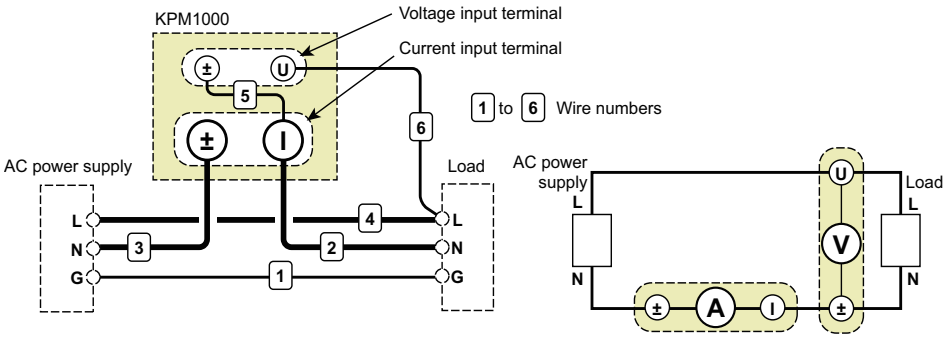
You can connect the current input terminal to the L side or the N side.

Connecting the current input terminal to the L side



Wire number	Start point	End point
1	Output terminal G of the AC power supply	Terminal G (ground) of the load
2	Output terminal N of the AC power supply	Terminal N of the load
3	± terminal of the KPM1000 current input	Terminal L of the load
4	Terminal I of the KPM1000 current input	Output terminal L of the AC power supply
5	± terminal of the KPM1000 voltage input	Terminal N of the load
6	Terminal U of the KPM1000 voltage input	Terminal L of the load

Connecting the current input terminal to the N side

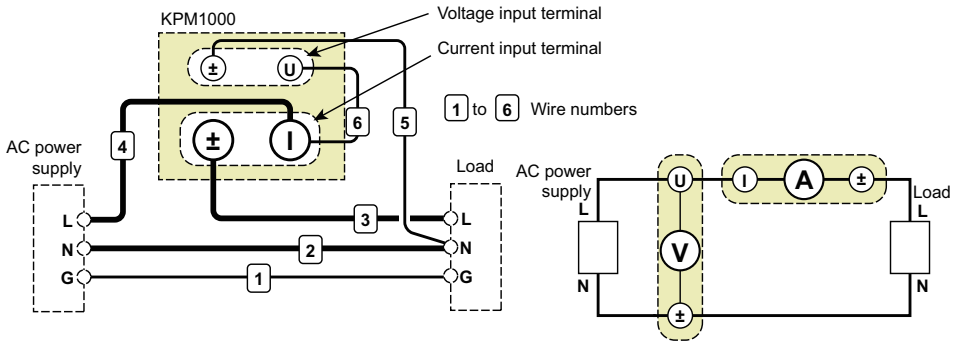


Wire number	Start point	End point
1	Output terminal G of the AC power supply	Terminal G (ground) of the load
2	Terminal I of the KPM1000 current input	Terminal N of the load
3	± terminal of the KPM1000 current input	Output terminal N of the AC power supply
4	Output terminal L of the AC power supply	Terminal L of the load
5	± terminal of the KPM1000 voltage input	Terminal I of the KPM1000 current input
6	Terminal U of the KPM1000 voltage input	Terminal L of the load

Connecting the current input terminal to the load

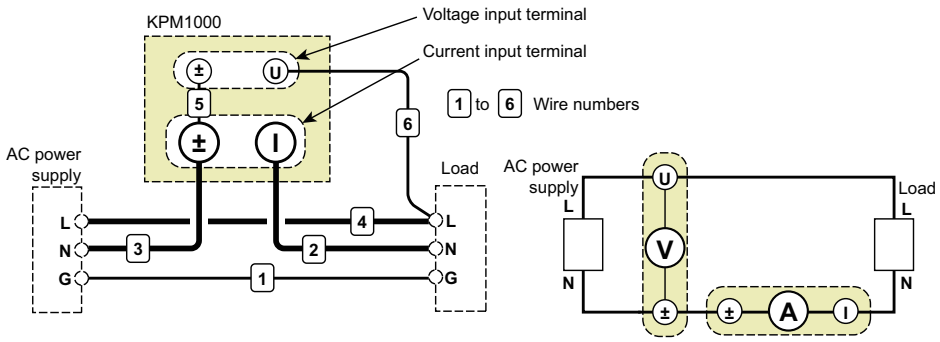
You can connect the current input terminal to the L side or the N side.
This section will present the wiring that is used to measure comparatively small currents, such as measuring the standby power of LCD TVs. This wiring method is designed to minimize the effect of the current flowing through the input resistance of the voltage input terminal.

Connecting the current input terminal to the L side



Wire number	Start point	End point
1	Output terminal G of the AC power supply	Terminal G (ground) of the load
2	Output terminal N of the AC power supply	Terminal N of the load
3	± terminal of the KPM1000 current input	Terminal L of the load
4	Terminal I of the KPM1000 current input	Output terminal L of the AC power supply
5	± terminal of the KPM1000 voltage input	Terminal N of the load
6	Terminal U of the KPM1000 voltage input	Terminal I of the KPM1000 current input

Connecting the current input terminal to the N side



Wire number	Start point	End point
1	Output terminal G of the AC power supply	Terminal G (ground) of the load
2	Terminal I of the KPM1000 current input	Terminal N of the load
3	± terminal of the KPM1000 current input	Output terminal N of the AC power supply
4	Output terminal L of the AC power supply	Terminal L of the load
5	± terminal of the KPM1000 voltage input	± terminal of the KPM1000 current input
6	Terminal U of the KPM1000 voltage input	Terminal L of the load

Using an external potential transformer (PT) and an external current transformer (CT)

When the maximum voltage and maximum current of the measured item exceed the maximum measurement ranges of the KPM1000, you can perform measurements by using an external potential transformer (PT) and an external current transformer (CT).

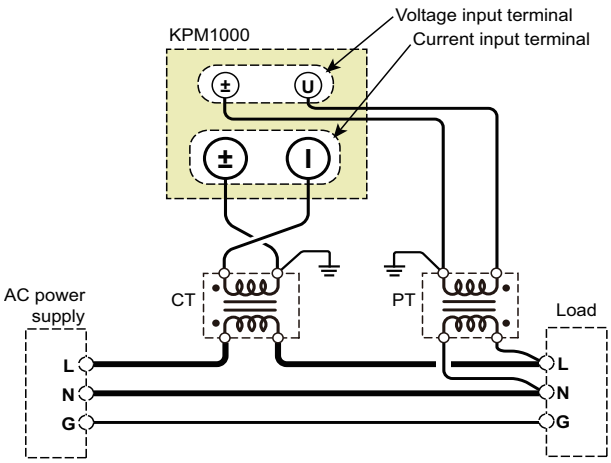
⚠WARNING

- **Possible electric shock. High voltages are generated from the secondary side of the current transformer (CT). When a current is flowing through the primary side of the CT, do not open the secondary side of the CT.**
- **Possibility of burns. An overcurrent flows in the secondary side of the potential transformer (PT). If a voltage is being applied to the primary side of the PT, do not short the secondary side of the PT.**
- **To ensure safe operation, ground the common terminal (the ± terminal) on the secondary side of the PT and CT.**

Connecting wires to the PT and CT

See the following figure for the PT and CT wiring methods. Connect the PT secondary side to the voltage input terminal and the CT secondary side to the current input terminal.

The frequency characteristics and phase characteristics of the PT and CT have an effect on the measured values. When you measure frequencies, use a PT and CT that have good frequency characteristics and phase characteristics.

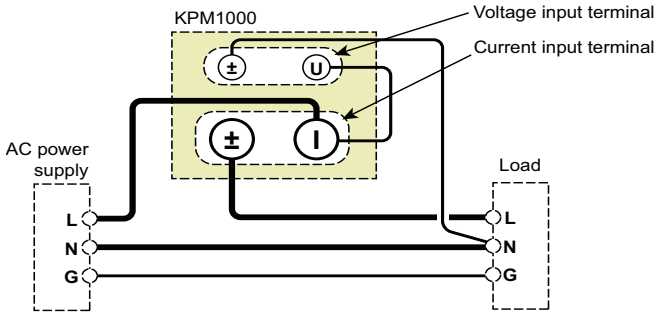


Double-checking the wiring

⚠CAUTION Overcurrents can damage the KPM1000. Do not apply the output voltage of an AC power supply to the KPM1000 current input terminal.

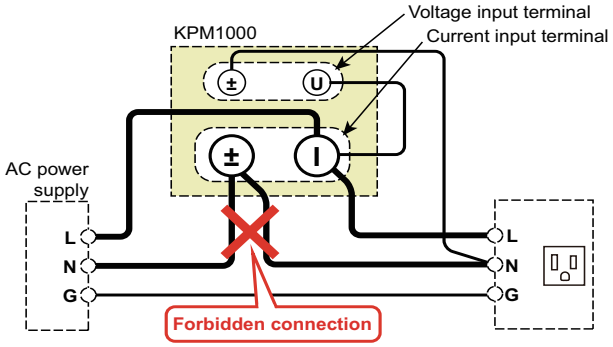
Below we will show the correct wiring and the incorrect wiring for the example of connecting the current input terminal to the L side.

- Correct wiring



- Incorrect wiring

  In the following figure, the KPM1000 current input terminal I is connected to load terminal L and AC power supply terminal L. The KPM1000 current input ± terminal is connected to load terminal N and AC power supply terminal N. The AC power supply's output voltage will be applied to the current input terminal, which will cause an overcurrent and may damage the KPM1000.



Turning the POWER switch on

Turning the POWER switch on

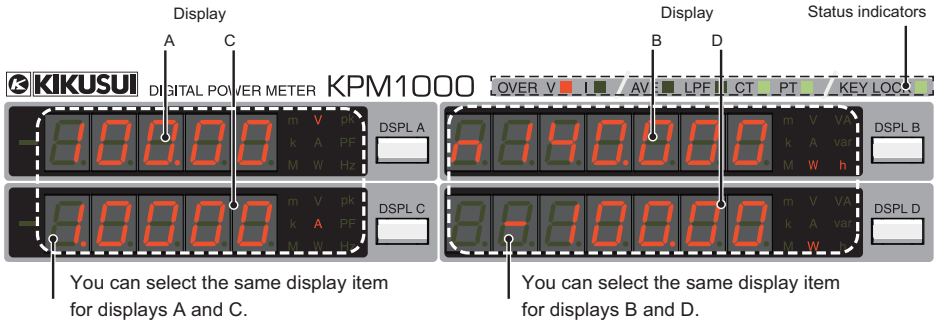
Flip the POWER switch to the (|) side to turn the KPM1000 on. The firmware version is displayed for approximately 1 second (display A shows “VEr” and display C shows the number), and then the KPM1000 starts in measurement mode. If you notice strange sounds, unusual odors, fire, or smoke around or from inside the KPM1000, turn the KPM1000 off.

See Factory default settingsp.50

The first time that you turn the KPM1000 on, it starts with the factory default settings. You can use these settings to start performing basic measurements. The following times that you turn the KPM1000 on, it will start with the settings that were in use immediately before it was last turned off.

See p.19

The KPM1000’s screen shows displays A, B, C, and D, and the status indicators. Displays A, B, C, and D show measured values. Use the DSPL keys to select the display items. The four displays are divided into two groups: (1) displays A and C and (2) displays B and D. The same types of display items are shown within each group. The status indicators show the operating status of the KPM1000.



Turning the POWER switch off

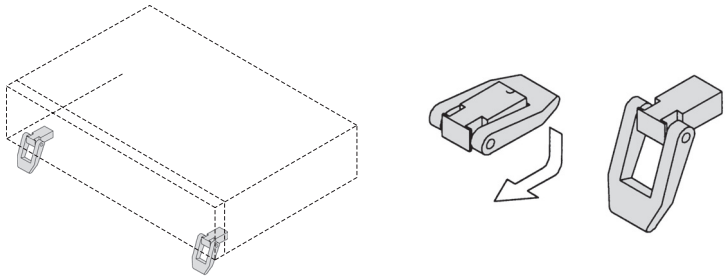
Flip the POWER switch to the (◯) side to turn the KPM1000 off.

2 Basic Operations

This chapter describes the basic operations of the KPM1000.

Using the stands

The stands are used to tilt the front panel, which makes the screen easier to see and makes the keys easier to operate. To use the stands, pull the two feet on the bottom-front of the KPM1000 out until they click into place.



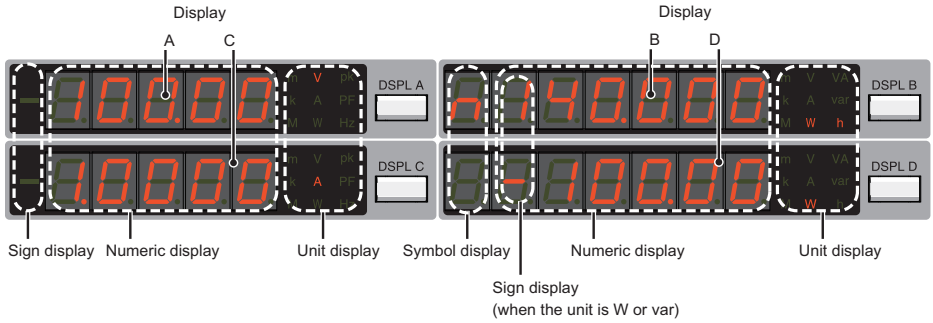
⚠CAUTION Possible damage to stands. When you are using the stands, do not place anything on top of the KPM1000, or press down on the top of the KPM1000.

Displayed contents

The KPM1000's screen shows displays A, B, C, and D, and the status indicators.

Displays A, B, C, and D

Displays A, B, C, and D show measured values. You can assign different display items to each display. The four displays are divided into two groups: (1) displays A and C and (2) displays B and D. The same types of display items are shown within each group.



See p.29

The factory default display update interval is 0.1 seconds. You can change the display update interval (ConF.8 rEF.rAtE) on the configuration menu.

Display configuration

- Sign display

  If there is no sign, the value is positive. If “-” is displayed, the value is negative.
- Symbol display

  If “P” is displayed, the value is the positive integrated power. If “n” is displayed, the value is the negative integrated power.
- Numeric display

  A 5- or 6-digit number and a decimal point are displayed. The number of displayed digits is determined by the display item.
- Unit display

  The unit—m (milli), k (kilo), or M (mega)—is selected automatically on the basis of the selected range. For Vpk, the V and pk indicators light independently. In this manner, the KPM1000 combines unit characters to display units according to the display item.

Display examples

8.00000 Wh integrated power (when the sum is negative)

8.00000 Wh integrated power (positive)

99 hour, 59 minute, 59 second integration time

8.00000 Wh integrated power (negative)

1.0000 voltage crest factor

-180.00 ° phase angle

Display item

The items that you can show on the displays are listed below.

■ Displays A and C

Display item	Unit display (center column)	Unit display (right column)	Description
Voltage	V	-	Values that are 0.5 % of the voltage range or less are displayed as 0.0000 (they are muted). This is the factory default setting for display A.
Current	A	-	Values that are 0.5 % of the current range or less are displayed as 0.0000 (they are muted). This is the factory default setting for display C.
Active power	W	-	-
Voltage peak	V	pk	The larger of the positive and negative peak values is displayed.
Current peak	A	pk	The larger of the positive and negative peak values is displayed.
Power factor	-	PF	If the voltage or current is muted, “-----” is displayed.
Frequency	-	Hz	Use the synchronization source setting (ConF.7 SynC) to select whether to display the voltage frequency or current frequency. If you set SynC to “oFF,” “-----” is displayed.

■ Displays B and D

Display item	Symbol display	Unit display (center column)	Unit display (right column)	Description
Voltage		V	-	Values that are 0.5 % of the voltage range or less are displayed as 0.0000 (they are muted).
Current		A	-	Values that are 0.5 % of the current range or less are displayed as 0.0000 (they are muted).
Active power		W	-	This is the factory default setting for display D.
Apparent power	-	-	VA	If both the voltage and current are muted, this displays 0.0000. This is the factory default setting for display B.
Reactive power	-	-	var	If both the measured voltage and measured current are muted, this displays 0.0000.
Integrated current (sum)	-	A	h	This displays the sum of the positive and negative integrated currents. If there is no integrated value, “-----” is displayed.
Integrated power (sum)	-	W	h	This displays the sum of the positive and negative integrated powers. If there is no integrated value, “-----” is displayed.
Integrated power (positive)	P	W	h	This displays the positive integrated power. If there is no integrated value, “-----” is displayed.
Integrated power (negative)	n	W	h	This displays the negative integrated power. If there is no integrated value, “-----” is displayed.
Integration time	-	-	h	Up to 99 hours, 59 minutes, and 59 seconds, this displays the hours, minutes, and seconds (in the following format: 99h59.99). From that point to 9999 hours and 59 minutes, this displays the hours and minutes (in the following format: 9999h59). When integration has been cleared, "-----" is displayed.
Voltage crest factor	C	V[1]	-	When the voltage is muted, “-----” is displayed.
Current crest factor	C	A[2]	-	When the current is muted, “-----” is displayed.
Phase angle	d	-	-	When the voltage is muted, "-----" is displayed.

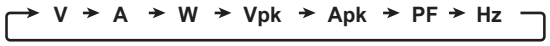
1 This displays the voltage.
2 This displays the current.

Selecting the display items for displays A, B, C, and D

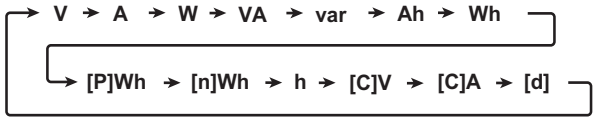
Each time that you press DSPL A, DSPL B, DSPL C, or DSPL D, the measurement unit changes to the next measurement unit in the following orders. Each time that you change the measurement unit, the measurement item changes as well.

The orders that the measurement units change in are shown below. The KPM1000 combines symbols and units to display units according to the display item.

DSPL A and DSPL C



DSPL B and DSPL D



Factory default settings
Display A: V
Display B: VA
Display C: A
Display D: W

[ ]: Symbol display

Over-range indicators

If the value exceeds the specified value, the item shown on display A, B, C, or D changes.

Display item; [symbol display]; (unit)	Over-range indicator
Voltage (V)	If only a peak over-range occurs: P.oVEr. If only an RMS over-range occurs: oVEr. If a peak and RMS over-range occur: oVEr.
Current (A)	If only a peak over-range occurs: P.oVEr. If only an RMS over-range occurs: oVEr. If a peak and RMS over-range occur: oVEr.
Active power (W)	If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i. If a voltage and current over-range occur: oVEr.
Voltage peak (Vpk)	If only a peak over-range occurs: P.oVEr. If only an RMS over-range occurs: Normal display. If a peak and RMS over-range occur: oVEr.
Current peak (Apk)	If only a peak over-range occurs: P.oVEr. If only an RMS over-range occurs: Normal display. If a peak and RMS over-range occur: oVEr.
Power factor (PF)	If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
Frequency (Hz)	If the frequency exceeds the upper measurement limit: oVEr. If the frequency falls below the lower measurement limit: undEr.
Apparent power (VA)	If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i. If a voltage and current over-range occur: oVEr.
Reactive power (var)	If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i. If a voltage and current over-range occur: oVEr.
Integrated current—sum—(Ah)	If the current display shows oVEr or P.oVEr during integration, “Ah” blinks. If the integrated value overflows: OVEr.F.
Integrated power—sum—(Wh)	If the voltage or current display shows oVEr or P.oVEr during integration, “Wh” blinks. If the integrated value overflows: OVEr.F.
Integrated power—positive—[P] (Wh)	If the voltage or current display shows oVEr or P.oVEr during integration, “Wh” blinks. If the integrated value overflows: OVEr.F.
Integrated power—negative—[n] (Wh)	If the voltage or current display shows oVEr or P.oVEr during integration, “Wh” blinks. If the integrated value overflows: OVEr.F.

Display item; [symbol display]; (unit)	Over-range indicator
Voltage crest factor [c] (V^1)	If oVEr or P.oVEr are displayed, this displays “oVEr.”
Current crest factor [c] (A^2)	If oVEr or P.oVEr are displayed, this displays “oVEr.”
Phase angle [d]	If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
Integration time (h)	If the time exceeds 9999 hours and 59 minutes (9999h59): oVEr.

1 This displays the voltage.
2 This displays the current.

Scaling feature

By using the scaling feature, you can display the measured values multiplied by a value that you have set in advance. This feature is useful when you are using an external potential transformer (PT) or an external current transformer (CT).

See p.29

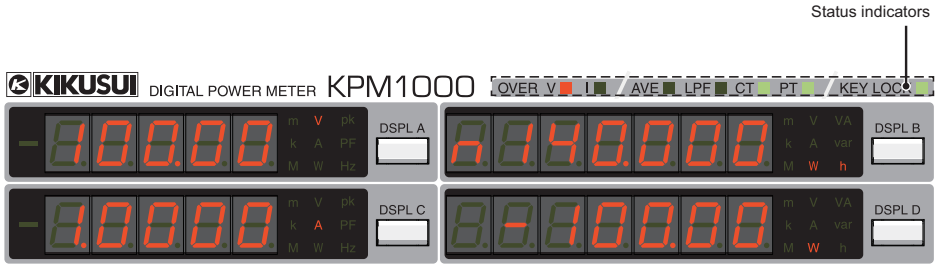
1 If you are using an external potential transformer, set the potential transformation ratio (ConF.6 Pt). If you are using an external current transformer, set the current transformation ratio (ConF.5 Ct).

2 Select whether you will use the scaling feature (ConF.4 SCALE).

If you have selected Ct, the CT LED lights. If you have selected Pt, the PT LED lights. If you have selected botH, both the CT and PT LEDs light. This indicates that the KPM1000 is using the scaling feature.

Status indicators

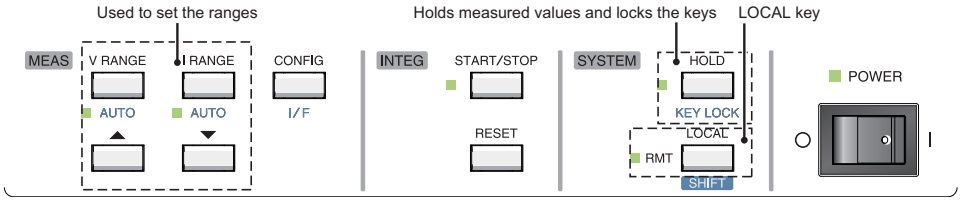
The LEDs light to indicate the status of the KPM1000. The different statuses are listed below. If the OVER V or OVER I LED lights, fix the corresponding range setting.



Type	Indicator	Status
OVER V	LED (red)	Lights when the peak value of the voltage input waveform exceeds 3 times the range or when the RMS value exceeds 1.3 times the range.
OVER I		Lights when the peak value of the current input waveform exceeds 6 times the range or when the RMS value exceeds 1.3 times the range.
AVE	LED (green)	Lights when the averaging count is set to a value between 2 and 64 (averaging is on) on the configuration menu. Turns off when the averaging count is set to “oFF” (averaging is turned off).
LPF	LED (green)	Lights when the low pass filter is set to “on” on the configuration menu. Turns off when the low pass filter is set to “oFF.”
CT (current transformer)	LED (green)	Lights when the CT scaling is set to “on” on the configuration menu.
PT (potential transformer)	LED (green)	Lights when the PT scaling is set to “on” on the configuration menu.
KEY LOCK	LED (green)	Lights when the keys are locked.

Basic operations

This section will explain how to operate the V RANGE, I RANGE, HOLD, KEY LOCK, and LOCAL keys.



Setting the range

Follow the procedure below to set the current or voltage range. In the factory default settings, these are both set to AUTO (auto range).

1 To set the current range, press I RANGE. To set the voltage range, press V RANGE.

The measurement range that is currently in use is shown on display D.

When you are setting the current range, “i.rAnGE” is shown on display B. When you are setting the voltage range, “V.rAnGE” is shown on display B.

You can press DSPL B to switch between the current range (i.rAnGE) and the voltage range (V.rAnGE).

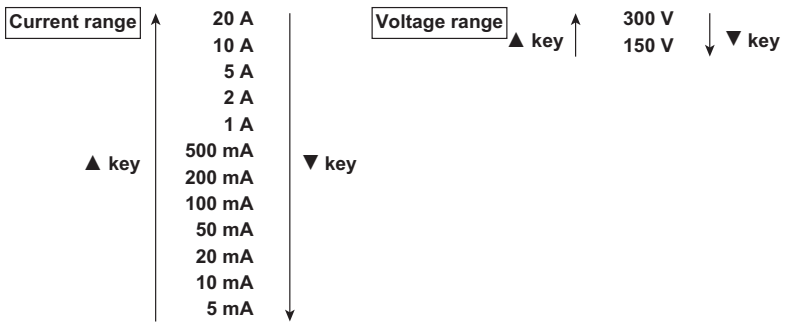
2 Press ▲ or ▼ to select the measurement range.

If the KPM1000 had been using the auto range, the AUTO LED turns off, and the auto range is cleared.

Press▲ to select a range that is higher than the one that is currently being used. Press▼ to select a range that is lower than the one that is currently being used.

You can also use the DSPL D key to change between ranges. Repeatedly press DSPL D to select a range that is higher than the one that is currently being used. Repeatedly press SHIFT+DSPL D to select a range that is lower than the one that is currently being used.

When you select a low measurement range, the OVER I LED (or the OVER V LED if you are selecting the voltage range) may light. This indicates that the input current has exceeded the measurement range. To enable correct measurements, select the measurement range so that the OVER I LED (or the OVER V LED) turns off.



3 If you were setting the current range, press I RANGE. If you were setting the voltage range, press V RANGE.

The KPM1000 returns to measurement mode.

■ Over-range

During current measurement, if the peak value exceeds 6 times the range or the RMS value exceeds 1.3 times the range, the OVER status indicator lights.

During voltage measurement, if the peak value exceeds 3 times the range or the RMS value exceeds 1.3 times the range, the OVER status indicator lights.

See p.29

■ When the CT or PT scaling feature has been set

The CT ratio or PT ratio is displayed together with the range.

Setting the KPM1000 to the auto range

When you set the KPM1000 to the auto range, the range is changed automatically to match the measured values.

■ Turning the auto range on

- Current range

  Press SHIFT+I RANGE to turn on the auto range. The AUTO LED turns on.
- Voltage range

  Press SHIFT+V RANGE to turn on the auto range. The AUTO LED turns on.

■ Turning the auto range off

- Current range

  When the auto range is on, press SHIFT+I RANGE to turn the auto range off. The AUTO LED turns off.
- Voltage range

  When the auto range is on, press SHIFT+V RANGE to turn the auto range off. The AUTO LED turns off.

Holding display values

You can hold (stop the updating of) the currently displayed measured values. The KPM1000 continues to measure the values in the background.

While values are held, you can operate the DSPL A, DSPL B, DSPL C, DSPL D, KEY LOCK, and LOCAL keys. In this situation, you cannot change the voltage range, current range, configuration menu settings, or interface menu settings. You can view the settings. To view the settings, perform the same key operations that you would perform to configure the settings.

■ Holding displayed values

Press HOLD to hold (stop the updating of) the currently displayed measured values. The HOLD LED lights.

■ Stopping holding displayed values

While values are held, press HOLD to start updating measured values again. The HOLD LED turns off.

Key lock

You can lock panel operations to prevent accidental changes to the settings.

When the keys are locked, the KPM1000 ignores the operations of all the panel keys except for the KEY LOCK key. In this situation, you cannot change the voltage range, current range, configuration menu settings, or interface menu settings. You can view the settings. To view the settings, perform the same key operations that you would perform to configure the settings.

■ Locking the keys

Press KEY LOCK (SHIFT+HOLD) to lock the operation of all panel keys except for the KEY LOCK key. The KEY LOCK LED lights.

■ Unlocking the keys

While the keys are locked, press KEY LOCK (SHIFT+HOLD) to unlock the operation of all panel keys. The KEY LOCK LED turns off.

Switching from remote mode to local mode

When the RMT LED is lit, press LOCAL to switch to local mode. The RMT LED turns off.

When the KPM1000 is in local mode, the LOCAL key operates as the SHIFT key.

Configuration settings

Use the configuration menu and the interface menu to set the configuration settings.

Menu operations

1 **To configure the settings on the configuration menu, press CONFIG. To configure the settings on the interface menu, press I/F (SHIFT+CONFIG).**

When you press the CONFIG key, “ConF.”—which indicates that this is the configuration menu—is shown on display A, the menu number is shown on display C, the menu item name is shown on display B, and the selection is shown on display D. When you press the I/F (SHIFT+CONFIG) key, “iF.”—which indicates that this is the interface menu—is shown on display A, the menu number is shown on display C, the menu item name is shown on display B, and the selection is shown on display D.

2 **Press DSPL C or DSPL B to select the menu item.**

The KPM1000 cycles through the items in increasing menu number order. Display B and display D also change according to the menu item.

Press SHIFT+DSPL C or SHIFT+DSPL B to cycle through the items in decreasing menu number order.

3 **Press DSPL D to select the option that you want.**

When you are setting an incremental numeric value, repeatedly press DSPL D to increase the value. Repeatedly press SHIFT+DSPL D to decrease the value. If you hold down the key, the value will increase or decrease more quickly.

To increase or decrease the integration time in units of 1 hour, press SHIFT+▲ or SHIFT+▼.

You can use the ▲ key and ▼ key to select the option in the same manner as the DSPL D key.

4 **If you want to select other items, return to step 2.**

To finish configuring settings, press CONFIG, DSPL A, V RANGE, or I RANGE to return to the measurement display.

5 **If you made changes to the interface menu settings, restart the KPM1000.**

This will apply the changes that you have made.

Configuration menu contents

In the following table, the underlined options are the factory default settings.

Display			Description
Number (DSPL C)	Item (DSPL B)	Option (DSPL D)	
ConF.1	LPF	on/oFF	• This turns the low pass filter with a 500 Hz cutoff frequency on and off. • The LPF LED lights when the filter is on. When you turn the filter on, you can attenuate high-frequency ripple noise, which enables you to perform highly reproducible measurements of minute current.
ConF.2	F.FiLt	on/oFF	• This turns the frequency filter with a 500 Hz cutoff frequency on and off. Normally turn this filter on, but turn it off when you want to measure the frequency of voltage or current whose frequency is greater than or equal to the cutoff frequency. • This filter prevents the measured frequency and values from becoming unstable because of the effect of high-frequency ripple noise. To synchronize measurements with the input signal, you need to correctly measure the frequency of the input signal and correctly detect the zero crossings of the input signal.
ConF.3	AVErAGE	oFF/2/4/8/16/32/64	• Use this setting when the fluctuations of the input signal are large. This sets the averaging count. The AVE LED lights when you select an option other than “oFF.” Because the KPM1000 displays a moving average, changing the averaging count does not affect the display update speed.
ConF.4	SCALE	oFF/ Ct/ Pt/ botH	• This selects the scaling feature that is used when you use an external current transformer (CT), external potential transformer for instrumentation (PT), or both. • When you select “Ct,” the current transformation ratio and current scaling are turned on. The CT LED lights. • When you select “Pt,” the potential transformation ratio and voltage scaling are turned on. The PT LED lights. • When you select “botH,” both voltage and current scaling are turned on. Both the CT LED and PT LED light. • When you select “oFF,” scaling is turned off. Both the CT LED and PT LED turn off.
ConF.5	Ct	1 to 2000 (steps of 1)	• This sets the CT ratio (current transformation ratio). If you set the ratio to 1, no scaling will be performed. • Example: Assume that we are using a current transformer that has a maximum measurement current of 200 A and a current transformation ratio of 1 mA/A (1000:1). If you set this setting to 1000, the measured values of each range are multiplied by 1000, so you can measure 200 A with the 200 mA range.
ConF.6	Pt	1 to 2000 (steps of 1)	• This sets the PT ratio (potential transformation ratio). If you set the ratio to 1, no scaling will be performed. • Example: Assume that we are using a potential transformer that has a potential transformation ratio of 60 and 110 V on its secondary side. If you set this setting to 60, you can use the 150 V range to measure 6600 V.
ConF.7	SynC	VoLt/CurrEnt/oFF	• This sets the synchronization source. • When you select “VoLt,” the source is voltage input. When you select “CurrEnt,” the source is current input. When you select “oFF,” synchronization is not performed.
ConF.8	rEF.rAtE	0.1/0.2/0.5/1/2/5/10	• This sets the display update interval. The unit is seconds.

Display			Description
Number (DSPL C)	Item (DSPL B)	Option (DSPL D)	
ConF.9	intEG	on/<u>oFF</u>	• This turns the integration timer on and off. • When you select “on,” integration continues until the time specified by ConF.10 elapses. • When you select “oFF,” integration continues until you stop it manually (or until 9999 hours and 59 minutes elapses).
ConF.10	intEG.t	0.0 to 9999.59 (the factory default setting is 0.01)	• This sets the integration time. Set the time using the following format: hours.minutes.

Interface menu contents

In the following table, the underlined options are the factory default settings.

Display			Description
Number (DSPL C)	Item (DSPL B)	Option (DSPL D)	
iF.1	SELECt	rS-232C/GPIb/ uSb	• This selects the remote interface. The RS232C interface is installed as standard. GPIb and uSb can only be selected when the corresponding optional interface is installed. • The interface that is selected in the factory default settings is the optional interface.
iF.2 (rS-232C)	bit.P.SEC	2400/4800/ 9600/ 19200/ <u>38400</u>	• This sets the baud rate. • You can only configure this setting when you set SELECt to “rS-232C.”
iF.3 (rS-232C)	FLo.Cont	<u>on</u>/oFF	• This turns the xon/xoff flow control on and off. • You can only configure this setting when you set SELECt to “rS-232C.”
iF.2 (GPIb)	AddrESS	<u>1</u> to 30 (steps of 1)	• This sets the GPIB address. • You can only configure this setting when you set SELECt to “GPIb.”
iF.2 (USb)	VEnd.id	None	• This displays the USB vendor ID. • This is only displayed when you set SELECt to “USb.”
iF.3 (USb)	Prod.id	None	• This displays the USB product ID. • This is only displayed when you set SELECt to “USb.”
iF.4	Err.trAC	on/<u>oFF</u>	• This turns the error trace display on and off. • When you turn the error trace display on, if a communication error occurs, the error number is shown on display D. Press ▼ to display the next error. When the error queue is empty, the KPM1000 returns to the normal display.

3 Measurement Applications

This chapter explains integrated power measurements and standby power measurements.

Measuring integrated power

Run the EUT for 1 hour. The following example will explain how to measure the power consumption (in Wh) over this period of time.

Wiring the measurement circuit

See p.9

Connect the AC power supply, KPM1000, and the EUT.

Preparation

1. **Turn the KPM1000 POWER switch on (|).**
2. **Set the voltage and frequency of the AC power supply, and then turn its output on.**
3. **Turn on the EUT, and then configure the conditions that you want to measure.**
   If you have test standards, configure the conditions to match the standards.

Configuring the KPM1000 settings

See p.25

1 Set the voltage and current ranges.

NOTE

- Set the current range to match the maximum load current during the test. For loads that have large fluctuations in their signals, even if you use the auto range feature, an over-range may occur during integration.
- If an over-range occurs during integration, the Wh indicator blinks.
- If the waveform's peak value or RMS value causes an over-range to occur, the OVER V LED or OVER I LED lights.
- If the active power becomes negative during measurement, check the wiring of the voltage input terminal. You can fix this problem by swapping the wires that are connected to terminal U and the ± terminal.

See p.29

2 Turn the LPF (low pass filter; ConF.1 LPF) on.

Press CONFIG, and then operate the menu to set this setting to "on."

Use the low pass filter when you are measuring a comparatively small current (100 mA or less). This limits the noise that the AC power supply generates and enables correct measurements.

3 Turn the integration timer (ConF.9 intEG) on.

Press CONFIG, and then operate the menu to set this setting to "on."

4 Set the integration time (ConF.10 intEG.t).

Press CONFIG, and then operate the menu to set the integration time.

5 Press DSPL B or DSPL D to select the integration display items that you want to show.

See p.22

The display items that you can select are shown in the following table. The selected display items are shown on the selected displays (before integration starts, "-----" is displayed).

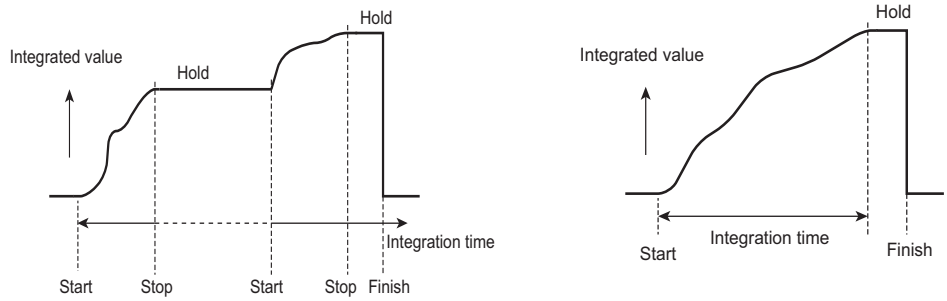
To display the integration time, press DSPL B or DSPL D to select "h." The integration time is displayed as a count down (before integration starts, "-----" is displayed).

Select the necessary items to show on the other displays. The KPM1000 performs integration even if it is not displaying the integrated values.

Display item	Symbol display	Unit display	Unit display (right column)
Integrated current (sum)	-	A	h
Integrated power (sum)	-	W	h
Integrated power (positive)	P	W	h
Integrated power (negative)	n	W	h
Integration time	-	-	h

Starting and pausing integration

After you configure the integration settings, start the integration.



■ Starting integration

Press START/STOP to start integration. The START/STOP LED lights.

While there is still integration time remaining, press START/STOP to pause integration. While integration is paused, the START/STOP LED blinks. The display of integrated values is held on displays B and D. Press START/STOP again to continue integration. The START/STOP LED lights.

■ Operations during integration

During integration, you can operate the START/STOP, RESET, DSPL A, DSPL B, DSPL C, DSPL D, HOLD, KEY LOCK, and LOCAL keys. If you press any other key, an error noise sounds.

In this situation, you cannot change the voltage range, current range, configuration menu settings, or interface menu settings. You can view the settings. To view the settings, perform the same key operations that you would perform to configure the settings.

If the auto range feature is turned on, the range is fixed to the range that the KPM1000 is set to when it starts integration.

■ Stopping integration

If you have set the integration time, integration stops after the specified time elapses. If you have not set the integration time, integration continues until you press the START/STOP key. When the integration time elapses, the START/STOP LED blinks, and integration stops. The display of integrated values is held on displays B and D. Even after integration stops, you cannot operate the V RANGE, I RANGE, ▲, ▼, CONFIG, and I/F keys until you clear integration.

Clearing integration

You can clear integration when integration is paused or when the integration time elapses. Press RESET to clear integration. The START/STOP LED turns off, and the Wh indicator displays "-----." At this point you can operate all the keys.

NOTE Check the displayed integrated power (Wh). When you clear integration, the measured results up to that point are discarded.

Stopping measurements

After you stop measuring, if necessary, turn off the EUT, and turn off the AC power supply's output.

Measuring standby power

The KPM1000 can perform standby power measurements in compliance with the IEC62301 Ed. 1.0 standard.

The power measurement method complies with IEC62301 (Household electrical appliances—Measurement of standby power). The KPM1000 can perform standby power consumption measurements as defined in ErP directive Lot6. The minimum power range is 0.75 W, which enables you to perform measurements with a resolution of 10 mW or greater as required by the standard.

Application software is required to perform the measurements. For information, contact your Kikusui agent or distributor.

4 Specifications

This chapter contains the specifications and gives the dimensions of the KPM1000.

Unless specified otherwise, the specifications are for the following settings and conditions.

- The warm-up time is 30 minutes.
- After the KPM1000 has been warmed up, it must be calibrated correctly in a 23 °C ± 5 °C environment.

Input

Item		Specification
Measurement line		Single-phase, two-wire system (measurement category: CAT II)[1]
Voltage input terminals		Safety terminals
Current input terminals		M6 terminal block
Rated measured voltage		300 Vrms
Rated measured current		20 Arms
Maximum allowable input voltage		900 Vpk or 360 Vrms
Maximum allowable input current		120 Apk or 24 Arms
Maximum isolation voltage		300 V
Input impedance (50/60 Hz)	Voltage input	6 MΩ ± 10 %
	Current input	2 mΩ or less
Line filter (LPF)	Cutoff frequency	500 Hz (can be turned on or off)

1 Applies to measurements on circuits directly connected to a low-voltage installation. This category applies to measurements on circuits of equipment on the primary side of a transformer. Such pieces of equipment have a power cord connected to a power outlet. Examples are household appliances and portable tools.

Display items

Item		Specification
Measurement items		Voltage, current, active power, apparent power, reactive power, power factor, phase angle, frequency, integrated current, integrated power, positive integrated power, negative integrated power, integration time voltage crest factor, current crest factor, voltage peak, current peak.
Display update interval		100 ms, 200 ms , 500 ms , 1 s , 2 s, 5 s , 10 s.
Number of displayed items		4 items simultaneously.
Display digits	Displays A and C	5.
	Displays B and D	7.
Display items	Displays A and C	V, A, W, Vpk, Apk, PF, Hz.
	Displays B and D	V, A, W, VA, var, Ah, Wh, [P]Wh, [n]Wh, h, [C]V, [C]A, [d]. ([P] means positive, [n] means negative, [C] means crest factor, and [d] means phase angle.)

Item		Specification
Status indicators	OVER V	LED color: Red. Lights when the peak value of the voltage input waveform exceeds 3 times the range or when the RMS value exceeds 1.3 times the range.
	OVER I	LED color: Red. Lights when the peak value of the current input waveform exceeds 6 times the range or when the RMS value exceeds 1.3 times the range.
	AVE	LED color: Green. Lights when the AvE setting on the CONFIG menu is set to a value between 2 and 64 (when averaging is turned on); turns off when AvE is set to “off” (averaging is turned off).
	LPF	LED color: Green. Lights when the LPF setting on the CONFIG menu is set to “on;” turns off when LPF is set to “off.”
	CT	LED color: Green. Lights when the Ct setting on the CONFIG menu is set to “on.”
	PT	LED color: Green. Lights when the Pt setting on the CONFIG menu is set to “on.”
	KEY LOCK	LED color: Green. Lights when the keys are locked.
	V RANGE AUTO	LED color: Green. Lights when the auto voltage range is turned on.
	I RANGE AUTO	LED color: Green. Lights when the auto current range is turned on.
	START/STOP	LED color: Green. Lights when integration starts; blinks when integration has been paused; turns off when integration is reset.
	RMT	LED color: Green. Lights when the KPM1000 is in remote mode.
	HOLD	LED color: Green. Lights when measured values are being held.
RMS voltage measurement: V	Display range	0.5 % to 130 % of the range. (The scaling feature can be used to display values in the range of 0.0000 m to 99999 M.) Mute: Values that are 0.5 % of the range or less are displayed as 0.0000.
	Over-range indicators	If a value exceeds 130 % of the range, the over-range indicators turn on. If an RMS over-range occurs, the buzzer also sounds. Over-range indicators: If only a peak over-range occurs: P.oVEr. If a peak and RMS over-range occur: oVEr. If only an RMS over-range occurs: oVEr.
RMS current measurement: A	Display range	0.5 % to 130 % of the range. (The scaling feature can be used to display values in the range of 0.0000 m to 99999 M.) Mute: Values that are 0.5 % of the range or less are displayed as 0.0000.
	Over-range indicators	If a value exceeds 130 % of the range, the over-range indicators turn on. If an RMS over-range occurs, the buzzer also sounds. Over-range indicators: If only a peak over-range occurs: P.oVEr. If a peak and RMS over-range occur: oVEr. If only an RMS over-range occurs: oVEr.

Item		Specification
Active power measurement: W	Display range	0 % to 169 % of the range. (The scaling feature can be used to display values in the range of 0.0000 m to ±99999 M.) Mute: Not used.
	Over-range indicators	If the measured voltage or current exceeds its range, the over-range indicators turn on. Over-range indicators: If both a voltage over-range and a current over-range occur: oVEr. If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
	Polarity display	If the current is leading the voltage, “-” is displayed. If the current is lagging the voltage, no sign is displayed.
Apparent power measurement: VA	Display range	0 % to 169 % of the range. (The scaling feature can be used to display values in the range of 0.0000 m to 99999 M.) Mute: If both the voltage and current are muted, 0.0000 is displayed.
	Over-range indicators	If the measured voltage or current exceeds its range, the over-range indicators turn on. Over-range indicators: If both a voltage over-range and a current over-range occur: oVEr. If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
	Polarity display	This value has no polarity.
Reactive power measurement: var	Display range	0 % to 169 % of the range. (The scaling feature can be used to display values in the range of 0.0000 m to ±99999 M.) Mute: If both the voltage and current are muted, 0.0000 is displayed.
	Over-range indicators	If the measured voltage or current exceeds its range, the over-range indicators turn on. Over-range indicators: If both a voltage over-range and a current over-range occur: oVEr. If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
	Polarity display	If the current is leading the voltage, “-” is displayed. If the current is lagging the voltage, no sign is displayed.
Power factor measurement: PF	Display range	±0.0000 to ±1.0000 If the voltage or current is muted, “-----” is displayed.
	Over-range indicators	If the measured voltage or current exceeds its range, the over-range indicators turn on. Over-range indicators: If both a voltage over-range and a current over-range occur: oVEr. If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
	Polarity display	If the current is leading the voltage, “-” is displayed. If the current is lagging the voltage, no sign is displayed.
Phase angle measurement: [d]	Display range	+180.00 to -179.99 If the voltage or current is muted, “-----” is displayed.
	Over-range indicators	If the measured voltage or current exceeds its range, the over-range indicators turn on. Over-range indicators: If both a voltage over-range and a current over-range occur: oVEr. If only a voltage over-range occurs: oVEr.V. If only a current over-range occurs: oVEr.i.
	Polarity display	If the current is leading the voltage, “-” is displayed. If the current is lagging the voltage, no sign is displayed.

Item		Specification
Integrated current measurement: Ah (sum)	Status indicators	The START/STOP LED is lit during integration. This LED blinks when integration is paused and turns off when integration is reset.
	Display range	±0.00000 m to ±999999 M Mute: Not used. If the integrated value overflows, “OVEr.F” is displayed. When the integrated value does not exist, “-----” is displayed.
	Error warning	If the integrated values contain values that would cause an over-range indicator to appear, the unit blinks.
Integrated power measurement: Wh (sum), [P]Wh (positive), [n]Wh (negative)	Status indicators	The START/STOP LED is lit during integration. This LED blinks when integration is paused and turns off when integration is reset.
	Display range	±0.00000 m to ±999999 M Mute: Not used. If the integrated value overflows, “OVEr.F” is displayed. When the integrated value does not exist (after INTEG RESET), “-----” is displayed.
	Error warning	If the integrated values contain values that would cause an over-range indicator to appear, the unit blinks.
Voltage crest factor: [C]V	Display range	0.0000 to 99.999 If the voltage is muted, “-----” is displayed.
	Over-range indicators	If a voltage peak over-range or RMS value over-range occurs: oVEr.
Current crest factor: [C]A	Display range	0.0000 to 99.999 If the current is muted, “-----” is displayed.
	Over-range indicators	If a current peak over-range or RMS value over-range occurs: oVEr.
Frequency measurement: Hz	Display range	10.000 Hz to 10.000 kHz You can select to display either the voltage frequency or the current frequency. When neither frequency is selected, “-----” is displayed.
	Over-range indicators	If a voltage over-range occurs or if the voltage is muted, “-----” is displayed. If the measured frequency is greater than the upper limit of the measurement range, “oVEr” is displayed. If the measured frequency is less than the lower limit of the measurement range, “undEr” is displayed.
	Measurement interval	Display update interval.
Voltage peak measurement: Vpk	Display range	Three times the voltage range. The peak displays the positive or negative value, whichever is larger. (The scaling feature can be used to display values in the range of 0.0000 m to ±99999 M.)
	Over-range indicators	If a value exceeds three times the range, the over-range indicators turn on. If only a peak over-range occurs: P.oVEr. If a peak and RMS over-range occur: oVEr. If only an RMS over-range occurs: Normal display.
Current peak measurement: Apk	Display range	Six times the current range. The peak displays the positive or negative value, whichever is larger. (The scaling feature can be used to display values in the range of 0.0000 m to ±99999 M.)
	Over-range indicators	If a value exceeds six times the range, the over-range indicators turn on. If only a peak over-range occurs: P.oVEr. If a peak and RMS over-range occur: oVEr. If only an RMS over-range occurs: Normal display.
Integration time: h	Display range	Up to 99 hours, 59 minutes, and 59 seconds, the hours, minutes, and seconds are all displayed (99h59.99). From this point to 9999 hours and 59 minutes, only the hours and minutes are displayed (9999h59). When the KPM1000 is not in integration mode, “-----” is displayed.
	Over-range indicators	If the time exceeds 9999 hours and 59 minutes (9999h59), “oVEr” is displayed.

Voltage measurement feature

Item			Specification
Measurement range	Resolution	150 V	0.01 V
		300 V	0.01 V
Allowable crest factor			3
Accuracy[1, 2]	Effective input range	Full range	1 % to 120 % of the range
	45 Hz ≤ f ≤ 66 Hz, LPF: On or off		±(0.1 % of reading + 0.1 % of range)
	66 Hz < f ≤ 400 Hz, LPF: Off		±(0.1 % of reading + 0.2 % of range)
	400 Hz < f ≤ 1 kHz, LPF: Off		±(0.1 % of reading + 0.2 % of range)
	1 kHz < f ≤ 5 kHz LPF: Off		±(3 % of range)
Residual noise	With the inputs shorted LPF: On or off		0.5 % of range
One-year accuracy (accuracy up to 12 months after calibration)			1.5 times the reading errors for the accuracy at 6 months
Auto range	UP condition		When the value exceeds 120 % of the range or when a peak over-range occurs
	DOWN condition		When the value is less than 30 % of the range, the value is less than or equal to 90 % of the next lower range, and a peak over-range is not occurring

1 Under the following conditions: within the effective input range, within six months after the last calibration, at a temperature of 23 °C ± 5 °C, sine wave, power factor of 1, and common mode voltage of 0 V.
If the waveform is asymmetrical (waveforms such as half-wave rectified waveforms and full-wave rectified waveforms), errors will occur.

2 The peak voltage accuracy is defined for a sine wave whose frequency is between 45 Hz and 66 Hz. Accuracy: ± (0.1 % of reading + 3.1 % of range)

Current measurement feature

<table>
<tr><th colspan="3">Item</th><th>Specification</th></tr>
<tr><td rowspan="12">Measurement range</td><td rowspan="12">Resolution</td><td>5 mA</td><td>0.0001 mA</td></tr>
<tr><td>10 mA</td><td rowspan="3">0.001 mA</td></tr>
<tr><td>20 mA</td></tr>
<tr><td>50 mA</td></tr>
<tr><td>100 mA</td><td rowspan="3">0.01 mA</td></tr>
<tr><td>200 mA</td></tr>
<tr><td>500 mA</td></tr>
<tr><td>1 A</td><td rowspan="3">0.1 mA</td></tr>
<tr><td>2 A</td></tr>
<tr><td>5 A</td></tr>
<tr><td>10 A</td><td rowspan="2">1 mA</td></tr>
<tr><td>20 A</td></tr>
<tr><td colspan="3">Allowable crest factor</td><td>6</td></tr>
<tr><td rowspan="5">Accuracy[1, 2, 3]</td><td>Effective input range</td><td rowspan="6">Full range</td><td>1 % to 120 % of the range</td></tr>
<tr><td>45 Hz ≤ f ≤ 66 Hz, LPF: On or off</td><td>±(0.1 % of reading + 0.1 % of range)</td></tr>
<tr><td>66 Hz < f ≤ 400 Hz, LPF: Off</td><td>±(0.1 % of reading + 0.2 % of range)</td></tr>
<tr><td>400 Hz < f ≤ 1 kHz, LPF: Off</td><td>±(0.1 % of reading + 0.2 % of range)</td></tr>
<tr><td>1 kHz < f ≤ 5 kHz LPF: Off</td><td>±(3 % of range)</td></tr>
<tr><td>Residual noise</td><td>With the inputs shorted
LPF: On or off</td><td>0.5 % of range</td></tr>
<tr><td colspan="3">One-year accuracy (accuracy up to 12 months after calibration)</td><td>1.5 times the reading errors for the accuracy at 6 months</td></tr>
<tr><td rowspan="2">Auto range</td><td colspan="2">UP condition</td><td>When the value exceeds 120 % of the range or when a peak over-range occurs</td></tr>
<tr><td colspan="2">DOWN condition</td><td>When the value is less than 30 % of the range, the value is less than or equal to 90 % of the next lower range, and a peak over-range is not occurring</td></tr>
</table>

1 Under the following conditions: within the effective input range, within six months after the last calibration, at a temperature of 23 °C ± 5 °C, sine wave, power factor of 1, and common mode voltage of 0 V.
If the waveform is asymmetrical (waveforms such as half-wave rectified waveforms and full-wave rectified waveforms), errors will occur.

2 When you are using the 5 mA range and the input is less than 10 % of the range, add (0.1 % of range).

3 The peak current accuracy is defined for a sine wave whose frequency is between 45 Hz and 66 Hz. Accuracy: ± (0.1 % of reading + 3.1 % of range)

Power measurement feature

Item			Specification
Measurement range (combination of the voltage and current ranges)	Resolution	750 mW	0.01 mW
		1.5 W	0.1 mW
		3 W	
		6 W	
		7.5 W	
		15 W	1 mW
		30 W	
		60 W	
		75 W	
		150 W	0.01 W
		300 W	
		600 W	
		750 W	
		1.5 kW	0.1 W
		3 kW	
		6 kW	
Accuracy[1, 2]	Effective input range	Full range	1 % to 144 % of the range
	45 Hz ≤ f ≤ 66 Hz, LPF: On or off		±(0.1 % of reading + 0.1 % of range)
	66 Hz < f ≤ 400 Hz, LPF: Off		±(0.1 % of reading + 0.2 % of range)
	400 Hz < f ≤ 1 kHz, LPF: Off		±(0.1 % of reading + 0.3 % of range)
	1 kHz < f ≤ 3 kHz LPF: Off		±(3 % of range)
Influence of the power factor	Power factor 0	45 Hz to 66 Hz	±0.4 % of VA
	0 < power factor < 1		Add (tanθ × 0.4)% of reading
One-year accuracy (accuracy up to 12 months after calibration)			1.5 times the reading errors for the accuracy at 6 months

1 Under the following conditions: within the effective input range, within six months after the last calibration, at a temperature of 23 °C ± 5 °C, sine wave, power factor of 1, and common mode voltage of 0 V.
If the waveform is asymmetrical (waveforms such as half-wave rectified waveforms and full-wave rectified waveforms), errors will occur.

2 When you are using the 5 mA range and the input is less than 10 % of the range, add (0.1 % of range).

Voltage measurement range and the display digits

The active power is displayed in units of W. For apparent power and reactive power, read the unit “W” in the following table as “VA” and “var,” respectively.

I range / V range	5.0000 mA	10.000 mA	20.000 mA	50.000 mA	100.00 mA	200.00 mA
150.00 V	750.00 mW	1.5000 W	3.0000 W	7.5000 W	15.000 W	30.000 W
300.00 V	1.5000 W	3.0000 W	6.0000 W	15.000 W	30.000 W	60.000 W

I range / V range	500.00 mA	1.0000 A	2.0000 A	5.0000 A	10.000 A	20.000 A
150.00 V	75.000 W	150.00 W	300.00 W	750.00 W	1.5000 kW	3.0000 kW
300.00 V	150.00 W	300.00 W	600.00 W	1.5000 kW	3.0000 kW	6.0000 kW

Frequency measurement feature

Item	Specification
Measurement range	10 Hz to 10 kHz
Measured item	Voltage or current
Measurement input level	30% to 120% of the measurement range
Frequency filter	On (cutoff frequency: 500 Hz) or off
Accuracy	±(0.06 % of reading)

Math features

Item		Specification
Apparent power[1, 2]		VA = V •A
Reactive power[1, 2]		$var = \sqrt{(VA)^2 - W^2}$
Power factor[1, 2]		PF = W/VA
Phase angle[1, 2]		$deg = \cos^{-1}(W/VA)$
Crest factor[1, 2]		Peak value/RMS value
Moving average (averaging)		Off, 2, 4, 8, 16, 32, 64
Selectable range for the PT ratio		1 to 2000 in steps of 1
Selectable range for the CT ratio		1 to 2000 in steps of 1
Accuracy of leading phase and lagging phase detection	The voltage and current input is 50 % to 120 % of the measurement range. 45 Hz ≤ f ≤ 1 kHz LPF: Off	±10 °

1 This is determined through a digital computation using the voltage, current, and active power. For distorted signal input, the value obtained on the KPM1000 may differ from that obtained on other instruments that use a different method.

2 The measurement accuracy is determined by an expression whose components are the measurement accuracies of the voltage, current, and active power.

Integration feature

Item		Specification
Integration	Accuracy	±(accuracy of the power or current + 0.1 % of reading)
Timer[1]	Selectable range	0 hours 00 minutes to 9999 hours 59 minutes
	Accuracy	±0.02 %

1 You can use the timer setting to automatically stop integration.

Other features

Item	Specification
Synchronization source	Voltage, current, off (the full display update interval)
Display hold	Holds the displayed values; you can switch between displayed (measured) values

Communication specifications

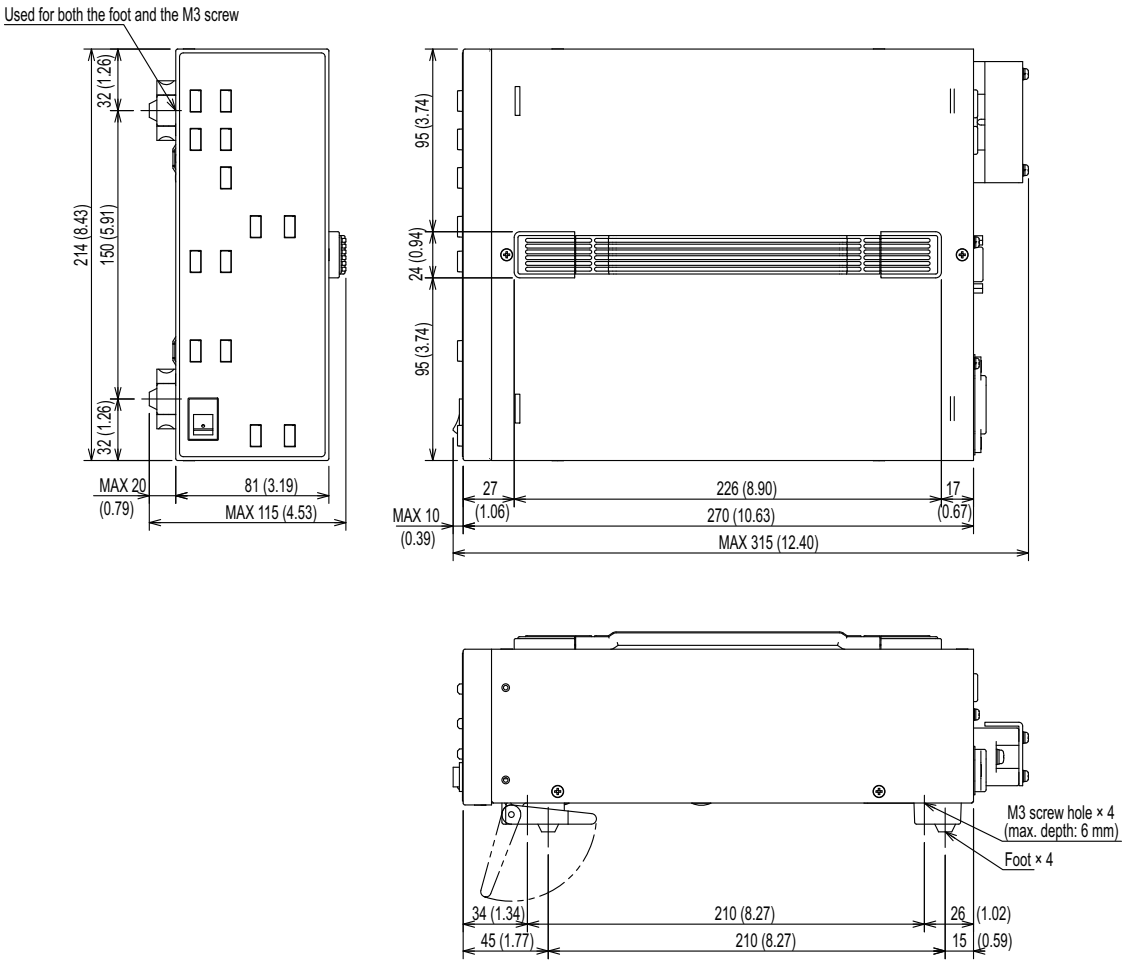
Item		Specification
Common specifications	Software protocol	IEEE std. 488.2-1992
	Command language	Complies with SCPI specification 1999.0
RS232C	Hardware	D-sub 9-pin connector that complies with the EIA232D specification
		D-sub 9-pin connector (male)
		Baud rate: 2400, 4800, 9600, 19200, 38400 bps
		Data bits: 8 bits; stop bits: 1 bit; parity bit: none
		Flow control: X-flow, none
	Message terminator	LF during reception, CR/LF during transmission
USB (factory option)	Hardware	Complies with the USB 2.0 specifications; data rate:12 Mbps (full speed)
		Socket B type
	Message terminator	LF or EOM during reception, LF + EOM during transmission
	Device class	Complies with the USBTMC-USB488 device class specifications
GPIB (factory option)	Hardware	Complies with IEEE Std 488.1-1987
		SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0, E1
		24-pin connector (receptacle)
	Message terminator	LF or EOI during reception, LF + EOI during transmission
	Primary address	1 to 30

General specifications

Item		Specification
AC input	Nominal input rating	100 V to 240 V, 50 Hz to 60 Hz
	Voltage range	90 V to 250 V
	Maximum power consumption	70 VA
Withstand voltage	Between the voltage and current input terminals and the chassis and interface	1980 Vac for 5 minutes
	Between the voltage and current input terminals and the AC input	
	Between the voltage input terminals and the current input terminals	
	Between the AC input and the chassis	1500 Vac for 1 minute
Insulation resistance	Between the voltage and current input terminals and the chassis and interface	100 MΩ or greater at 500 Vdc
	Between the voltage and current input terminals and the AC input	
	Between the voltage input terminals and the current input terminals	
	Between the AC input and the chassis	
Environmental conditions	Operating environment	Indoor use, overvoltage category II
	Operating temperature	0 °C to +40 °C
	Operating humidity	20 %rh to 80 %rh (no condensation)
	Storage temperature	-20 ° to +70 °
	Storage humidity	90 %rh or less (no condensation)
	Elevation	2000 m or less
Earth continuity		0.1 Ω or less at 25 Aac
Safety[1]		Complies with the requirements of the following directive and standard Low Voltage Directive 2006/95/EC[2] EN61010-1, class I, pollution degree 2
Electromagnetic compatibility (EMC)[1, 2, 3]		Complies with the requirements of the following directive and standard EMC Directive 2004/108/EC EN 61326-1 Compliance condition: The maximum length of all cabling and wiring connected to the KPM1000 must be less than 3 m.
Dimensions		See the outline drawing
Weight		Approx. 2.5 kg (5.51 lb.)
Accessories	Power cord (three-pronged)	1
	Safety plugs (solder-connection type)	1 set (red and black)
	CD-ROM[4]	1
	Quick start	English: 1, Japanese: 1
	Safety information	1 (contains English, Chinese, and Japanese)
	Packing list	1 (contains both English and Japanese)

1 Does not apply to specially ordered or modified KPM1000s.
2 Limited to products that have the CE mark on their panels.
3 The measured values may be affected by noise.
Use shielded cables for the communication cables. The act of connecting measuring cables may cause radio interference, in which case users may be required to correct the interference.
4 Contains the User's Manual, the Communication Interface Manual, and the KI-VISA library.

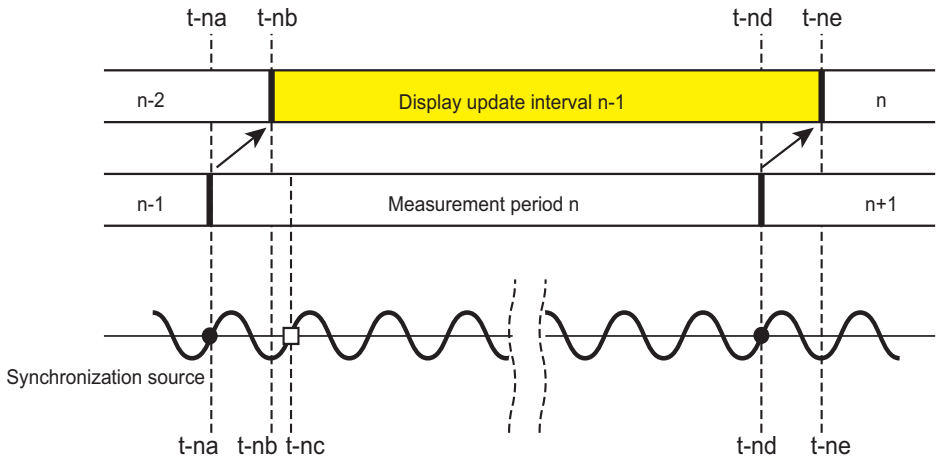
Outline drawing



Unit: mm (inch)

App. A Display Update Interval and Measurement Period

The KPM1000 measurement period is determined by the zero crossing points of the synchronization source and the display update interval (which can be selected on the configuration menu). The figure below shows the temporal relationship between the display update interval and the measurement period.



● Zero crossing

t-na: Immediately before the display is updated (t-nb)
t-nd: Immediately before the display is updated (t-ne)

Synchronization source

You can set the synchronization source to voltage input (factory default setting) or current input. The points in time when the amplitude crosses the zero level on the rising slope are known as zero crossings.

If the synchronization source waveform is distorted or if it contains harmonics, the KPM1000 may not be able to accurately detect the zero crossings. In this situation, change the synchronization source (switch between voltage and current input), or turn the frequency filter on. If the KPM1000 cannot accurately detect the zero crossings, the measured values may not be stable.

Measurement period

The KPM1000's measurement period is defined as the time between (1) the zero crossing immediately before the display is updated (t-na) and (2) the zero crossing immediately before the display is updated the next time (t-nd).

If the synchronization source has been turned off or if zero crossings could not be detected because the input is not at a valid input level even though the synchronization source has been turned on, measurements will be performed asynchronously. In this situation, the measurement period is the same as the display update interval (t-na equals t-nb and t-nd equals t-ne).

Consecutive measurements

For example, in a measurement between two zero crossings (t-nc and t-nd) within the display update interval, there is a gap between the display update interval and the next measurement period (from t-na to t-nc). To perform consecutive measurements with no gaps between them, the KPM1000 sets the measurement period as the time between (1) the zero crossing immediately before the display is updated (t-na) and (2) the zero crossing immediately before the display is updated the next time (t-nd).

App. B Troubleshooting

See p.50

This section introduces troubleshooting measures. Typical symptoms are listed. Check whether any of the items listed below apply to your case. In some cases, the problem can be solved quite easily.

If none of the items apply to your case, we recommend that you initialize the KPM1000 to its factory default settings. If the corrective action does not correct the problem, Contact your Kikusui agent or distributor..

The power does not turn on

Symptom	Item to check	Corrective action	See
The KPM1000 does not operate when the POWER switch is turned on.	Is the power cord disconnected?	Connect the power cord correctly.	p.8

Unable to carry out panel operations

Symptom	Item to check	Corrective action	See
Unable to operate the panel keys.	Is the KEY LOCK LED status indicator lit?	Press the KEY LOCK key to release the key lock.	p.27
	Is the RMT LED lit?	The KPM1000 is being operated through the RS232C, GPIB, or USB interface. To control the KPM1000 from the panel, press the LOCAL key to switch to local mode.	p.27
Unable to change range, configuration, or interface settings.	Is the HOLD LED lit?	Values are being held. Press the HOLD key to stop holding values.	p.26
	Is the KEY LOCK LED status indicator lit?	Press the KEY LOCK key to release the key lock.	p.27
	Is the START STOP LED lit?	Integration is being performed. When the KPM1000 is in this state, you cannot change settings; you can only view them.	p.33
	Is the START STOP LED blinking?	Integration has been paused. When the KPM1000 is in this state, you cannot change settings; you can only view them.	p.33
Even though the auto range feature is turned on, pressing the START STOP key turns the auto range feature off.	Is the START STOP LED lit?	When integration is being performed, you cannot use the auto range feature. It will be turned off automatically.	p.33

Remote interface

Symptom	Item to check	Corrective action	See
The remote interface factory default setting is different between multiple KPM1000s.	Is a communication interface factory option installed in the KPM1000?	The interface that is selected in the factory default settings is the optional interface.	p.50
Even though I changed the remote interface setting, I cannot perform communications using the specified interface.		Change the setting on the configuration menu, and then restart the KPM1000.	p.50

The measured values are not correct

Symptom	Item to check	Corrective action	See
The measured values are not updated.	Is the HOLD LED lit?	Values are being held. Press the HOLD key to stop holding values.	p.26
	Is the averaging count too large?	Check the AVErAGE setting on the configuration menu.	p.29
A negative power value is displayed.	Is the measurement circuit wired correctly?	Swap the wire that is connected to the ± terminal with the wire that is connected to terminal U.	p.9
	Are you measuring a load that has an electricity regeneration feature?	Power is regenerated on the AC power supply side. Check the condition of the load.	p.9
When I measure a small current, the measured value suddenly jumps to 0 from a certain value.	Is the current range set to a large value?	When the measured voltage or current becomes 0.5 % of the range or lower, the displayed value becomes 0.0000 (the measured value is muted).	p.20
Even though the measured current is within the range, the Over I LED lights.	Is the current peak six times the range or greater?	Press DSPL A or DSPL C to view the value of the current peak (Apk).	p.22
The phase angle value is not correct.	Is the current or voltage less than 50 % of its range?	Set the current or voltage range correctly.	p.25
Even though I'm using a resistive load, the power factor is not 1.0000.			
The display of measured values changes too slowly or too fast.	Is the display update interval set too long or too short?	Check the rEF.rAtE setting on the configuration menu.	p.29
The measured value was supposed to change suddenly, but the value changed slowly.	Is the averaging count too large?	Check the AVErAGE setting on the configuration menu.	p.29
	Is the display update interval set too long?	Check the rEF.rAtE setting on the configuration menu.	p.29
The measured power and current are very different from the measured values of another power meter.	Is the CT ratio setting incorrect?	Check the Ct setting on the configuration menu.	p.29
	Is the PT ratio setting incorrect?	Check the Pt setting on the configuration menu.	p.29
	Is high-frequency noise present in the AC power supply?	Set the LPF to ON on both power meters, and compare the results.	p.29
	Are you measuring a hair dryer in low mode (a half-wave rectified waveform) or other similar item as the load?	This product is designed for use with alternating current. With loads that have a DC component, the KPM1000's internal current transformer may become saturated, which may lead to large measurement errors.	p.9
	When you are measuring a fluctuating load, is the display update interval of the KPM1000 different from that of the power meter you are comparing with?	Check the measurement conditions.	p.29
	When you are measuring a load that has many harmonic components, do the LPF setting and the frequency bandwidth of the KPM1000 differ from from those of the power meter that you are comparing with?	Check the measurement conditions.	p.29
The calculated frequency is not stable.	Is there high-frequency noise in the signal input?	Check the F.FiLt setting on the configuration menu. Change the setting to "on" if necessary.	p.29

Symptom	Item to check	Corrective action	See
I cannot measure frequencies.	Is the synchronization source setting set to “oFF?”	Check the SynC setting on the configuration menu.	p.29
	Is the synchronization source setting set to “Curr” even though no current is flowing?		
	Are you trying to measure a frequency of 500 Hz or more with the frequency filter turned on?	Check the F.FiLt setting on the configuration menu. Change the setting to “oFF” if necessary.	p.29
	Is the frequency that you are applying outside of the measurement range (10 Hz to 10 kHz)?	Use an external measuring instrument to check the frequency.	-
Integration starts, but it stops after a certain amount of time has elapsed.	Is the integration time correct?	Check the intEG setting on the configuration menu.	p.29
During integration, the Wh and Ah indicators are blinking.	Is an over-range occurring during integration?	Set the range to a higher range, and then start integration again.	p.25 p.31

App. C Factory Default Settings

While holding down SHIFT, turn the POWER switch on to set the KPM1000 to its factory default settings.

Item		Factory default setting
Voltage range		AUTO (auto range)
Current range		AUTO (auto range)
Display	DSPL A	V (voltage)
	DSPL B	VA (apparent power)
	DSPL C	A (current)
	DSPL D	W (active power)
Integration feature		Stopped
Configuration menu	Low pass filter	Off
	Frequency filter	On
	Averaging count	Off
	Scaling	Off
	Current transformation ratio	1
	Potential transformation ratio	1
	Synchronization source	Voltage input
	Display update interval	0.1 s
	Integration timer	Off
	Integration time	0.01 (1 minute)
Interface menu	Interface	RS232C[1]
	Baud rate	38400
	Flow control	On
	GPIB address	1
	Error trace display	Off

1 The interface that is selected in the factory default settings is the optional interface.

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