User's Manual

# WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer Getting Started Guide

YOKOGAWA
Yokogawa Test & Measurement Corporation

IM WT1801R-03EN
1st Edition

# User Registration

YOKOGAWA provides registered users with useful information and services. Please allow us to serve you best by completing the user registration form accessible from our website.

**https://tmi.yokogawa.com/support/**

# Contact Us

If you want to resolve a technical support issue or need to contact YOKOGAWA, please fill out the inquiry form on our website.

**https://tmi.yokogawa.com/contact/**

Thank you for purchasing the WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, or WT1806R Precision Power Analyzer.
This instrument is capable of measuring parameters such as voltage, current, and power with high precision.

This getting started guide primarily explains the handling precautions and basic operations of this instrument. To ensure correct use, please read this manual thoroughly before beginning operation. Keep this manual in a safe place for quick reference in the event that a question arises. The manuals for this instrument are listed on page page iii. Please read all manuals.
Contact information of Yokogawa offices worldwide is provided on the following sheet.

| Document No. | Description |
|---|---|
| PIM 113-01Z2 | List of worldwide contacts |

## Notes

- The contents of this manual are subject to change without prior notice as a result of improvements to the product's performance and functionality. Refer to our website to view our latest manuals.
- The figures given in this manual may differ from those that actually appear on your screen.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of YOKOGAWA is strictly prohibited.
- A warranty sheet is included at the end of this document.
- The TCP/IP software of this product and the documents concerning it have been developed/created by YOKOGAWA based on the BSD Networking Software, Release 1 that has been licensed from the Regents of the University of California.

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## Updating the firmware

It is recommended to update the firmware to the latest version to improve the features and usability of this instrument.
Download the latest firmware from the YOKOGAWA website, or contact your nearest YOKOGAWA dealer for details.

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## Revisions

- 1st Edition: September 2024

# Manuals

The following manuals, including this one, are provided as manuals for this instrument. Please read all manuals.

## Manuals included with the product

| Manual Title | Manual No. | Description |
|---|---|---|
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer Getting Started Guide | IM WT1801R-03EN | This document. This guide explains the handling precautions and basic operations of this instrument. |
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer Request to Download Manuals | IM WT1801R-73Z2 | Describes the manuals provided on the website. |
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer | IM WT1801R-92Z1 | Document for China |
| Safety Instruction Manual | IM 00C01C01-01Z1 | Safety manual (European languages) |

## Manuals provided on the website

Download the following manuals from the YOKOGAWA website.

| Manual Title | Manual No. | Description |
|---|---|---|
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer Features Guide | IM WT1801R-01EN | Explains all the instrument's features other than the communication interface features. |
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer User's Manual | IM WT1801R-02EN | Explains how to operate this instrument. |
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer Communication Interface User's Manual | IM WT1801R-17EN | Explains the functions of this instrument's communication interface, how to configure it, and the commands used to control this instrument from a PC through the interface. |

For details on downloading manuals, see Request to Download Manuals (IM WT1801R-73Z2). To view the PDF data, you need Adobe Acrobat Reader or a software application that can open PDF data.

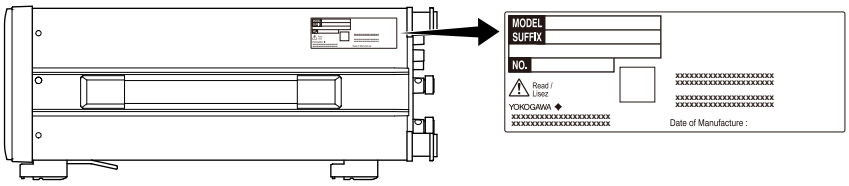
The "EN," "E," "Z1," and "Z2" in the manual numbers are the language codes.
Refer to the "Optional Accessories (Sold Separately)" about the accessory's manual number.

# Checking the Contents of the Package

Unpack the box, and check the following before operating the instrument. If the wrong items have been delivered, if items are missing, or if there is a problem with the appearance of the items, contact your nearest YOKOGAWA dealer.

## WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R

Check that the product that you received is what you ordered by referring to the model name and suffix code given on the name plate on the left side panel.




| Model/Item | Suffix Code[1] | | | Description |
|---|---|---|---|---|
| WT1801R | | | | 1-Input Element Model |
| WT1802R | | | | 2-Input Element Model |
| WT1803R | | | | 3-Input Element Model |
| WT1804R | | | | 4-Input Element Model |
| WT1805R | | | | 5-Input Element Model |
| WT1806R | | | | 6-Input Element Model |
| 5 A input element configuration | -5A0 | | | None 5A Input Element |
| | -5A1 | | | 5Ax1 Input Element |
| | -5A2 | | | 5Ax2 Input Element |
| | -5A3 | | | 5Ax3 Input Element |
| | -5A4 | | | 5Ax4 Input Element |
| | -5A5 | | | 5Ax5 Input Element |
| | -5A6 | | | 5Ax6 Input Element |
| 50 A input element configuration | | -50A0 | | None 50A Input Element |
| | | -50A1 | | 50Ax1 Input Element |
| | | -50A2 | | 50Ax2 Input Element |
| | | -50A3 | | 50Ax3 Input Element |
| | | -50A4 | | 50Ax4 Input Element |
| | | -50A5 | | 50Ax5 Input Element |
| | | -50A6 | | 50Ax6 Input Element |
| GP-IB interface | | | -N01 | No GP-IB interface |
| | | | -C01 | With GP-IB interface |
| Language | | | -HE | English menu |
| | | | -HJ | Japanese/English menu |
| | | | -HC | Chinese/English menu |
| | | | -HG | German/English menu |

| Model/Item | Suffix Code[1] | | Description |
|---|---|---|---|
| Power cord[2] | | -D | UL/CSA standard and PSE compliant, rated voltage, rated voltage: 125 V |
| | | -F | VDE/Korean standard, rated voltage: 250 V |
| | | -H | Chinese standard, rated voltage: 250 V |
| | | -N | Brazilian standard, rated voltage: 250 V |
| | | -Q | British standard, rated voltage: 250 V |
| | | -R | Australian standard, rated voltage: 250 V |
| | | -T | Taiwanese standard, rated voltage: 125 V |
| | | -B | Indian standard, rated voltage: 250 V |
| | | -U | IEC Plug Type B, rated voltage: 250 V |
| | | -Y | No power cord included[3] |
| Options | | /EX1 | External current sensor input for WT1801R |
| | | /EX2 | External current sensor input for WT1802R |
| | | /EX3 | External current sensor input for WT1803R |
| | | /EX4 | External current sensor input for WT1804R |
| | | /EX5 | External current sensor input for WT1805R |
| | | /EX6 | External current sensor input for WT1806R |
| | | /G5 | Harmonic measurement[4] |
| | | /G6 | Simultaneous dual harmonic measurement (except for /WT1801R)[4] |
| | | /V1 | RGB output |
| | | /DA | 20-channel D/A output[5] |
| | | /MTR | Motor evaluation function[6] |
| | | /AUX | 2-channel auxiliary input[6] |
| | | /PD2 | Current sensor power |

1 For products whose suffix code contains “Z,” an exclusive manual may be included. Please read it along with the standard manual.
2 Make sure that the attached power cord meets the designated standards of the country and area that you are using it in.
3 Prepare a power cord that complies with the standard specified by the country or region that the instrument will be used in.
4 The /G5 and /G6 options cannot be installed on the same instrument.
5 One 36-pin connector (A1005JD) is installed in the instrument.
6 The /MTR and /AUX options cannot be installed on the same instrument.

## No. (instrument number)

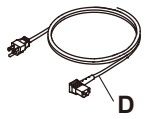
When contacting the dealer from which you purchased the instrument, please give them the instrument number.

## Standard accessories

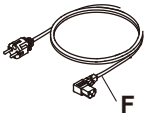
The following accessories are included. Check that all contents are present and undamaged.

**Power cord (one cord that matches the suffix code is included) [1]**

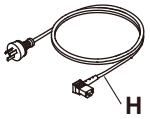
**UL/CSA standard and PSE compliant**
**A1006WD**



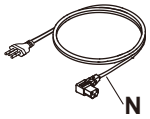

**VDE/Korean standard**
**A1009WD**



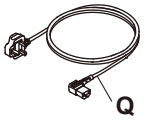

**Chinese standard**
**A1064WD**



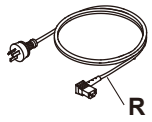

**Brazilian standard**
**A1088WD**



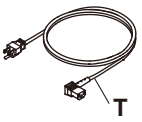

**British standard**
**A1054WD**



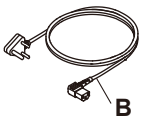

**Australian standard**
**A1024WD**



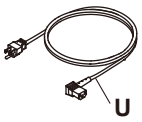

**Taiwanese standard**
**A1100WD**



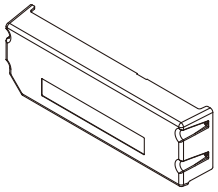

**Indian standard**
**A1101WD**




**IEC plug Type B**
**A1102WD**

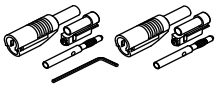



**Current input protection cover**
**B8211BX**

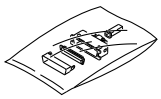


**Rubber stoppers**
**A9088ZM**

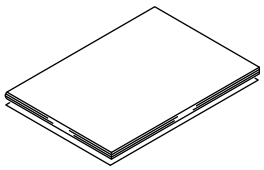
**Safety terminal adapter set[2]**
**758931**



**36-pin connector[3]**
**A1005JD**



**Manuals[4]**



Standard accessories are not covered by warranty.

1 Make sure that the attached power cord meets the designated standards of the country and area that you are using it in. If the suffix code is -Y, a power cord is not included.
2 Included according to the number of installed input elements
WT1801R: One set with one hexagonal socket wrench
WT1802R: Two sets with one hexagonal socket wrench
WT1803R: Three sets with one hexagonal socket wrench
WT1804R: Four sets with one hexagonal socket wrench
WT1805: Five sets with one hexagonal socket wrench
WT1806R: Six sets with one hexagonal socket wrench
For the assembly procedure, see section 2.6.
3 Included with models that have 20-channel D/A output and remote control (/DA)
4 Manuals

| Model or Part No. | Quantity | Notes |
|---|---|---|
| IM WT1801R-03EN | 1 | Getting Started Guide (this guide) |
| IM WT1801R-73Z2 | 1 | Request to Download Manuals |
| IM WT1801R-92Z1 | 1 | Document for China |
| IM 00C01C01-01Z1 | 1 | Safety manual (European languages) |
| PIM 113-01Z2 | 1 | List of worldwide contacts |

## Optional accessories (sold separately)

The following optional accessories are available for purchase separately. For information about ordering accessories, contact your nearest YOKOGAWA dealer.

- Use the following accessories within the ranges indicated in the specifications of each accessory. When using several accessories together, use them within the specification range of the accessory with the lowest rating.
- If you use accessories other than those below, YOKOGAWA assumes no responsibility or liability for the specifications of this instrument or any damage caused by the use of this instrument.
- Accessories (sold separately) are not covered by this instrument's warranty.
- Each product is sold in units of 1 piece.
- The maximum rated voltage to ground is an rms value.

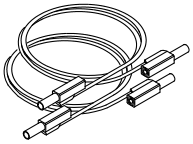
### Group 1

Compliance with EN standards is achieved by using the following in combination with the instrument.

| Item | Model or Part No. | Maximum Rated Voltage to Ground Measurement category | Notes | Manual No. |
|---|---|---|---|---|
| Measurement lead | 758917 | 1000 V CAT II | Two pieces in one set<br>Used with the 758922 , 758929 or 758921 adapter (sold separately).<br>Cable length: 0.75 m | — |
| Safety terminal adapter set | 758923 | 600 V CAT II | Two pieces in one set | — |
| | 758931 | 1000 V CAT II | Two pieces in one set<br>Hexagonal wrench (B9317WD) included | IM 758931-01 |
| Alligator clip adapter set | 758922 | 300 V CAT II | Two pieces in one set<br>For the 758917 measurement lead | — |
| | 758929 | 1000 V CAT II | Two pieces in one set<br>For the 758917 measurement lead | — |
| Fork terminal adapter set | 758921 | 1000 V CAT II | Two pieces in one set<br>For the 758917 measurement lead<br>Rated current: 25 A | |
| BNC cable | 366924 | — | 42 V or less. Total length: 1 m. | — |
| | 366925 | — | 42 V or less. Total length: 2 m. | — |
| Safety BNC cable | 701902 | 1000 V CAT II | Cable length: 1 m | — |
| | 701903 | 1000 V CAT II | Cable length: 2 m | — |
| External sensor cable | B9284LK | — | For connecting to the external current sensor input terminal of this instrument. Cable length: 0.5 m. | — |
| Conversion adapter | 758924 | 1000 V CAT II | BNC-4 mm socket adapter<br>Rated voltage: 500 V | — |
| Shunt resistor box (5 Ω) | A1323EZ | | Rating: 580 mA<br>Usage is limited to 5 minutes for 580 mA to 667 mA input. | |
| Shunt resistor box (10 Ω) | A1324EZ | | Rating: 300 mA | |
| Shunt resistor box (20 Ω) | A1325EZ | | Rating: 200 mA | |
| Current sensor cable[1] | A1559WL | | Cable length: 3 m | |
| Current sensor cable[1] | A1560WL | | Cable length: 5 m | |
| Direct current input cable[2] | A1589WL | | Cable length: 3 m, rating: 667 mA | |
| Direct current input cable[2] | A1628WL | | Cable length: 5 m | |

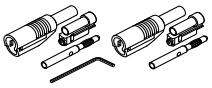
1 Used with the shunt resistor box (A1323EZ, A1324EZ, or A1325EZ)
2 Used with the fork terminal adapter set (758921)

**Measurement leads 758917**

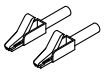


**Safety terminal adapter set 758923**

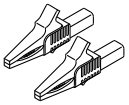
**Safety terminal adapter set 758931**



**Alligator clip adapter set 758922**



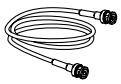
**Alligator clip adapter set 758929**



**Fork terminal adapter set 758921**

**BNC cable (1 m) 366924**

**BNC cable (2 m) 366925**



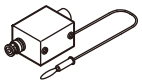
**Safety BNC cable (1 m) 701902**

**Safety BNC cable (2 m) 701903**

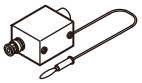
**Conversion adapter 758924**

**External sensor cable B9284LK**

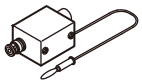
**Shunt resistor box (5 Ω) A1323EZ**



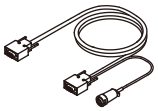
**Shunt resistor box (10 Ω) A1324EZ**



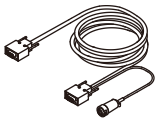
**Shunt resistor box (20 Ω) A1325EZ**



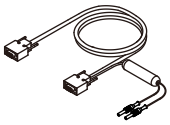
**Current sensor cable (3 m) A1559WL**



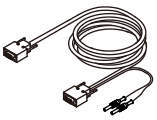
**Current sensor cable (5 m) A1560WL**



**Direct current input cable (3 m) A1589WL**



**Direct current input cable (5 m) A1628WL**



### Group 2

The following accessories by themselves comply with EN standards.

| Item | Model/ Part No. | Maximum Rated Voltage to Ground Measurement category | Notes | Manual No. |
|---|---|---|---|---|
| AC/DC current sensor | CT2000A | 1000 Vrms CAT III | DC: 0 to 2000 A<br>AC: 3000 Apeak | IM CT2000A-01 |
| AC/DC current sensor | CT1000A | 1000 V CAT III | DC: 0 to 1000 A<br>AC: 1000 Arms, 1500 Apeak | IM CT1000A-01 |
| AC/DC current sensor | CT1000 | 1000 Vrms CAT III | DC: 0 to 1000 A<br>AC: 1000 Apeak | IM CT1000-01 |
| AC/DC current sensor | CT200 | 1000 Vrms CAT III | DC: 0 to 200 A<br>AC: 200 Apeak | IM CT1000-01 |
| AC/DC current sensor | CT60 | 1000 Vrms CAT III | DC: 0 to 60 A<br>AC: 60 Apeak | IM CT1000-01 |
| AC/DC split core current sensor | CT1000S | CAT O | DC: 0 to 1000 A<br>AC: 1000 Arms | IM CT1000S-01 |
| Clamp-on probe | 720930 | 300 Vrms CAT III | AC: 0 to 50 Arms | IM 720930-01 |
| Clamp-on probe | 720931 | 600 Vrms CAT III | AC: 0 to 200 Arms (300 Apeak) | IM 720930-01 |
| Clamp-on Probe | 751552 | 600 Vrms CAT III | AC: 0.001 to 1200 Arms | IM 751552-01 |

# Conventions Used in This Manual

## Prefixes k and K

Prefixes k and K used before units are distinguished as follows:

| | | |
|---|---|---|
| k: | Denotes 1000. | Example: 100 kHz |
| K: | Denotes 1024. | Example: 720 KB (file size) |

## Displayed characters

Bold characters in procedural explanations are used to indicate panel keys and soft keys that are used in the procedure and menu items that appear on the screen.

## Notes and cautions

The notes and cautions in this manual are categorized using the following symbols.

*Improper handling or use can lead to injury to the user or damage to the instrument.* This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

**WARNING** Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

**CAUTION** Calls attention to actions or conditions that could cause light injury to the user or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

**French**

**AVERTISSEMENT** Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures graves (voire mortelles), et sur les précautions de sécurité pouvant prévenir de tels accidents.

**ATTENTION** Attire l'attention sur des gestes ou des conditions susceptibles de provoquer des blessures légères ou d'endommager l'instrument ou les données de l'utilisateur, et sur les précautions de sécurité susceptibles de prévenir de tels accidents.

***Note*** Calls attention to information that is important for proper operation of the instrument.

# Safety Precautions

This product is designed to be used by a person with specialized knowledge.
This instrument is an IEC safety class I instrument (provided with a terminal for protective earth grounding).
The general safety precautions described herein must be observed during all phases of operation. If the instrument is used in a manner not specified in this manual, the protection provided by the instrument may be impaired. YOKOGAWA assumes no liability for the customer's failure to comply with these requirements.

This manual is part of the product and contains important information. Store this manual in a safe place close to the product so that you can refer to it immediately. Keep this manual until you dispose of the product.

## The following symbols are used on this instrument.

| | | | |
|---|---|---|---|
|  | **Warning: handle with care. Refer to the user's manual or service manual. This symbol appears on dangerous locations on the instrument which require special instructions for proper handling or use. The same symbol appears in the corresponding place in the manual to identify those instructions.** | | |
|  | **Electric shock, danger** |  | **Protective earth ground or protective ground terminal** |
|  | **Ground or the functional ground terminal (do not use as the protective ground terminal)** |  | **Alternating current** |
|  | **Direct current** |  | **Both direct and alternating current** |
|  | **On (power)** |  | **Off (power)** |
|  | **Power-on state** |  | **Power-off state** |

**French**

| | | | |
|---|---|---|---|
|  | **À manipuler délicatement. Toujours se reporter aux manuels d'utilisation et d'entretien. Ce symbole a été apposé aux endroits dangereux de l'instrument pour lesquels des consignes spéciales d'utilisation ou de manipulation ont été émises. Le même symbole apparaît à l'endroit correspondant du manuel pour identifier les consignes qui s'y rapportent.** | | |
|  | **Choc électrique, danger** |  | **Protection à la terre ou borne de protection à la terrel** |
|  | **Borne de terre ou borne de terre fonctionnelle (ne pas utiliser cette borne comme prise de terre)** |  | **Courant alternatif** |
|  | **Courant direct** |  | **Courant direct et alternatif** |
|  | **Marche (alimentation)** |  | **Arrêt (alimentation)** |
|  | **Marche** |  | **Arrêt** |

## Failure to comply with the precautions below could lead to injury or death or damage to the instrument.

**WARNING**

**Use the instrument only for its intended purpose**
This instrument is a power measurement instrument that can measure parameters such as voltage, current, and power. Do not use this instrument for anything other than as a power measurement instrument.

**Check the physical appearance**
Do not use the instrument if there is a problem with its physical appearance.

**Use the correct power supply**
First, ensure that the source voltage matches the rated supply voltage of the instrument and that it is less than or equal to the rated voltage of the power cord you will use. Then connect the power cord.

**Use the correct power cord and plug**
To prevent electric shock and fire, be sure use the power cord for this instrument. The main power plug must be plugged into an outlet with a protective earth terminal. Do not invalidate this protection by using an extension cord without protective earth grounding. Further, do not use the power cord with other instruments.

**Connect the protective ground terminal**
To prevent electric shock, make sure to connect the instrument to a protective ground (earth) before turning on the power. A three-prong power cord can be used with this instrument. Connect the power cord to a properly grounded three-prong outlet.

**Do not impair the protective grounding**
Never cut off the internal or external protective earth wire or disconnect the wiring of the protective ground terminal. Doing so may result in electric shock or damage to the instrument.

**Do not use when the protection functions are defective**
Before using this instrument, check that the protection functions, such as the protective grounding and fuse, are working properly. If you suspect a defect, do not use the instrument.

**Do not operate in an explosive atmosphere**
Do not operate the instrument in the presence of flammable gases or vapors. Doing so is extremely dangerous.

**Fuse**
To have the instrument's fuse replaced, contact your nearest YOKOGAWA dealer.

**Do not remove the covers or disassemble or alter the instrument**
Only qualified YOKOGAWA personnel may remove the covers and disassemble or alter the instrument.
The inside of the instrument is dangerous because parts of it have high voltages.

**Ground the instrument before making external connections**

Securely connect the protective grounding before connecting to the item under measurement or to an external control unit. Before touching a circuit, turn off its power and check that it has no voltage.

**Measurement category**

This instrument is a measurement category II product. Do not use it for measurement categories III and IV.

**Install or use the instrument in appropriate locations**

- Do not install or use the instrument outdoors or in locations subject to rain or water.
- Install the instrument so that you can immediately remove the power cord if an abnormal or dangerous condition occurs.

**Connect cables correctly**

This instrument can measure large voltages and currents directly. If you use a voltage transformer or a current transformer together with this power meter, you can measure even larger voltages or currents. When you are measuring a large voltage or current, the power capacity of the item under measurement becomes large. If you do not connect the cables correctly, an overvoltage or overcurrent may be generated in the circuit under measurement. This may lead to not only damage to the instrument and the item under measurement, but electric shock and fire as well. Be careful when you connect the lead wires, and be sure to check the following points.

Before you begin measuring (before you turn the item under measurement on), check that:

- Cables have been connected to the terminals of this instrument correctly.
  Check that there are no voltage measurement cables that have been connected to the current input terminals.
  Check that there are no current measurement cables that have been connected to the voltage input terminals.
  If you are measuring multiphase power, check that there are no mistakes in the phase wiring.
- Cables have been connected to the power supply and the item under measurement correctly.
  Check that there are no short circuits between terminals or between connected cables.
- The cables are connected firmly to the current input terminals.
- There are no problems with the current input terminals and the crimping terminals, such as the presence of foreign substances.

During measurement (never touch the terminals and the connected cables when the item under measurement is on), check that:

- There no problems with the input terminals and the crimping terminals, such as the presence of foreign substances.
- The input terminals are not abnormally hot.
- The cables are connected firmly to the input terminals.
  The terminal connections may become loose over time. If this happens, heat may be generated due to changes in contact resistance. If you are going to take measurements using the same setup for a long time, periodically check that the cables are firmly connected to the terminals. (Be sure to turn both the power meter and the item under measurement off before you check the connections.)

After measuring (immediately after you turn the item under measurement off):

After you measure a large voltage or current, power may remain for some time in the item under measurement even after you turn it off. This remaining power may lead to electric shock, so do not touch the input terminals immediately after you turn the item under measurement off. The amount of time that power remains in the item under measurement varies depending on the item.

**Accessories**

Use the accessories specified in this manual. Moreover, use the accessories of this product only with Yokogawa products that specify them as accessories.
Do not use faulty accessories.

## CAUTION

**Operating Environment Limitations**

This product is classified as Class A (for use in industrial environments). Operation of this product in a residential area may cause radio interference, in which case the user will be required to correct the interference.

**French**

## AVERTISSEMENT

**Utilisez cet instrument uniquement pour l'usage prévu.**

Cet instrument est un instrument de mesure de puissance pouvant mesurer des paramètres tels que la tension, le courant et la puissance. Ne pas utiliser cet instrument à des fins autres que la mesure de puissance.

**Inspecter l’apparence physique**

N'utilisez pas l'instrument s'il y a un problème avec son apparence physique.

**Utiliser l'alimentation électrique adéquate**

Tout d'abord, vérifiez que la tension de la source correspond à la tension d'alimentation nominale de l'appareil et qu'elle est inférieure ou égale à la tension nominale du cordon d'alimentation que vous utilisez. Puis raccordez le cordon d'alimentation.

**Utiliser le cordon d’alimentation et la fiche adaptés**

Pour éviter tout risque de choc électrique, utiliser exclusivement le cordon d’alimentation prévu pour cet instrument. La fiche doit être branchée sur une prise secteur raccordée à la terre. En cas d’utilisation d’une rallonge, celleci doit être impérativement reliée à la terre. Par ailleurs, ne pas utiliser ce cordon d’alimentation avec d’autres instruments.

**Brancher la prise de terre**

Avant de mettre l’instrument sous tension, penser à brancher la prise de terre pour éviter tout choc électrique. Le cordon d’alimentation que vous utilisez pour l’instrument est un cordon à trois broches. Brancher le cordon d’alimentation sur une prise de courant à trois plots et mise à la terre.

**Ne pas entraver la mise à la terre de protection**
Ne jamais neutraliser le fil de terre interne ou externe, ni débrancher la borne de mise à la terre. Cela pourrait entraîner un choc électrique ou endommager l'instrument.

**Ne pas utiliser lorsque les fonctions de protection sont défectueuses**
Avant d'utiliser l'instrument, vérifier que les fonctions de protection, telles que le raccordement à la terre et le fusible, fonctionnent correctement. En cas de dysfonctionnement possible, ne pas utiliser l'instrument.

**Ne pas utiliser dans un environnement explosif**
Ne pas utiliser l'instrument en présence de gaz ou de vapeurs inflammables. Cela pourrait être extrêmement dangereux.

**Fusibles**
Pour remplacer le fusible de l'instrument, contactez le concessionnaire YOKOGAWA le plus proche.

**Ne pas retirer le capot, ni démonter ou modifier l'instrument**
Seul le personnel YOKOGAWA qualifié est habilité à retirer le capot et à démonter ou modifier l'instrument.
Certains composants à l'intérieur de l'instrument sont à haute tension et par conséquent, représentent un danger.

**Relier l'instrument à la terre avant de le brancher sur des connexions externes**
Toujours relier l'instrument à la terre avant de le brancher aux appareils à mesurer ou à une commande externe. Avant de toucher un circuit, mettre l'instrument hors tension et vérifier l'absence de tension.

**Catégorie de mesure**
Cet instrument est un produit de mesure de catégorie II. Ne l'utilisez pas pour des mesures de catégories III et IV.

**Installer et utiliser l'instrument aux emplacements appropriés**
- Ne pas installer, ni utiliser l'instrument à l'extérieur ou dans des lieux exposés à la pluie ou à l'eau.
- Installer l'instrument de manière à pourvoir immédiatement le débrancher du secteur en cas de fonctionnement anormal ou dangereux.

**Brancher les câbles correctement**
L'instrument est capable de mesurer directement les tensions et les courants élevés. L'utilisation d'un transformateur de tension ou d'un transformateur de courant avec cet instrument permet de mesurer des tensions et des courants encore plus élevés. Lors de la mesure d'une tension ou d'un courant élevé, la capacité de l'appareil mesuré devient élevée. Si les câbles sont incorrectement branchés, une surtension ou une surintensité risque de se produire dans le circuit soumis à la mesure. Cela pourrait non seulement endommager l'instrument et l'appareil mesuré, mais aussi entraîner un choc électrique et un incendie. Toujours brancher les câbles correctement et vérifier les points suivants.

Avant de procéder à une mesure (avant de mettre l'appareil mesuré sous tension), vérifier que :

- Les câbles ont été correctement branchés sur les bornes de l'instrument.
  Les câbles de mesure de la tension n'ont pas été malencontreusement branchés sur les bornes d'entrée de courant.
  Les câbles de mesure du courant n'ont pas été malencontreusement branchés sur les bornes d'entrée de tension.
  Pour la mesure d'alimentation multiphase, vérifier que le câblage est correct.
- Les câbles ont été correctement branchés sur le secteur et sur l'appareil à mesurer.
  Vérifier qu'il n'y a pas de court-circuit entre les bornes ou les câbles.
- Les câbles sont correctement raccordés aux bornes d'entrée de courant.
- Il n'y a aucun problème avec les bornes d'entrée de courant et les bornes de sertissage, comme par exemple une présence de corps étrangers.

Pendant la mesure (ne jamais toucher les bornes et les câbles branchés lorsque l'appareil à mesurer est sous tension), vérifier que :

- Il n'y a aucun problème avec les bornes d'entrée et les bornes de sertissage, comme par exemple une présence de corps étrangers.
- Les bornes d'entrée ne chauffent pas anormalement.
- Les câbles sont correctement connectés aux bornes d'entrée.
  Les connexions des bornes peuvent se desserrer au fil du temps. Le cas échéant, une génération de chaleur peut se produire en raison de modifications au niveau de la résistance de contact. Si des mesures doivent être réalisées en utilisant la même configuration pendant une durée prolongée, vérifier périodiquement que les câbles sont correctement connectés aux bornes. (Veiller à mettre hors tension le mesureur de puissance et le dispositif mesuré est réalisée avant de vérifier les raccordements.)

Après la mesure (tout de suite après avoir mis l'appareil mesuré hors tension) :
Si vous avez mesuré une tension ou un courant élevé, une puissance résiduelle peut rester un certain temps dans l'appareil mesuré, même après sa mise hors tension. La puissance résiduelle peut entraîner un choc électrique, par conséquent, après avoir mis l'appareil hors tension, il convient d'attendre avant de toucher les bornes d'entrée. La durée pendant laquelle la puissance résiduelle reste dans l'appareil mesuré varie selon les appareils.

**Accessoires**

Utiliser les accessoires spécifiés dans ce manuel. En outre, utiliser les accessoires de ce produit uniquement avec des produits Yokogawa pour lesquels ils sont spécifiés comme accessoires.
Ne pas utiliser d'accessoires défectueux.

## ATTENTION

**Limitations relatives à l'environnement opérationnel**

Ce produit est un produit de classe A (pour environnements industriels). L'utilisation de ce produit dans un zone résidentielle peut entraîner une interférence radio que l'utilisateur sera tenu de rectifier.

# Regulations and Sales in Various Countries and Regions

## Waste Electrical and Electronic Equipment (WEEE)

(EU WEEE Directive valid only in the EEA* and UK WEEE Regulation in the UK)
This product complies with the WEEE marking requirement. This marking indicates that you must not discard this electrical/electronic product in domestic household waste. When disposing of products in the EEA or UK, contact your local Yokogawa office in the EEA or UK respectively.
* EEA: European Economic Area

## Batteries and waste batteries

(EU Battery Directive/Regulation valid only in the EEA and UK Battery Regulation in the UK)
Batteries are included in this product. This marking indicates they shall be sorted out and collected as ordained in the EU battery Directive/Regulation and UK battery Regulation.

Battery type: Lithium battery
When you need to replace batteries, contact your local Yokogawa office in the EEA or UK respectively.

## Authorized representative in the EEA

Yokogawa Europe B.V. is the authorized representative of Yokogawa Test & Measurement Corporation for this product in the EEA. To contact Yokogawa Europe B.V., see the separate list of worldwide contacts, PIM 113-01Z2.

## 關於在台灣銷售

This section is valid only in Taiwan.
關於在台灣所販賣的符合其相關規定的電源線 A1100WD 的限用物質含量信息，請至下麵的網址進行查詢

https://tmi.yokogawa.com/support/service-warranty-quality/product-compliance/

## Disposal

When disposing of YOKOGAWA products, follow the laws and ordinances of the country or region where the products will be disposed of.

# Workflow

The following figure is provided to familiarize the first-time user with the workflow of this instrument's operation. For a description of an item, see the relevant section or chapter. In addition to the sections and chapters that are referenced in the following figure, this manual also contains safety precautions for handling and wiring the instrument. Be sure to observe the precautions.

## Installation and circuit wiring

| | Getting Started Guide (this guide) |
|---|---|
| Install the instrument. | ⇢ Section 2.2 |
| Connect the power supply, and turn the power on. | ⇢ Sections 2.3 and 2.4 |
| Select the measurement method. | ⇢ Section 2.8 |
| Wire the circuit under measurement. | ⇢ Sections 2.9 to 2.11 |

Read the precautions in sections 2.5 and 2.7 thoroughly before connecting the wires. Also, if necessary, assemble the input terminal adapter that connects to the voltage input terminal (see section 2.6) before connecting the wires.

## Common operations

| | User's Manual* |
|---|---|
| Perform key operations. | ⇢ Sections 1.1 to 1.4 |
| Synchronize the clock. | ⇢ Section 1.5 |
| Initialize settings. | ⇢ Section 1.6 |
| Display help. | ⇢ Section 1.7 |

## Set the measurement conditions

| | User's Manual* |
|---|---|
| Basic measurement conditions | ⇢ Chapter 2 |
| Harmonic measurement conditions (option) | ⇢ Chapter 3 |
| Motor evaluation conditions (option) | ⇢ Chapter 4 |
| Auxiliary input conditions (option) | ⇢ Chapter 5 |

## Display measured/calculated results

| | User's Manual* |
|---|---|
| Power measurements and calculations | ⇢ Chapters 7 and 8 |
| Integrated power (watt hours) | ⇢ Chapter 9 |
| Voltage/current waveforms | ⇢ Chapter 10 |
| Trend | ⇢ Chapter 11 |
| Harmonic measurements (option), bar graphs, vectors | ⇢ Chapters 12 and 13 |
| Cursor measurement | ⇢ Chapter 15 |

## Acquire data

| | User's Manual* |
|---|---|
| Store data to the internal RAM disk. | ⇢ Chapter 17 |
| Save data to internal memory or a USB memory device. | ⇢ Chapters 17 and 18 |
| D/A output (option) | ⇢ Section 21.4 |
| Transmit data through the USB, GP-IB, or Ethernet interface. | ⇢ Chapter 20 and the communication interface user's manual |

* IM WT1801R-02EN

# Contents

# 1.1 Front Panel, Rear Panel, and Top Panel

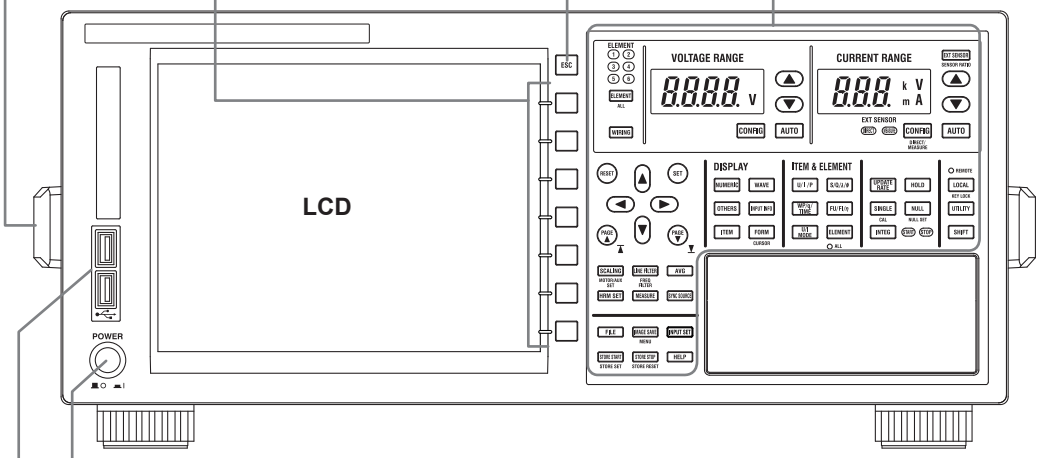
## Front panel

**Soft keys**
Use to select items on the setup menus that appear during configuration.

**ESC key**
Use to clear setup menus and pop-up menus.

**Handle**

**Setup and execution keys**
Explanation → sec. 1.2




**Power switch**

**USB ports for peripherals**
Use to connect a USB keyboard, mouse, or memory device.
Usage explanation → user's manual IM WT1801R-02EN

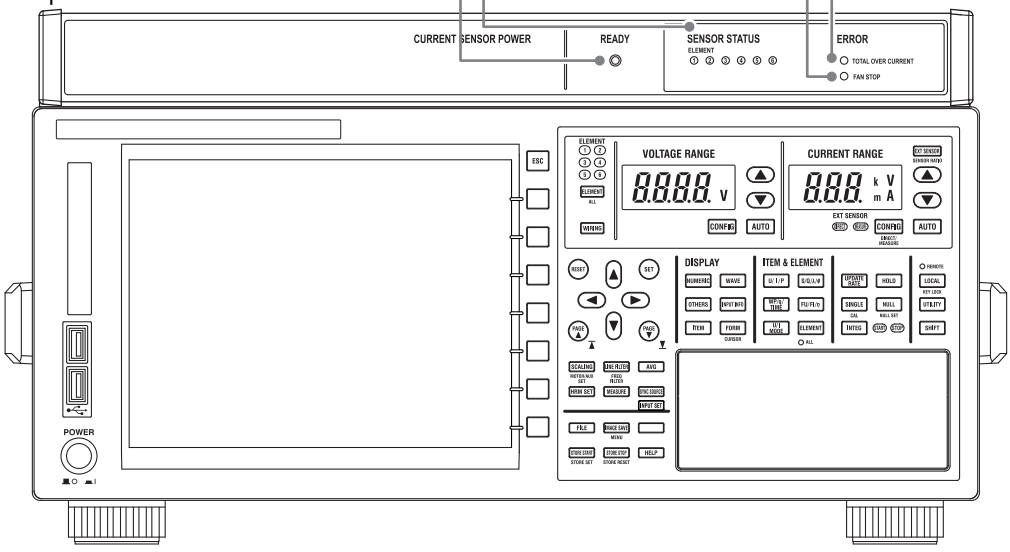
### Models with the current sensor power (/PD2) option

**Sensor status indicator**
Displays the CT connection status and the detection of overcurrent of each channel
Explanation → sec. 2.11

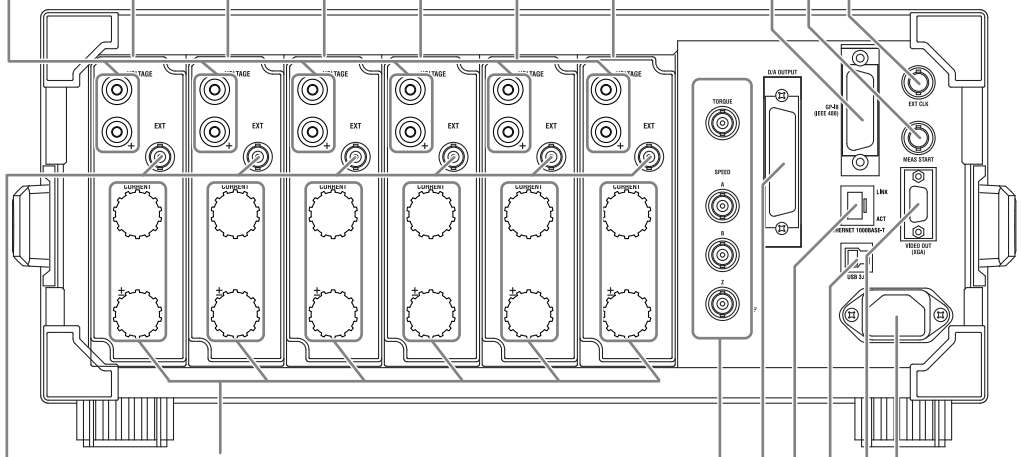
**Fan stop indicator**
Displays the detection of fan stoppage
Explanation → sec. 2.11

**Total overcurrent detection indicator**
Displays the detection of overcurrent in the total current of each channel
Explanation → sec. 2.11

**READY indicator**
Displays the status of the current sensor power supply.
Explanation → sec. 2.11



# Rear panel



**GP-IB connector (-C01)***
Use to communicate with the instrument through the GP-IB interface.
Explanation of the communication feature → communication interface user's manual

**External start signal I/O connector** ⚠
- Use to perform master and slave synchronized measurement. → sec. 3.4
- Receives external sync signals for high speed data capturing. → sec. 3.4

**Voltage input terminals** ⚠
For connecting voltage measurement cables → sec. 2.8 to 2.11

**External clock input connector** ⚠
- Receives the sync source (signal), which determines the measurement period. → sec. 3.3
- Receives the external PLL source (signal) for harmonic measurement. → sec. 3.3

**Input element 1**
**Input element 2**
**Input element 3**
**Input element 4**
**Input element 5**
**Input element 6**

**Current input terminals** ⚠
For connecting current measurement cables → sec. 2.8, 2.9, and 2.11

**Power connector** ⚠
Power connection → sec. 2.3

**External current sensor input terminal** ⚠
For connecting a cable from an external current sensor → sec. 2.10

**RGB (XGA) output connector (option)** ⚠
Transmits image signals. → sec. 3.5

**Models with the motor evaluation function option**

**Torque signal input connector (option)** ⚠
Receives signals from a torque meter during motor evaluation. → sec. 3.1

**Revolution signal input connectors (option)** ⚠
Receive signals from a revolution sensor during motor evaluation. → sec. 3.1

**USB port for PCs**
Use to connect to a PC with a USB port.
Usage explanation → communication interface user's manual

**Ethernet port**
Use to connect to a LAN.
Usage explanation → Features guide and communication interface user's manual

**Model with the auxiliary input option**

**Auxiliary input connectors (option)** ⚠
Receive signals from sensors. → sec. 3.2

**D/A output and remote control connector (option)** ⚠

**D/A output**
Transmits DC voltage (an analog signal) that corresponds to the numeric data. → sec. 3.6

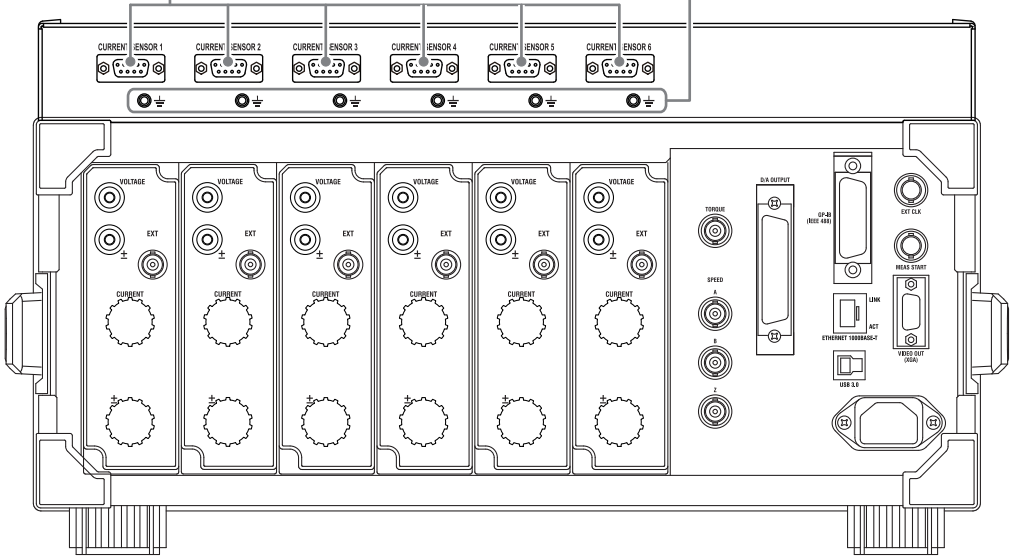
**Remote control**
Receives control signals for holding values; performing single measurements; and starting, stopping, and resetting integration → sec. 3.6

*** Models with the GP-IB interface**

### Models with the current sensor power (/PD2) option

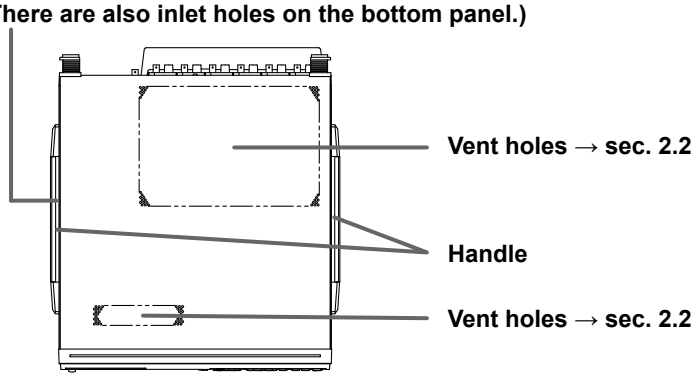
**Sensor power supply terminal** ⚠
Explanation → sec. 2.11

**Shunt resistor box functional ground terminal**
Connect the shunt resistor box ground terminal. → sec. 2.11



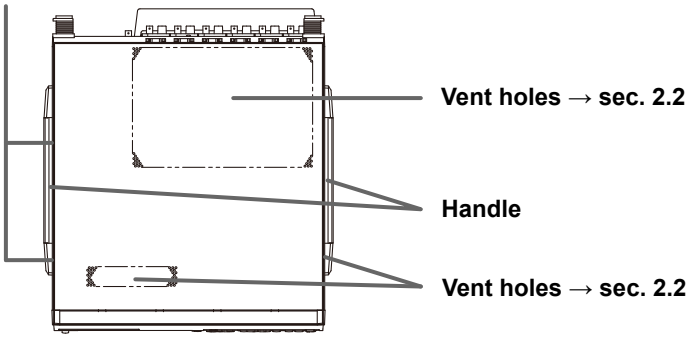
## Top panel

**Inlet holes → sec. 2.2**
**(There are also inlet holes on the bottom panel.)**




### Models with the current sensor power (/PD2) option

**Inlet holes → sec. 2.2**
**(There are also inlet holes on the bottom panel.)**



# 1.2 Keys

## Measurement conditions

### WIRING key

Press this key to display the menu for selecting the wiring system, setting the efficiency formula, selecting the independent input element configuration, setting the delta calculation, and configuring all elements.

### ELEMENT key

- Press this key to select the input element that you want to select the measurement range for. The selected input element changes each time that you press ELEMENT.
- When you select the wiring system, input elements that are assigned to the same wiring unit are selected at the same time.

### SHIFT+ELEMENT (ALL) key combination

Press this key combination to collectively set the voltage range, current range, or external current sensor range (option) of all the input elements that satisfy the following conditions.

- The input elements are the same type (5 A or 50 A input elements).
- The valid measurement range settings are the same.

Press ELEMENT again to configure settings for individual elements.

### ▲ and ▼ keys

Use these keys to select the voltage range, current range, or external current sensor range (option). The ranges selected with these keys are valid when the AUTO key described below is not lit (when the fixed range feature is being used).

### AUTO key

Press AUTO to activate the auto range feature. When this feature is active, the AUTO key lights. The auto range feature automatically sets the voltage, current, and external current sensor ranges depending on the amplitude of the received electrical signal. Press AUTO again to activate the fixed range feature. The AUTO key turns off.

### EXT SENSOR key

When you press EXT SENSOR the EXT SENSOR key lights. In this state, you can press the current range's ▲ and ▼ keys to select the external current sensor range that is used when this instrument measures the output from the current sensor. When you press EXT SENSOR again, the EXT SENSOR key turns off. You will be able to select the current range for direct input.

### SHIFT+EXT SENSOR (SENSOR RATIO) key combination

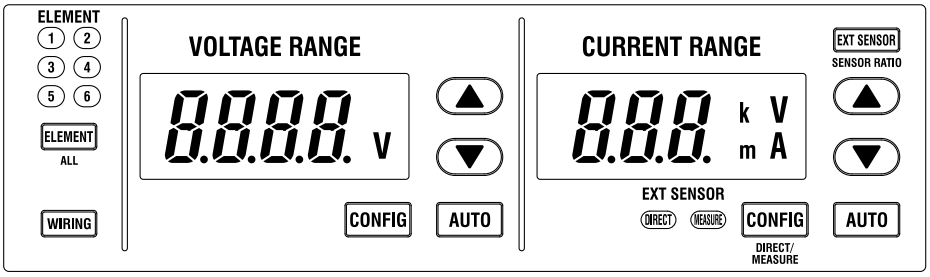
Press this key combination to display a menu for setting the external current sensor conversion ratio for each input element. These conversion ratios are used to convert current sensor output to current.

### CONFIG key

Press this key to display a menu for setting the valid measurement ranges for the voltage range, current range, or external current sensor range (option). You can also set the measurement range to switch to when a peak over-range occurs.

## SHIFT+CONFIG (DIRECT/MEASURE) key combination

Press this key combination to display a menu for setting the display format of the external current sensor range.




## SCALING key

Press this key to display the menu for turning the scaling feature on and off, setting the VT ratio, setting the CT ratio, setting the power coefficient, and configuring all elements.

## LINE FILTER key

Press this key to display a menu for setting the filters to apply to the circuit under measurement for each input element.

## SHIFT+LINE FILTER (FREQ FILTER) key combination

Press this key combination to display a menu for setting the filters to apply to the circuit under frequency measurement for each input element.

## AVG key

Press this key to display a menu for configuring the measured value averaging feature.

## SYNC SOURCE key

Press this key to display a menu for setting the sync source for each wiring unit. The sync source defines the period (measurement period) over which sampled data, which is used to produce numeric data (measured values such as voltage, current, and power), is acquired.


## UPDATE RATE key

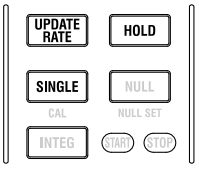
Press this key to display a menu for selecting the period (data update interval) at which sampled data, which is used to produce numeric data (measured values such as voltage, current, and power), is acquired.

## HOLD key

When you press HOLD, the HOLD key lights. Data measurement and display operations per data update interval stop, and the numeric data display is held. When you press HOLD again, the HOLD key turns off. Updating of the numeric data display resumes.

## SINGLE key

While the numeric data is held, press SINGLE to measure data only once at the set data update interval and then hold the numeric data.



# Harmonic measurement (option), motor evaluation (option), and auxiliary input (option)

## HRM SET key

- Press this key on models with the harmonic measurement option to display a menu for setting the PLL source, the measured harmonic orders, and the distortion factor formula.
- Press this key on models with the simultaneous dual harmonic measurement option to display a menu for configuring the input element groups and setting the PLL source, the measured harmonic orders, and the distortion factor formula for each group.

## SHIFT+SCALING (MOTOR/AUX SET) key combination

- Press this key combination on models with the motor evaluation function (option) to display a menu for configuring the motor evaluation function.
- Press this key combination on models with the auxiliary input option to display a menu for configuring the auxiliary input feature.


# Displaying the measured results

## NUMERIC key

Press this key to display numeric data.

- When numeric data is displayed, you can press ITEM, which is described later in this section, to display a menu for changing the displayed items.
- When numeric data is displayed, you can press FORM, which is described later in this section, to display a menu for changing the display format.

## WAVE key

Press this key to display waveforms.

- When waveforms are displayed, you can press ITEM, which is described later in this section, to display a menu for selecting and zooming in on the displayed waveforms.
- When waveforms are displayed, you can press FORM, which is described later in this section, to display a menu for configuring settings such as the time axis of the displayed waveforms, the triggers for displaying waveforms on the screen, the number of divisions of the waveform screen, and the mapping of waveforms to parts of the divided screen.

## OTHERS key

Press this key to display a menu for selecting the trend, bar graph,* vector,* and split displays and high speed data capturing.

* Models with the harmonic measurement option or simultaneous dual harmonic measurement option

## INPUT INFO key

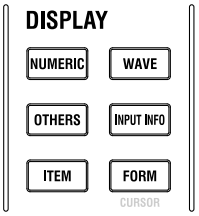
Press this key to display the list of conditions for measuring voltage or current signals, such as the wiring system, wiring unit, measurement range, input filter, scaling, and sync source, for each input element. A list of the measurement range and valid measurement range settings are also displayed.

## ITEM key

Press this key to display a menu for setting the displayed items in the display that has been selected using NUMERIC, WAVE, or OTHERS.

## FORM key

Press this key to display a menu for selecting the display format for the display that has been selected using NUMERIC, WAVE, or OTHERS.




## U/I/P key, S/Q/λ/Φ key, WP/q/TIME key, and FU/FI/η key

Each time you press U/I/P, the measurement function of the selected display item switches between measurement functions in the following order: U, I, P, the measurement function that was selected before you pressed U/I/P, and then back to U. The numeric data for the selected measurement function is displayed.

- The above behavior takes place when numeric data is being displayed but a menu is not being displayed.
- Only the measurement function changes.
- When you press S/Q/λ/Φ, WP/q/TIME, or FU/FI/η, the measurement function changes in the same manner as was explained above for the U/I/P key.

## U/I MODE key

Each time you press U/I MODE, the measurement function U or I of the selected display item switches between modes in the following order: rms, mean, dc, rmean, ac, and then back to rms. The numeric data for the selected measurement function is displayed. The above behavior takes place when numeric data is being displayed but a menu is not being displayed.

## ELEMENT key

On the instrument that has six input elements installed, each time you press ELEMENT, the input element or wiring unit of the selected display item switches between input elements and wiring units in the following order: 1, 2, 3, 4, 5, 6, ΣA, ΣB, ΣC, and then back to 1. The numeric data for the selected input element or wiring unit is displayed.

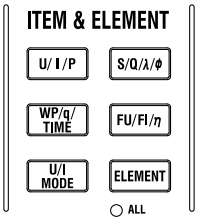
- The above behavior takes place when numeric data is being displayed but a menu is not being displayed.
- Only the input element or wiring unit changes.
- The displayed input elements and wiring units vary depending on the number of input elements that are installed in this instrument and the selected wiring system.

## SHIFT+ELEMENT (ALL) key combination

On the instrument that has six input elements installed, pressing SHIFT+ELEMENT (ALL) causes the ALL indicator to light. In this state, each time you press ELEMENT, the input elements or wiring units of the displayed page switch between input elements and wiring units in the following order: 1, 2, 3, 4, 5, 6, ΣA, ΣB, ΣC, and then back to 1. The numeric data for the selected input element or wiring unit is displayed. Pressing SHIFT+ELEMENT (ALL) again causes the ALL indicator to turn off and disables the feature for changing all the input elements or wiring units on the page.

- The above behavior takes place when numeric data is being displayed but a menu is not being displayed.
- Only the input element or wiring unit changes.

- The displayed input elements and wiring units vary depending on the number of input elements that are installed in this instrument and the selected wiring system.




# Computation

## MEASURE key

Press this key to display a menu for configuring settings for user-defined functions, MAX hold, user-defined events, apparent and reactive power formulas, corrected power formulas, for selecting the phase difference display format and the sampling frequency, and for configuring settings for master and slave synchronized measurement.

## SHIFT+MEASURE key

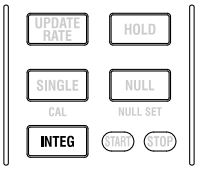
This instrument can measure the frequencies of the voltages or currents of all elements, so the FREQ MEASURE menu will not be displayed even if you press SHIFT+MEASURE.*

* A feature available on the WT1800


# Integrated power (watt hours)

## INTEG key

Press this key to display a menu for turning independent integration on and off; starting, stopping, and resetting integration; and setting the integration mode, the integration timer, the scheduled integration, the integration auto calibration, the watt-hour integration methods for each polarity, the current mode for current integration, and the rated time of integrated D/A output (option).

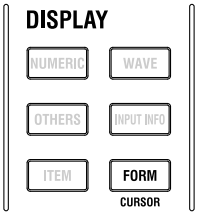



# Cursor measurement

## SHIFT+FORM (CURSOR) key combination

Press this key combination when you are displaying waveforms, trends, or bar graphs* to display a menu for measuring values such as waveform and graph values using cursors.

* Models with the harmonic measurement option or simultaneous dual harmonic measurement option



## Storing data and saving and loading data

### STORE START key

Press this key to start the storage operation.

### STORE STOP key

Press this key to stop the storage operation.

### SHIFT+STORE STOP (STORE RESET) key combination

Press this key combination to reset the storage operation.

### SHIFT+STORE START (STORE SET) key operation

Press this key combination to display a menu for setting storage control, stored items, and save conditions.

### FILE key

Press this key to display a menu for performing operations such as saving and loading setup data, saving measured data, deleting and copying folders (directories) and files, renaming folders and files, and making folders.

### IMAGE SAVE key

Press this key to save the screen image data.

### SHIFT+IMAGE SAVE (MENU) key combination

Press this key combination to display a menu for setting screen image data save options such as the file name, data format, color mode, and comments.


## Other features

### SHIFT+SINGLE (CAL) key combination

Press this key combination to execute zero-level compensation. When zero level compensation is executed, the instrument creates a zero input condition in its internal circuitry and sets the zero level to the level at that point.

### NULL key

Press NULL to enable the NULL feature. The NULL indicator lights. Press NULL again to disable the NULL feature. The NULL indicator turns off.

### SHIFT+NULL (NULL SET) key combination

Press this key combination to display a menu for setting the NULL feature.

### UTILITY key

Press this key to display a menu for displaying system information (input element information, installed options, and firmware version); initializing settings; configuring communication settings, system settings, network settings, D/A output settings; and performing self-tests.

### LOCAL key

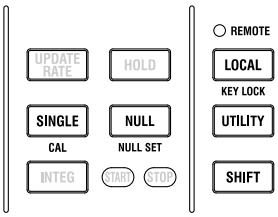
Press this key to switch this instrument from remote mode (in which the REMOTE indicator is lit) to local mode (in which front panel key operations are valid). This key is disabled when the instrument is in local lockout mode.

## SHIFT+LOCAL (KEY LOCK) key combination

Press this key combination to lock the keys on the front panel. The LOCAL (KEY LOCK) key lights. Press this key combination again to unlock the keys.

## SHIFT key

Pressing this key once causes the key to light and enables access to the features that are written in purple below each key. Pressing the key again disables the shifted state.




## RESET key

Press this key to reset an entered value to its default value.

## SET key

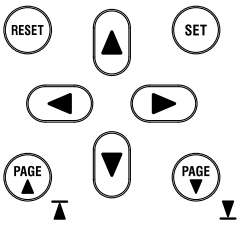
Press this key to display menus that you select using the cursor keys and to confirm items and values in the selected window. When the menu is turned off on the numeric data display, press this key to open a menu for changing displayed items.

## Cursor keys (▲▼◄►)

Press the ◄ and ► keys to move the cursor between digits when entering a number. Press the ▲ and ▼ keys to increase and decrease the number you are entering. Press these keys also to select settings.

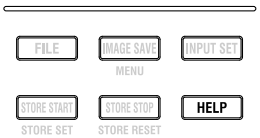
## PAGE▼ and PAGE▲ keys

When measured items span over multiple pages on the numeric data display, press these keys to switch between pages. Press SHIFT+PAGE▲ to move to the first page and SHIFT+PAGE▼ to move to the last page.



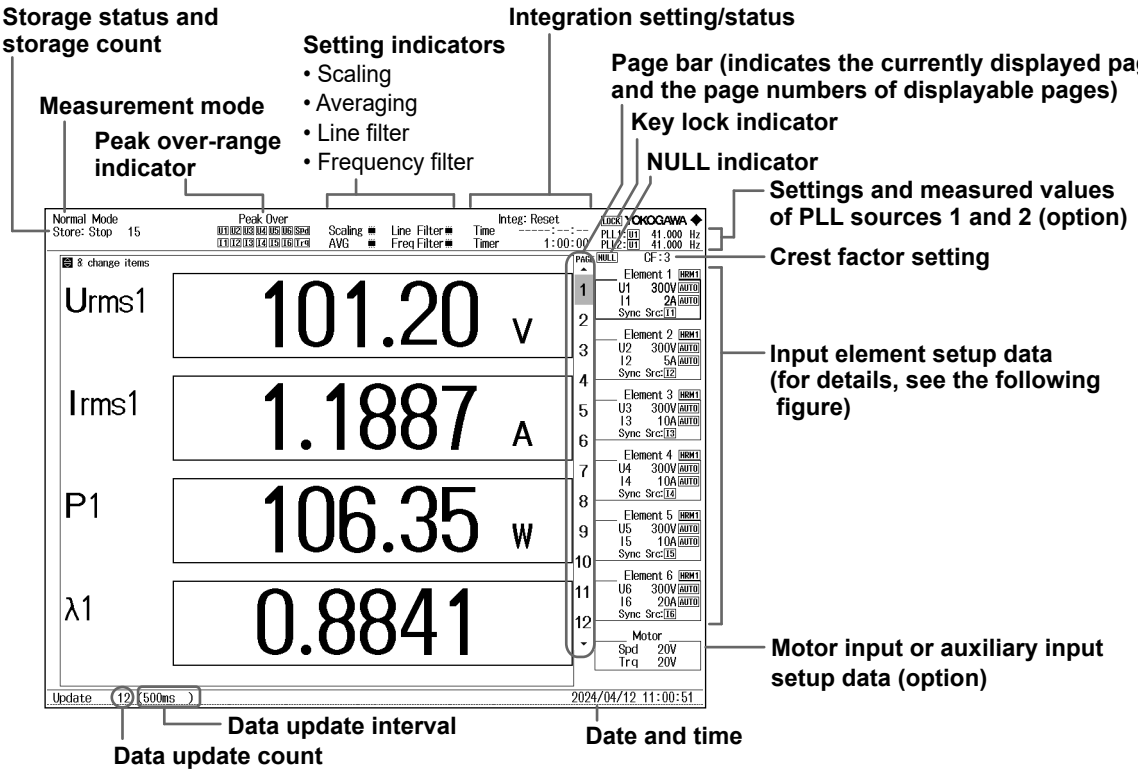

## HELP key

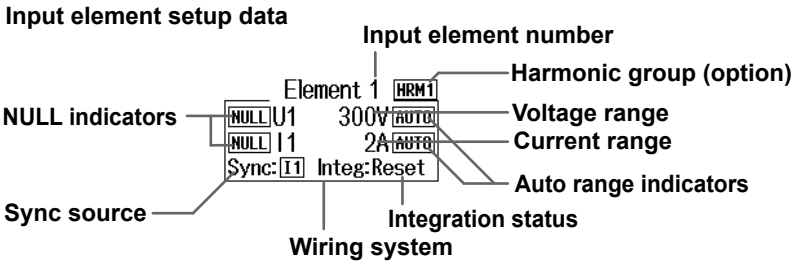
Press this key to display and hide the help window, which explains various features.



# 1.3 Display Screen

## Example of power measurement (numeric) display




(Input elements of the same wiring unit are indicated with a border.)

### Indicators

**--OL--** **Overload indicator**
Displayed if the measured value exceeds 140 % of the measurement range for crest factor CF3 or CF6. Displayed if the measured value exceeds 280 % of the measurement range for crest factor CF6A.

**--OF--** **Overflow indicator**
Displayed if the measured or calculated result cannot be displayed using the specified decimal place or unit.

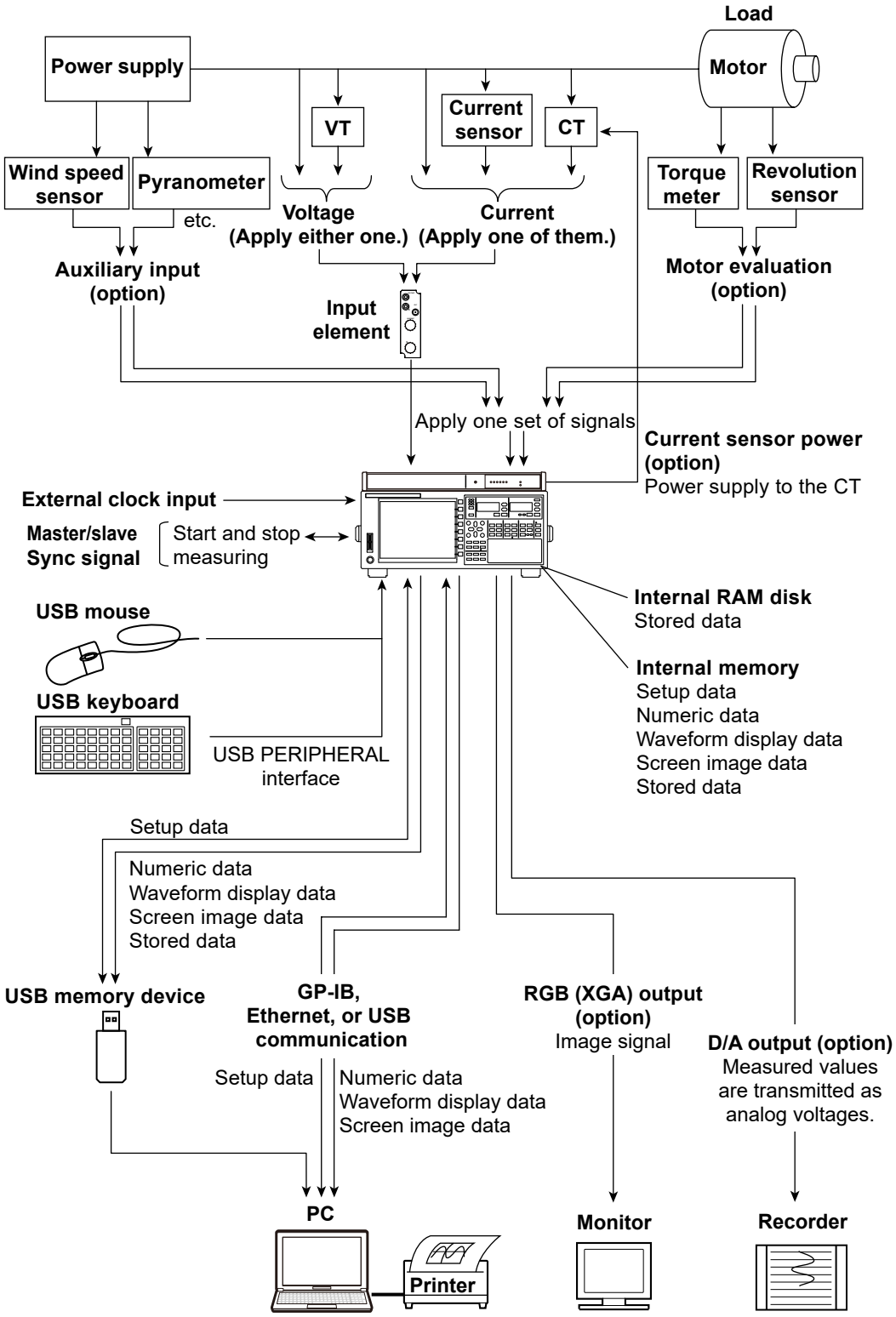
**-------** **No-data indicator**
Displayed if a measurement function is not selected or if there is no numeric data.

**Error** **Error indicator**
Displayed in cases such as when a measured value is outside of its determined range.

***Note***

The LCD of this instrument may have a few defective pixels. For details, see section 5.2, “Display.”

# 1.4 System Configuration



# 2.1 Handling Precautions



## Safety precautions

If you are using this instrument for the first time, make sure to read “Safety Precautions” on pages x to page xv.

### Do not remove the case

Do not remove the case from the instrument. Some parts of the instrument use high voltages and are extremely dangerous. For internal inspection and adjustment, contact your nearest YOKOGAWA dealer.

### Unplug if abnormal behavior occurs

If you notice smoke or unusual odors coming from the instrument, immediately turn off the power and unplug the power cord. Also, turn off the power to any circuits under measurement that are connected to the input terminals. Then, contact your nearest YOKOGAWA dealer.

### Do not damage the power cord

Nothing should be placed on top of the power cord. The power cord should also be kept away from any heat sources. When removing the plug from the power outlet, do not pull on the cord. Pull from the plug. If the power cord is damaged or if you are using the instrument in a location where the power supply specifications are different, purchase a power cord that matches the specifications of the region that the instrument will be used in.

## Operating environment and conditions

This instrument complies with the EMC standard under specific operating environment and operating conditions. If the installation, wiring, and so on are not appropriate, the compliance conditions of the EMC standard may not be met. In such cases, the user will be required to take appropriate measures.

## General handling precautions

### Do not place objects on top of the instrument

Never stack the instrument or place other instruments or any objects containing water on top of it. Doing so may cause a malfunction.

### Keep electrically charged objects away from the instrument

Keep electrically charged objects away from the input terminals. They may damage the internal circuitry.

### Do not damage the LCD

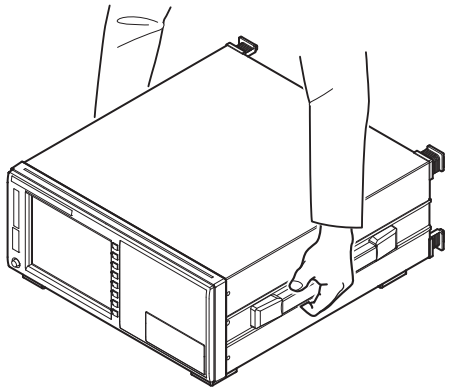
Because the LCD is very vulnerable and can be easily scratched, do not allow any sharp objects near it. Also it should not be exposed to vibrations and shocks.

## Unplug during extended non-use

Turn off the power to the circuit under measurement and the instrument and remove the power cord from the outlet.

## When carrying the instrument

First, turn off the circuit under measurement and remove the measurement cables. Then, turn off the instrument and remove the power cord and any attached cables.
We recommend that two persons carry this instrument. If one person is to carry this instrument, use both hands to firmly hold the handles as indicated in the following figure.
In addition, if storage device is inserted in the instrument, be sure to remove the storage device before you move the instrument.



**WARNING**

- When you hold or put away the handle, be careful not to get your hand caught between the handle and the case.
- When you carry the instrument, be careful not to get your hand caught between the wall, installation surface, or other objects and the instrument.

**French**

**AVERTISSEMENT**

- Lorsque vous attrapez ou rabattez la poignée, veillez à ne pas vous coincer la main entre la poignée et l'instrument.
- Lorsque vous déplacez l'instrument, veillez à ne pas vous coincer la main entre l'instrument et le mur, la surface d'installation ou tout autre objet.

## When cleaning the instrument

When cleaning the case or the operation panel, turn off the circuit under measurement and the instrument and remove the instrument's power cord from the outlet. Then, wipe the instrument lightly with a clean dry cloth. Do not use chemicals such as benzene or thinner. These can cause discoloring and deformation.

# 2.2 Installing the Instrument



**WARNING**

- Do not install or use the instrument outdoors or in locations subject to rain or water.
- Install the instrument so that you can immediately remove the power cord if an abnormal or dangerous condition occurs.

**CAUTION**

If you block the inlet or vent holes on the instrument, it will become hot and may break down.

**French**

**AVERTISSEMENT**

- Ne pas installer, ni utiliser l'instrument à l'extérieur ou dans des lieux exposés à la pluie ou à l'eau.
- Installer l'instrument de manière à pourvoir immédiatement le débrancher du secteur en cas de fonctionnement anormal ou dangereux.

**ATTENTION**

Ne pas boucher les orifices d'entrée ou de sortie de l'instrument pour éviter toute surchauffe et panne éventuelle.

## Installation conditions

Install the instrument in an indoors environment that meets the following conditions.

### Flat, even surface

Install the instrument on a stable surface that is level in all directions. If you use the instrument on an unstable or tilted surface, the accuracy of its measurements may be impeded.

### Well-ventilated location

Inlet and vent holes are located on the top and bottom of the instrument. To prevent internal overheating, allow at least 20 mm of space around the inlet and vent holes.

When connecting measurement wires and other various cables, allow extra space for operation.

### Ambient temperature and humidity

Ambient temperature: 5 to 40 °C

Ambient humidity: 20 to 80 % RH (no condensation)

### Do not install the instrument in the following places

- Outdoors
- In direct sunlight or near heat sources
- Where the instrument is exposed to water or other liquids
- Where an excessive amount of soot, steam, dust, or corrosive gas is present
- Near strong electromagnetic field sources
- Near high voltage equipment or power lines
- Where the level of mechanical vibration is high
- On an unstable surface

***Note***

- For the most accurate measurements, use the instrument in the following kind of environment.
  Ambient temperature: 23 °C ± 5 °C; ambient humidity: 30 % RH to 75 % RH (no condensation)
  When using the instrument in a place where the ambient temperature is 5 °C to 18 °C or 28 °C to 40 °C, add the temperature coefficient to the accuracy as specified in chapter 5.
- When installing the instrument in a place where the ambient humidity is 30 % or less, take measures to prevent static electricity such as using an anti-static mat.
- Condensation may occur if the instrument is moved to another place where the ambient temperature or humidity is higher, or if the temperature changes rapidly. In such cases, allow the instrument to acclimate to the ambient temperature for at least one hour before using it under non-condensing conditions.

## Storage location

- Ambient temperature: –25 °C to 60 °C (no condensation)
- Ambient humidity: 20 % RH to 80 % RH (no condensation)

Do not store the instrument:

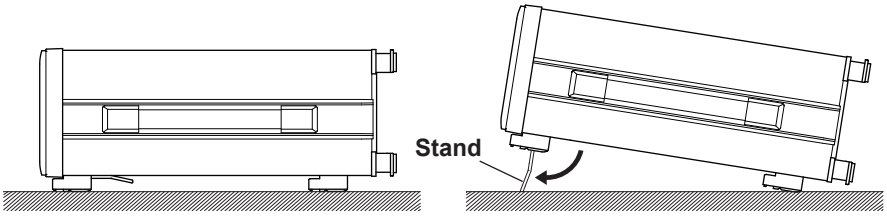
- Where the level of mechanical vibration is high
- In direct sunlight
- Where there are corrosive or explosive gases
- Where an excessive amount of soot, dust, salt, or iron is present
- Near a strong source of heat or moisture
- Where water, oil, or chemicals may splash onto the instrument

We recommend that the instrument be stored in an environment where the temperature is between 5 °C and 40 °C.

# Installation orientation

## Desktop

Place the instrument on a flat, level surface as shown in the following figure.




## Rubber stoppers

If the instrument is installed so that it is flat as shown in the above figure, rubber stoppers can be attached to the feet to prevent the instrument from sliding. Two sets of rubber stoppers (four stoppers) are included in the package.

**WARNING**

- When you put away the stand, be careful not to get your hand caught between the stand and the instrument.
- Handling the stand without firmly supporting the instrument can be dangerous. Please take the following precautions.
  - Only handle the stand when the instrument is on a stable surface.
  - Do not handle the stand when the instrument is tilted.
- Do not place the instrument in any position other than those shown in the above figures.

**CAUTION**

Do not apply excessive force or shock to the stand. Doing so may break the stand support.

**French**

**AVERTISSEMENT**

- Lorsque vous rabattez le support, veillez à ne pas vous coincer la main entre le support et l’instrument.
- Lorsque vous manipulez le support, soutenez toujours l’instrument fermement. Prenez les précautions suivantes.
  - Ne manipulez le support que lorsque l’instrument est placé sur une surface stable.
  - Ne manipulez pas le support lorsque l’instrument est incliné.
- Ne pas placer l’instrument dans des positions autres celles indiquées ci-dessus.

**ATTENTION**

Évitez d'appliquer une force excessive ou des chocs sur le support. Le système de soutien du support peut se casser.

## Rack mounting

To mount the instrument on a rack, use a rack mount kit (sold separately).

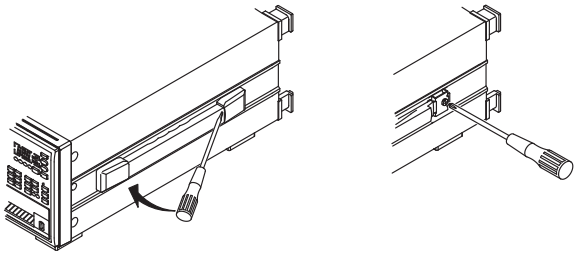
| Name | Model | Notes |
|---|---|---|
| Rack mount kit | 751535-E4 | For EIA |
| Rack mount kit | 751535-J4 | For JIS |

On models with the /PD2 option, use the following rack mount kit.

| Name | Model | Notes |
|---|---|---|
| Rack mount kit | 751535-E5 | For EIA |
| Rack mount kit | 751535-J5 | For JIS |

A summary of the procedure for mounting the instrument on a rack is given below. For detailed instructions, see the manual that is included with the rack mount kit.

***1.*** Remove the handles from both sides of the instrument.



***2.*** Remove the four feet from the bottom of the instrument.

***3.*** Remove the two plastic rivets and the four seals covering the rack mount attachment holes on each side of the instrument near the front.

***4.*** Place seals over the feet and handle attachment holes.

***5.*** Attach the rack mount kit to the instrument.

***6.*** Mount the instrument on a rack.

***Note***

- When rack-mounting the instrument, allow at least 20 mm of space around the inlet and vent holes to prevent internal heating.
- Make sure to provide adequate support from the bottom. The support should not block the inlet and vent holes.

# 2.3 Connecting the Power Supply

## Before connecting the power supply

To prevent electric shock and damage to the instrument, follow the warnings below.

**WARNING**

- Make sure that the power supply voltage matches the instrument's rated supply voltage and that it does not exceed the maximum voltage range of the power cord to use.
- Connect the power cord after checking that the power switch of the instrument is turned OFF.
- To prevent electric shock and fire, be sure to use the power cord for this instrument.
- To prevent electric shock, make sure to connect the instrument to a protective ground (earth). Connect the power cord to a three-prong power outlet with a protective ground terminal.
- Do not use an ungrounded extension cord. If you do, the instrument will not be grounded.
- If there is no AC outlet that is compatible with the power cord that you will be using and you cannot ground the instrument, do not use the instrument.

**French**

**AVERTISSEMENT**

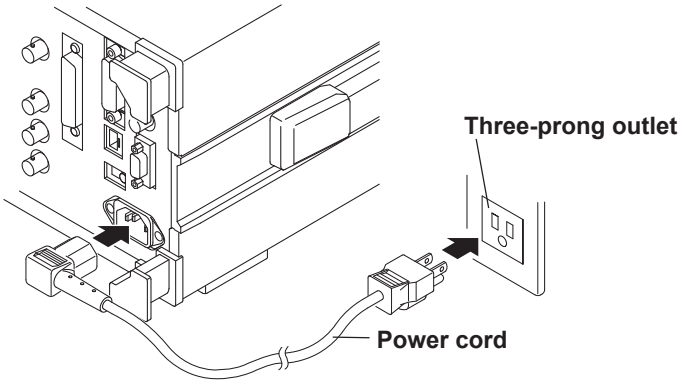
- Assurez-vous que la tension d'alimentation correspond à la tension d'alimentation nominale de l'appareil et qu'elle ne dépasse pas la plage de tension maximale du cordon d'alimentation à utiliser.
- Brancher le cordon d'alimentation après avoir vérifié que l'interrupteur d'alimentation de l'instrument est sur off.
- Pour éviter tout risque de choc électrique, utiliser exclusivement le cordon d'alimentation prévu pour cet instrument.
- Pour éviter tout choc électrique, veillez à raccorder l'instrument à une mise à la terre de protection. Brancher le cordon d'alimentation sur une prise de courant à trois plots reliée à la terre.
- Toujours utiliser une rallonge avec broche de mise à la terre, à défaut de quoi l'instrument ne serait pas relié à la terre.
- Si une sortie CA conforme au câble d'alimentation fourni n'est pas disponible et que vous ne pouvez pas relier l'instrument à la terre, ne l'utilisez pas.

## Connecting the power cord

1. Check that the instrument's power switch is off.
2. Connect the power cord plug to the power inlet on the rear panel of the instrument.
3. Connect the other end of the cord to an outlet that meets the following conditions. Use a grounded three-prong outlet with a protective ground terminal.

| Item | Specifications |
|---|---|
| Rated supply voltage | 100 to 240 VAC |
| Permitted supply voltage range | 90 to 264 VAC |
| Rated supply frequency | 50/60 Hz |
| Permitted supply frequency range | 48 to 63 Hz |
| Maximum power consumption | 150 VA<br>450 VA (with the /PD2 option) |

* This instrument can use a 100 V or a 200 V power supply. The maximum voltage rating differs according to the type of power cord. Check that the voltage supplied to the instrument is less than or equal to the maximum voltage rating of the power cord that you will be using before use.



# 2.4 Turning the Power Switch On and Off

## Before turning on the power, check that:

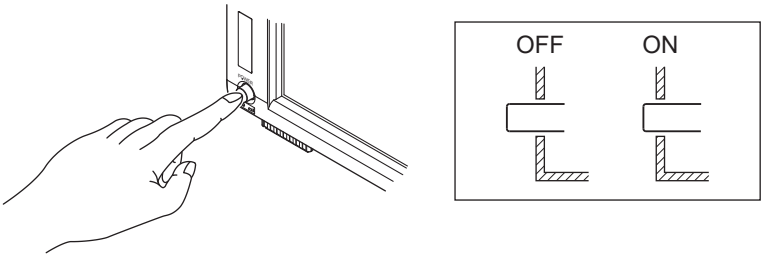
- The instrument is installed properly. See section 2.2, “Installing the Instrument.”
- The power cord is connected properly. See section 2.3, “Connecting the Power Supply.”

## Power switch location

The power switch is located in the lower left of the front panel.

## Turning the power switch on and off

The power switch is a push button. Press the button once to turn the instrument on and press it again to turn the instrument off.




## Operations performed when the power is turned on

When the power switch is turned on, a self-test starts automatically. When the self-test completes successfully, the screen that was displayed immediately before the power was turned off appears. Before using the instrument, make sure that the self-test completes successfully.

***Note***

- After turning the power off, wait at least 10 seconds before you turn it on again.
- If the instrument still does not work properly, contact your nearest YOKOGAWA dealer for repairs.
- It may take a few seconds for the startup screen to appear.

## When the power-on operation does not finish normally

Turn off the power switch, and check that:

- The power cord is securely connected.
- The correct voltage is coming to the power outlet. See section 2.3, “Connecting the Power Supply.”
- Initialize the settings to their factory defaults by turning on the power switch while holding down the RESET key.

If the instrument still does not work properly, contact your nearest YOKOGAWA dealer for repairs.

## To make accurate measurements

- After turning on the power switch, wait at least 30 minutes to allow the instrument to warm up.
- After warm-up, execute zero-level compensation. See the User’s Manual (IM WT1801R-02EN).

## Operations performed when the power is turned off

After the power is turned off, the instrument stores the setup data in its memory before shutting down. The same is true when the power cord is disconnected from the outlet. The next time the power is turned on, the instrument powers up using the stored setup data.

***Note***

The instrument stores the settings using an internal lithium battery. When the lithium battery voltage falls below a specified value, you will no longer be able to store setup data, and a message (error 901) will appear on the screen when you turn on the power. If this message appears frequently, you need to replace the battery soon. You cannot replace batteries by yourself. Contact your nearest YOKOGAWA dealer to have the battery replaced.

**CAUTION**

Turning off the power switch or unplugging the power cord while the instrument is saving data may corrupt the media on which data is being saved. Also, the data being saved is not guaranteed. Be sure to turn the power switch off after data has been saved.

French

**ATTENTION**

Le fait d'éteindre l'interrupteur d'alimentation ou de débrancher le cordon d'alimentation pendant que l'instrument enregistre des données peut corrompre le support sur lequel les données sont enregistrées. De plus, les données enregistrées ne sont pas garanties. Assurez-vous de mettre l’interrupteur hors tension une fois les données enregistrées.

# 2.5 Precautions When Wiring the Circuit under Measurement

To prevent electric shock and damage to the instrument, follow the warnings below.

**WARNING**

- Make sure to connect the instrument to a protective ground (earth) before connecting measurement cables. The power cord to use is a three-prong type power cord. Insert the power cord into a grounded three-prong outlet.
- Turn the circuit under measurement off before connecting and disconnecting cables to it. Connecting or removing measurement cables while the power is on is dangerous.
- Do not wire a current circuit to the voltage input terminal or a voltage circuit to the current input terminal.
- Strip the insulation covers of measurement cables so that when they are wired to the input terminals, the conductive parts (bare wires) do not protrude from the terminals. Also, make sure to fasten the input terminal screws securely so that cables do not come loose.
- When connecting measurement cables to the voltage input terminals, only connect measurement cables that have safety terminals that cover their conductive parts. Using a terminal with bare conductive parts (such as a banana plug) can be dangerous if the terminal comes loose.
- When connecting connectors to the external current sensor input terminals, connect only those that have safety terminals that cover their conductive parts. Using a connector with bare conductive parts can be dangerous if the voltage is 42 V or higher.
- When the voltage of the circuit under measurement is being applied to the current input terminals, do not touch the external current sensor input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.
- When connecting a measurement cable from an external current sensor to an external current sensor input terminal, remove the cables connected to the current input terminals. Also, when the voltage of the circuit under measurement is being applied to the external current sensor input terminals, do not touch the current input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.
- When using an external voltage transformer (VT) or current transformer (CT), make sure that it has enough dielectric strength for the voltage (U) being measured (2 U + 1000 V recommended). Also, make sure that the secondary side of the CT does not become an open circuit while the power is being applied. If this happens, high voltage will appear at the secondary side of the CT, making it extremely dangerous.
- When using a 50 A High Accuracy Element (760901) and applying a current exceeding 10 A from a current transformer (CT) to this instrument, provide protection.
- When using a 5 A High Accuracy Element and applying a current exceeding 0.7 A from a current transformer (CT) to this instrument, provide protection.
- When using an external current sensor, make sure to use a sensor that comes in a case. The conductive parts and the case should be insulated, and the sensor should have enough dielectric strength for the voltage of the circuit under measurement. Using a bare sensor is dangerous, because there is a high probability that you might accidentally touch it.
- When using a shunt-type current sensor as an external current sensor, turn off the circuit under measurement before you connect the sensor. Connecting or removing the sensor while the power is on is dangerous.

- When using a clamp-type current sensor as an external current sensor, make sure that you understand the voltage of the circuit under measurement and the specifications and handling of the clamp-type sensor, and then confirm that there are no dangers, such as shock hazards.
- For safety reasons, when using the instrument after mounting it on a rack, furnish a switch for turning off the circuit under measurement from the front side of the rack.
- For safety reasons, after you connect the measurement cables, use the included screws to attach the current input protection cover (screw tightening torque: 0.6 N•m). Make sure that the conductive parts do not protrude from the protection cover.
- To make the protective features effective, before applying the voltage or current from the circuit under measurement, check that:
  - The power cord for the instrument is being used to connect to the power supply, and the instrument is grounded.
  - The instrument is turned on.
  - The current input protection cover provided with the instrument is attached.
- When the instrument is turned on, do not apply a signal that exceeds the following values to the voltage or current input terminals. When the instrument is turned off, turn the circuit under measurement off. For information about other input terminals, see the specifications in chapter 5.

**Instantaneous maximum allowable input (within 20 ms)**

**Voltage input**

Peak value of 4 kV or rms value of 2 kV, whichever is less.

**Current input**

**Direct input**

5 A input element

Peak value of 30 A or rms value of 15 A, whichever is less.

50 A input element

Peak value of 450 A or rms value of 300 A, whichever is less.

**External current sensor input**

Peak value less than or equal to 10 times the range.

**Instantaneous maximum allowable input (1 s or less)**

**Voltage input**

Peak value of 3 kV or rms value of 1.5 kV, whichever is less.

**Current input**

**Direct input**

5 A input element

Peak value of 10 A or rms value of 7 A, whichever is less.

50 A input element

Peak value of 150 A or rms value of 55 A, whichever is less.

**External current sensor input**

Peak value less than or equal to 10 times the range.

**Continuous maximum allowable input**

**Voltage input**

Peak value of 2 kV or rms value of 1.1 kV, whichever is less.

**Current input**

**Direct input**

5 A input element

Peak value of 10 A or rms value of 7 A, whichever is less.

50 A input element

Peak value of 150 A or rms value of 55 A, whichever is less.

**External current sensor input**

Peak value less than or equal to 5 times the range.

**CAUTION**

- Use measurement cables with dielectric strengths and current capacities that are appropriate for the voltage or current being measured.
  Example: When making measurements on a current of 20 A, use copper wires that have a conductive cross-sectional area of 4 $mm^2$ or greater.
- Attaching a measurement cable to this product may cause radio interference in which case the user will be required to correct the interference.

**French**

## AVERTISSEMENT

- Veillez à connecter l'instrument à une mise à la terre de protection avant de brancher les câbles de mesure. Le cordon d'alimentation à utiliser est un cordon d'alimentation à trois broches. Brancher le cordon d'alimentation sur une prise de courant à trois plots mise à la terre.
- Mettre le circuit à mesurer hors tension avant de brancher et de débrancher les câbles. Il est dangereux de brancher ou de débrancher les câbles de mesure lorsque le circuit est sous tension.
- Ne pas brancher un circuit de courant sur une borne d'entrée de tension ou un circuit de tension sur une borne d'entrée de courant.
- Retirer les caches d'isolation des câbles de mesure de façon que les éléments conducteurs (fils nus) ne dépassent pas des bornes lorsque les câbles sont branchés sur les bornes d'entrée. Veiller également à serrer correctement les vis des bornes d'entrée de façon à éviter la désolidarisation des câbles.
- Lors de la connexion des câbles de mesure sur les bornes d'entrée de tension, ne brancher que des câbles de mesure dotés de bornes de sécurité capables de couvrir leurs éléments conducteurs. L'utilisation d'une borne dotée d'éléments conducteurs nus (comme une fiche banane) serait dangereuse si la borne venait à se détacher.
- Lors de la connexion de câbles sur les bornes d'entrée du capteur de courant, ne brancher que des câbles dotés de bornes de sécurité capables de couvrir leurs éléments conducteurs. L'utilisation d'un connecteur doté d'éléments conducteurs peut être dangereuse si la tension est de 42 V ou plus.
- Lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de courant, ne pas toucher les bornes d'entrée de capteur de courant externe, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.
- Lors du branchement d'un câble de mesure d'un capteur de courant externe sur un connecteur d'entrée de capteur de courant externe, retirer les câbles branchés sur les bornes d'entrée de courant. De plus, lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de capteur de courant externe, ne pas toucher les bornes d'entrée de courant, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.
- En cas d'utilisation d'un transformateur externe de tension ou de courant, vérifier que la rigidité diélectrique est suffisante pour la tension (U) à mesurer (2U + 1000 V recommandé). De plus, il convient d'éviter que le côté secondaire du transformateur de courant devienne un circuit ouvert pendant que le courant est appliqué. Si cela se produisait, la haute tension se déplacerait du côté secondaire du transformateur de courant, le rendant extrêmement dangereux.
- Il faut fournir une protection en cas d'utilisation d'un élément d'entrée de 50 A et si le courant appliqué sur cet instrument en provenance d'un transformateur de courant (CT) dépasse 10 A.
- Il faut fournir une protection en cas d'utilisation d'un élément d'entrée de 5 A et si le courant appliqué sur cet instrument en provenance d'un transformateur de courant (CT) dépasse 0.7 A.
- Lors de l'utilisation d'un capteur de courant externe, toujours utiliser un capteur rangé dans un étui. Les éléments conducteurs et l'étui doivent être isolés, et le capteur doit avoir une rigidité diélectrique suffisante pour la tension du circuit à mesurer. L'utilisation d'un capteur nu est dangereuse car le risque de le toucher accidentellement est très élevé.

- Lors de l'utilisation d'un capteur de courant de type shunt en guise de capteur de courant externe, mettre le circuit à mesurer hors tension avant de brancher le capteur. Il est dangereux de brancher ou de débrancher le capteur lorsque le circuit est sous tension.
- Lors de l'utilisation d'un capteur de courant par serrage en guise de capteur de courant externe, tenir compte de la tension du circuit à mesurer, des spécifications et des consignes de manipulation du capteur par serrage, puis vérifier l'absence de dangers, tels le choc électrique.
- Pour des raisons de sécurité, lors de l'utilisation de l'instrument après son installation sur un rack, prévoir un commutateur pour mettre le circuit mesuré hors tension depuis l'avant du rack.
- Pour des raisons de sécurité, après connexion des câbles de mesure, utiliser les vis fournies pour fixer le cache de protection d'entrée de courant (couple de serrage des vis : 0,6 N•m). Veiller à ce que les éléments conducteurs ne dépassent pas du cache de protection.
- Pour garantir la sécurité, avant d'appliquer la tension ou le courant depuis le circuit à mesurer, vérifier ce qui suit :
  - Le cordon d'alimentation de l'instrument est utilisé pour la connexion à l'alimentation, et l'instrument est bien relié à la terre.
  - L'instrument est sous tension.
  - Le cache de protection d'entrée de courant fourni avec l'instrument est fixé.
- Lorsque l'instrument est sous tension, ne pas appliquer de signal sur les bornes d'entrée de tension ou de courant dépassant les valeurs suivantes. Lorsque l'instrument est hors tension, éteindre également le circuit à mesurer. Pour de plus amples informations sur d'autres bornes d'entrée, se reporter aux spécifications au chapitre 5.

**Entrée instantanée maximale admissible (dans une fourchette de 20 ms)**

**Entrée de tension**

Valeur crête de 4 kV ou valeur efficace de 2 kV, selon la valeur la plus basse.

**Entrée de courant**

**Entrée directe**

Élément d'entrée 5 A

Valeur crête de 30 A ou valeur efficace de 15 A, selon la valeur la plus basse.

Élément d'entrée 50 A

Valeur crête de 450 A ou valeur efficace de 300 A, selon la valeur la plus basse.

**Entrée de capteur externe**

Valeur crête inférieure ou égale à 10 fois la plage.

**Entrée instantanée maximale admissible (1 s ou moins)**

**Entrée de tension**

Valeur crête de 3 kV ou valeur efficace de 1,5 kV, selon la valeur la plus basse.

**Entrée de courant**

**Entrée directe**

Élément d'entrée 5 A

Valeur crête de 10 A ou valeur efficace de 7 A, selon la valeur la plus basse.

Élément d'entrée 50 A

Valeur crête de 150 A ou valeur efficace de 55 A, selon la valeur la plus basse.

**Entrée de capteur externe**

Valeur crête inférieure ou égale à 10 fois la plage.

**Entrée continue maximale admissible**

**Entrée de tension**

Valeur crête de 2 kV ou valeur efficace de 1,1 kV, selon la valeur la plus basse.

**Entrée de courant**

**Entrée directe**

Élément d'entrée 5 A

Valeur crête de 10 A ou valeur efficace de 7 A, selon la valeur la plus basse.

Élément d'entrée 50 A

Valeur crête de 150 A ou valeur efficace de 55 A, selon la valeur la plus basse.

**Entrée de capteur externe**

Valeur crête inférieure ou égale à 5 fois la plage.

**ATTENTION**

- Utiliser des câbles de mesure dont la rigidité diélectrique et la capacité de courant conviennent pour la tension ou le courant à mesurer.
  Exemple : Lors de la réalisation de mesures sur un courant de 20 A, utiliser des fils en cuivre à section transversale conductrice de 4 $mm^2$.
- Le branchement d'un câble de mesure sur ce produit peut entraîner une interférence radio que l'utilisateur sera tenu de rectifier.

***Note***

- If you are measuring large currents or voltages or currents that contain high frequency components, take special care in dealing with mutual interference and noise when you wire the cables.
- Keep measurement cables as short as possible to minimize the loss between the circuit under measurement and the instrument.
- The thick lines on the wiring diagrams shown in sections 2.9 to 2.11 are the circuits where the current flows. Use wires that are suitable for the current levels.
- To make accurate measurements of the voltage of the circuit under measurement, connect the measurement cable that is connected to the voltage input terminal to the circuit as closely as possible.
- To make accurate measurements, separate the measurement cables as far away from the ground wires and the instrument's case as possible to minimize static capacitance to the ground.
- To measure the apparent power and power factor more accurately on an unbalanced three-phase circuit, we recommend that you use a three-phase three-wire system with a three-voltage three-current method (3P3W; 3V3A).

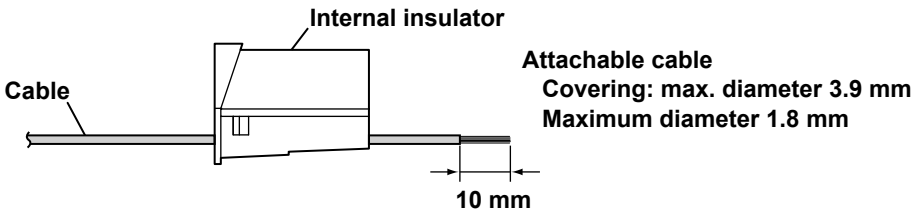
# 2.6 Assembling the Adapters for the Voltage Input Terminals

## Assembling the 758931 safety terminal adapter

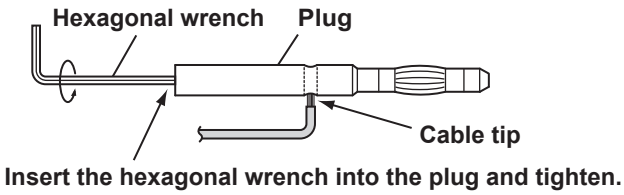
When connecting a measurement cable to a voltage input terminal of this instrument, use the included 758931 Safety Terminal Adapter or the 758923 Safety Terminal Adapter (sold separately). When using the 758931 Safety Terminal Adapter, assemble it according to the following procedure.

### Assembling the safety terminal adapter

*1.* Remove approximately 10 mm of the covering from the end of the cable and pass the cable through the internal insulator.

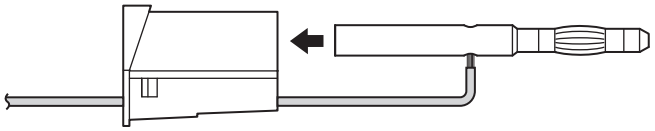



*2.* Insert the tip of the cable into the plug. Fasten the cable in place using the hexagonal wrench.

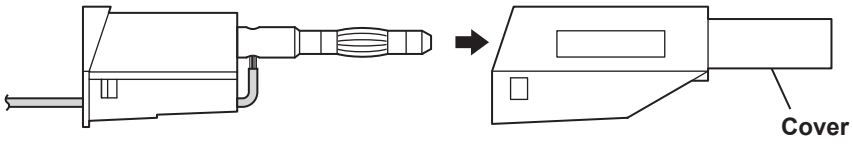



**Insert the hexagonal wrench into the plug and tighten.**

*3.* Insert the plug into the internal insulator.



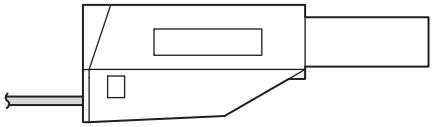
*4.* Attach the external cover. Make sure that the cover does not come off.




***Note***

Once you attach the cover, it is difficult to disassemble the safety terminal adapter. Use care when attaching the cover.

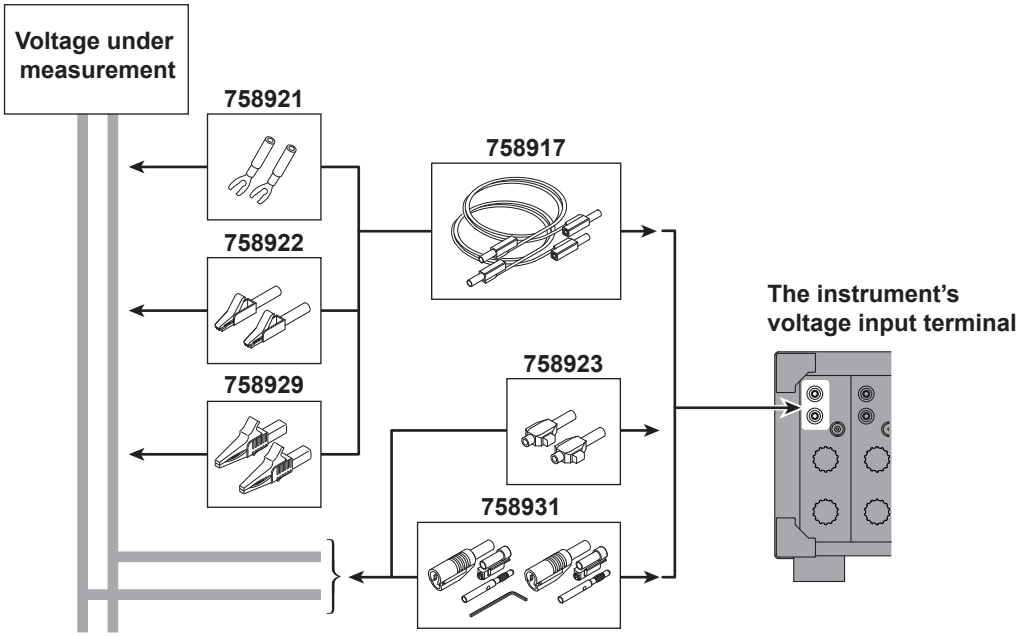
Below is an illustration of the adapter after it has been assembled.



## Explanation

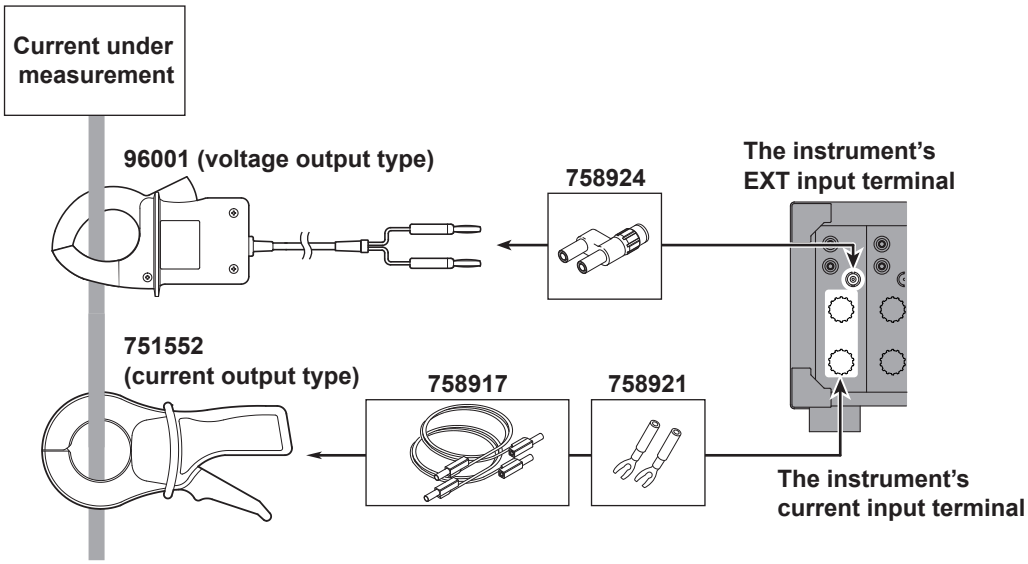
Wire the adapters that come with this instrument or the adapters and various sensors that are sold separately as shown below:

### Wiring for measuring voltage




Use the clamp-on probes (sold separately) as shown below.

### Wiring for measuring current




Connecting a clamp-on probe

*** The current input terminal and EXT input terminal cannot be wired (used) simultaneously.**

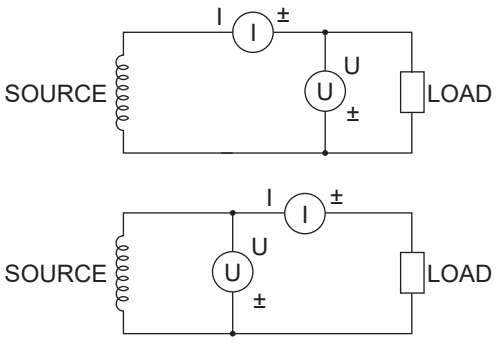
# 2.7 Wiring for Accurate Measurements

When you are wiring a single-phase device, there are the four patterns of terminal wiring positions shown in the following figures for wiring the voltage input and current input terminals. Depending on the terminal wiring positions, the effects of stray capacitance and the effects of the measured voltage and current amplitudes may become large. To make accurate measurements, refer to the items below when wiring the voltage input and current input terminals.

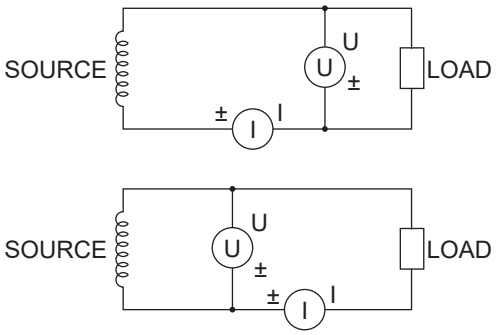
## Effects of stray capacitance

When measuring a single-phase device, the effects of stray capacitance on measurement accuracy can be minimized by connecting the instrument's current input terminal to the side that is closest to the earth potential of the power supply (SOURCE).

- **Easily affected**

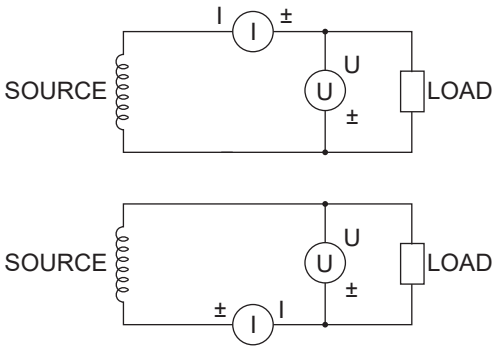



- **Not easily affected**

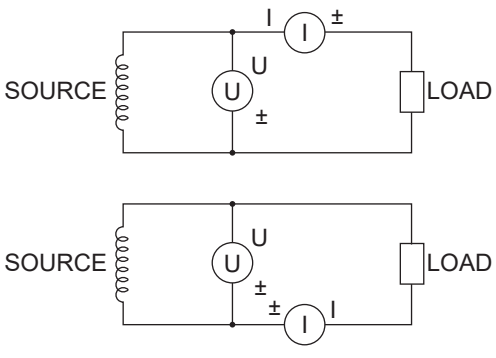



## Effects of the measured voltage and current amplitudes

- **When the measured current is relatively large**
  Connect the voltage




- **When the measured current is relatively small**
  Connect the current

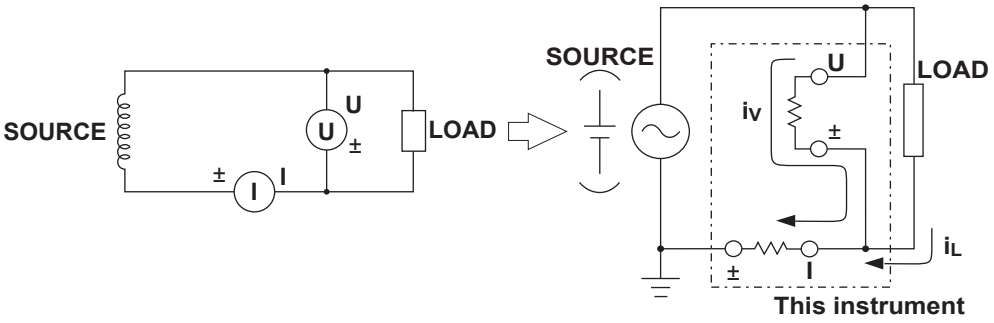


# Effects of power loss

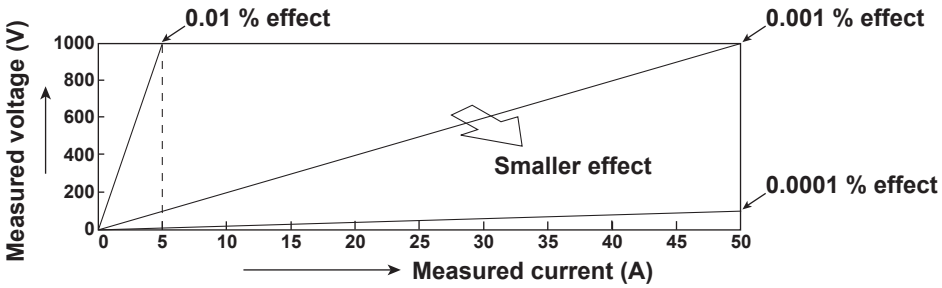
By wiring a circuit to match the load, you can minimize the effects of power loss on measurement accuracy. We will discuss the wiring of the DC power supply (SOURCE) and a load resistance (LOAD) below.

## When the measured current is relatively large

Connect the voltage measurement circuit between the current measurement circuit and the load. The current measurement circuit measures the sum of $i_L$ and $i_V$. $i_L$ is the current flowing through the load of the circuit under measurement, and $i_V$ is the current flowing through the voltage measurement circuit. Because the current flowing through the circuit under measurement is $i_L$, only $i_V$ reduces measurement accuracy. The input resistance of the voltage measurement circuit of the instrument is approximately 2 MΩ. For 1000 V input $i_V$ is approximately 0.5 mA (1000 V/2 MΩ). If the load current $i_L$ is 5 A or more (the load resistance is 200 Ω or less), the effect on the measurement accuracy is 0.01 % or less. If the input voltage is 100 V and the current is 5 A, $i_V$ = 0.05 mA (100 V/2 MΩ), so the effect of $i_V$ on the measurement accuracy is 0.001 % (0.05 mA/5 A).

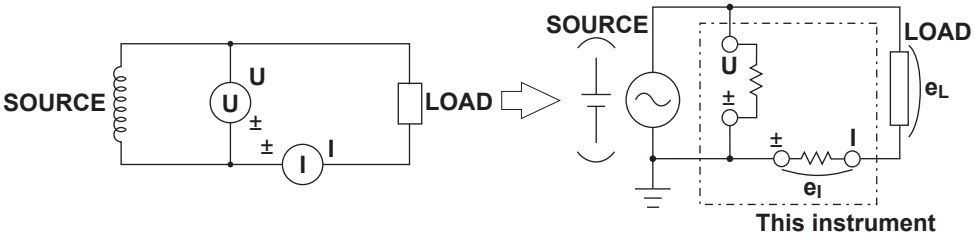



As a reference, the relationships between the voltages and currents that produce effects of 0.01 %, 0.001 %, and 0.0001 % are shown in the figure below.




## When the measured current is relatively small

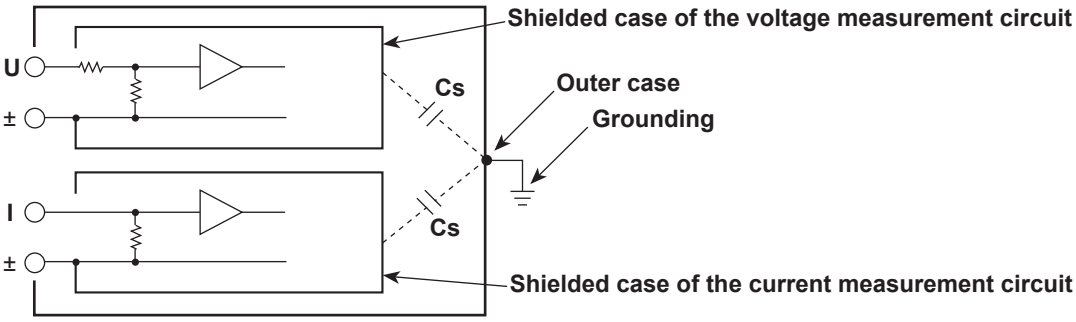
Connect the current measurement circuit between the voltage measurement circuit and the load. In this case, the voltage measurement circuit measures the sum of $e_L$ and $e_I$. $e_L$ is the load voltage, and $e_I$ is the voltage drop across the current measurement circuit. Only $e_I$ reduces measurement accuracy. The input resistance of the current measurement circuit of the instrument is approximately 100 mΩ for the 5 A input terminals and approximately 2 mΩ for the 50 A input terminals. If the load resistance is 1 kΩ, the effect on the measurement accuracy is approximately 0.01 % (100 mΩ/1 kΩ) for the 5 A input terminals and approximately 0.0002 % (2 mΩ/1 kΩ) for the 50 A input terminals.




## Effects of stray capacitance

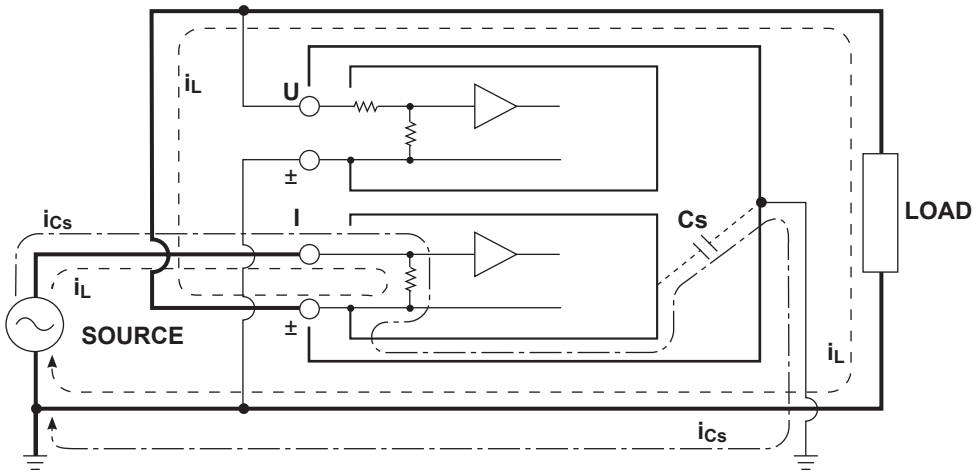
The effects of stray capacitance on measurement accuracy can be minimized by connecting the instrument's current input terminal to the side of the power supply (SOURCE) that is closest to its earth potential.

The internal structure of the instrument is explained below.
The voltage and current measurement circuits are each enclosed in shielded cases. These shielded cases are contained within an outer case. The shielded case of the voltage measurement circuit is connected to the positive and negative voltage input terminals, and the shielded case of the current measurement circuit is connected to the positive and negative current input terminals.
Because the outer case is insulated from the shielded cases, there is stray capacitance, which is expressed as Cs. Cs is approximately 40 pF. The current generated by stray capacitance Cs causes errors.




As an example, we will consider the case when the outer case and one side of the power supply are grounded.
In this case, there are two conceivable current flows, $i_L$ and $i_{Cs}$. $i_L$ is the load current, and $i_{Cs}$ is the current that flows through the stray capacitance. $i_L$ flows through the current measurement circuit, then through the load, and returns to the power supply (shown with a dotted line). $i_{Cs}$ flows through the current measurement circuit, the stray capacitance, and the earth ground of the outer case, and then returns to the power supply (shown with a dot-dash line).
Therefore, the current measurement circuit will measure the sum of $i_L$ and $i_{Cs}$, even if the objective is just to measure $i_L$. The measurement will be off by $i_{Cs}$. If the voltage applied to Cs is $V_{Cs}$ (common mode voltage), $i_{Cs}$ can be found using the formula shown below. Because the phase of $i_{Cs}$ is ahead of the voltage by 90°, the effect of $i_{Cs}$ on the measurement accuracy increases as the power factor gets smaller.

$$i_{Cs} = V_{Cs} \times 2\pi f \times C_s$$




Because the instrument measures high frequencies, the effects of $i_{Cs}$ cannot be ignored.
If you connect the instrument's current input terminal to the side of the power supply (SOURCE) that is close to its earth potential, the instrument's current measurement circuit positive and negative terminals are close to the earth potential, so $V_{Cs}$ becomes approximately zero and very little $i_{Cs}$ flows. This reduces the effect on measurement accuracy.

# 2.8 Guide for Selecting the Method Used to Measure the Power

Select the measurement method from the table below according to the amplitude of the measured voltage or current. For details on wiring methods, see the appropriate sections.

## Voltage measurement methods

| | | Voltage at 1000 V or less | Voltage exceeding 1000 V |
|---|---|---|---|
| **Voltage wiring** | **Direct input** | → section 2.9 | Direct input is not possible. |
| | **VT (voltage transformer)** | → section 2.11 | |

## Current measurement methods

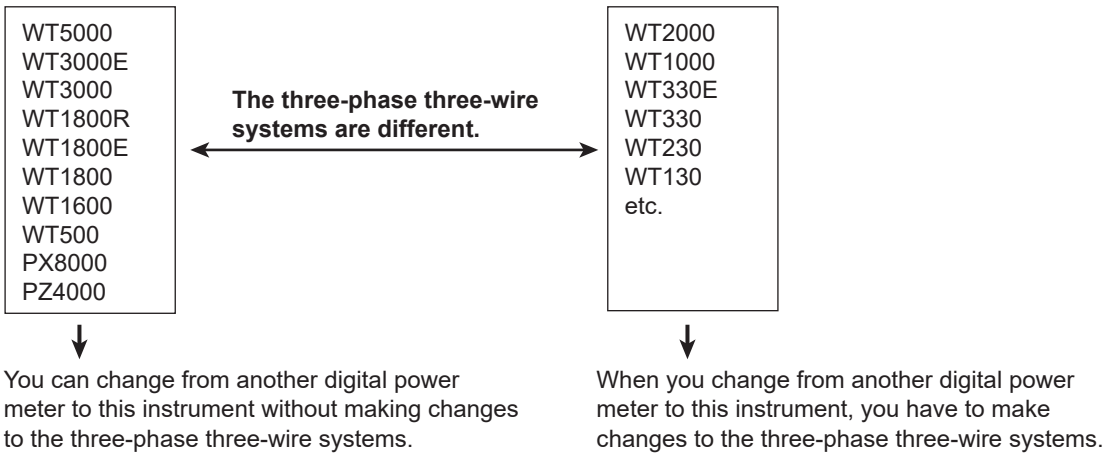
| | | Voltage at 1000 V or less | | Voltage exceeding 1000 V |
|---|---|---|---|---|
| **Input element** | **50 A** | **Current at 50 A or less** | **Current exceeding 50 A** | |
| | **5 A** | **Current at 5 A or less** | **Current exceeding 5 A** | |
| **Voltage wiring** | **Direct input** | → section 2.9* | Direct input is not possible. | |
| | **Shunt-type current sensor** | → section 2.10** | | Shunt-type current sensors cannot be used. |
| | **Clamp-type current sensor (voltage output type)** | → section 2.10 | | |
| | **Clamp-type current sensor (current output type)** | → section 2.11 | | |
| | **CT (current transformer)** | → section 2.11 | | |

* With any of the /EX1 to /EX6 options
Voltage: 1000 V or less (maximum allowable voltage that can be measured)
600 V or less (rated voltage as specified by the safety standard)
Do not touch the inside of the external current sensor input BNC connector.
Without the /EX1 to /EX6 options
Voltage: 1000 V or less

** Voltage at 600 V or less

## Notes on replacing other power meters with this instrument

In three-phase three-wire systems (3P3W) and three-phase three-wire systems that use a three-voltage three-current method (3P3W; 3V3A), the wiring system of this instrument may be different from that of another product (another digital power meter) depending on whether the reference voltage is set to S phase or T phase when measuring the line voltage (see appendix 2 in the features guide, IM WT1801R-01EN). To make accurate measurements, see the referenced sections in the selection guide above and check the wiring method of the corresponding three-phase three-wire system.




For example, if you replace the WT1000 (used in a three-phase three-wire system) with this instrument and leave the wiring unchanged, the measured power of each element will be different between the WT1000 and this instrument. Refer to this manual and re-wire the system correctly.

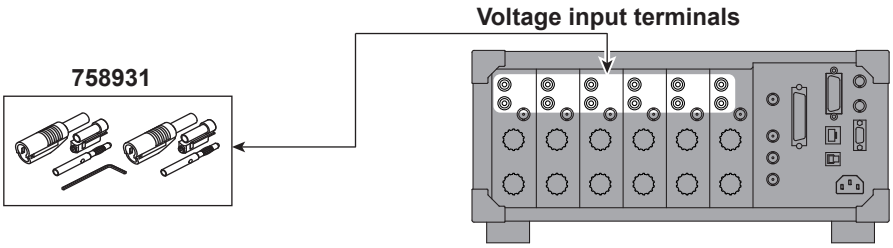
# 2.9 Wiring the Circuit under Measurement for Direct Input

This section explains how to wire the measurement cable directly from the circuit under measurement to the voltage or current input terminal.
To prevent electric shock and damage to the instrument, follow the warnings given in section 2.5, “Precautions When Wiring the Circuit under Measurement.”

## Connecting to the input terminals

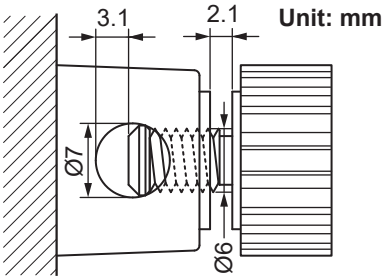
### voltage input terminals

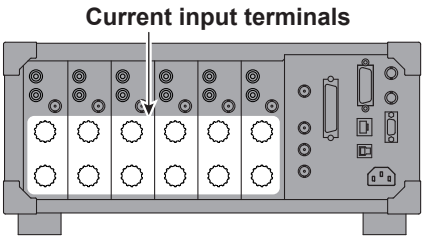
The terminals are safety banana jacks (female) that are 4 mm in diameter.
Only insert a safety terminal whose conductive parts are not exposed into a voltage input terminal.
If you are using the included 758931 Safety Terminal Adapter, see section 2.6.




### Current input terminals

The terminals are binding posts, and the screws are M6. Either wind the wire around the screw or pass the crimping terminal through the screw axis, and then tighten firmly with the terminal knob.




**WARNING**

- When the voltage of the circuit under measurement is being applied to the current input terminals, do not touch the external current sensor input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.
- When connecting a measurement cable from an external current sensor to an external current sensor input terminal, remove the cables connected to the current input terminals. Also, when the voltage of the circuit under measurement is being applied to the external current sensor input terminals, do not touch the current input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.

**CAUTION**

- Confirm that no foreign materials are caught between the current input terminal and the crimping terminal.
- Periodically confirm that the current input terminal is not loose and that there are no foreign materials caught between the current input terminal and the crimping terminal.

**French**

**AVERTISSEMENT**

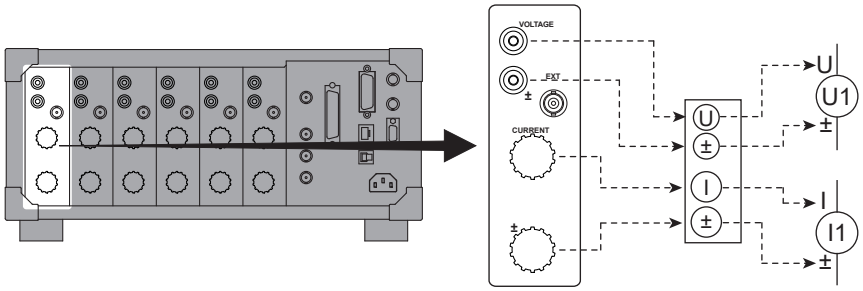
- Lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de courant, ne pas toucher les bornes d'entrée de capteur de courant externe, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.
- Lors du branchement d'un câble de mesure d'un capteur de courant externe sur un connecteur d'entrée de capteur de courant externe, retirer les câbles branchés sur les bornes d'entrée de courant. De plus, lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de capteur de courant externe, ne pas toucher les bornes d'entrée de courant, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.

**ATTENTION**

- Lors de cette opération, s'assurer de l'absence de corps étranger au niveau des contacts entre la borne d'entrée de courant et les cosses à sertir.
- Vérifier périodiquement si le bouton de la borne d'entrée de courant est desserré, et si des corps étrangers sont présents au niveau des contacts entre la borne d'entrée de courant et les cosses à sertir.

## Connecting to this instrument

In the figures that follow, the input elements of this instrument, voltage input terminals, and current input terminals are shown simplified as follows.




The voltage input terminals and current input terminals are labeled as U and I, respectively.

**Input element**

The wiring examples shown below are examples of the following wiring systems in which the specified input elements have been wired. To wire other input elements, substitute the numbers in the figures with the appropriate element numbers.

- Single-phase two-wire systems (1P2W): Input element 1
- Single-phase three-wire system (1P3W) and three-phase three-wire system (3P3W): Input elements 1 and 2
- Three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A) and three-phase four-wire system (3P4W): Input elements 1 to 3

**CAUTION**

The thick lines on the wiring diagrams are the circuits where the current flows. Use wires that are suitable for the current levels.

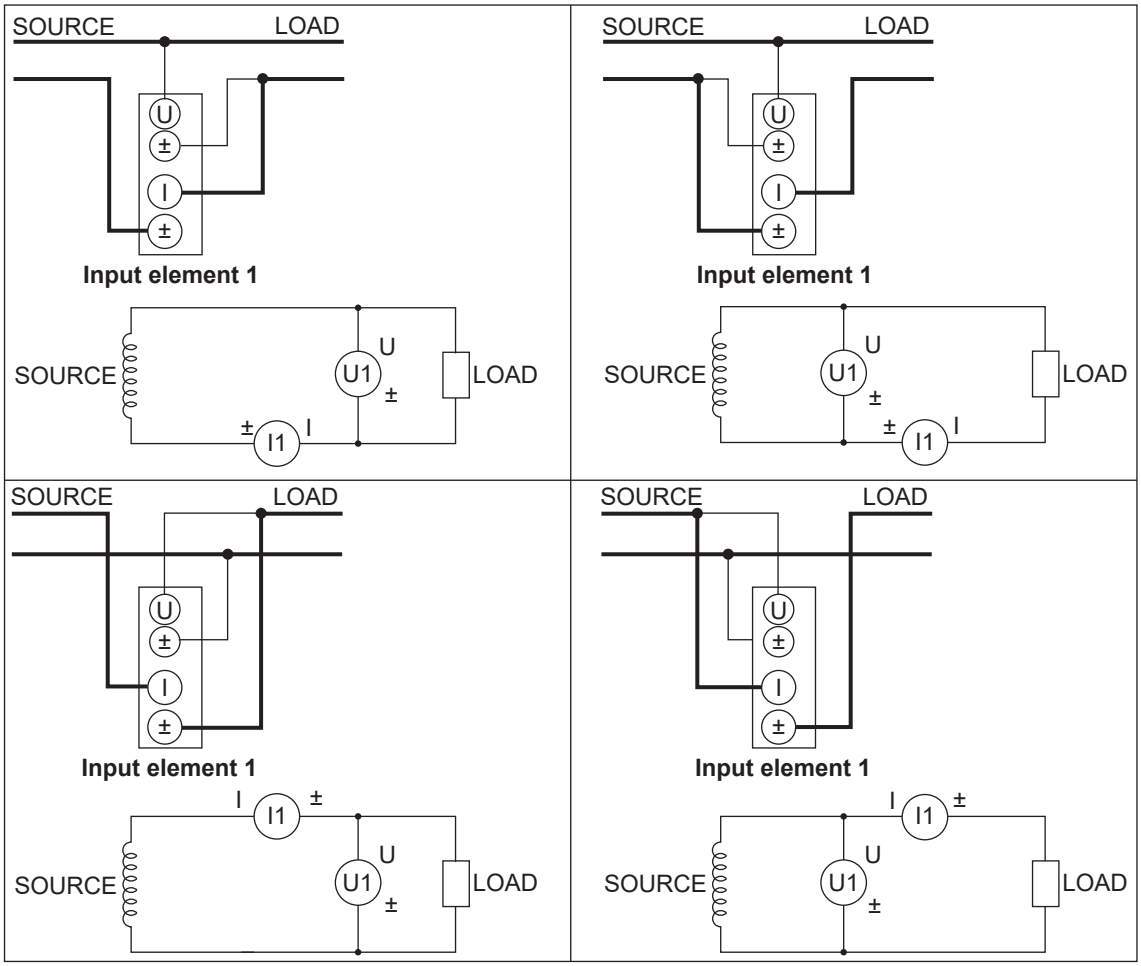
**French**

**ATTENTION**

Les lignes épaisses dans les schémas de câblage sont les circuits où circule le courant. Utilisez des fils adaptés aux niveaux de courant.

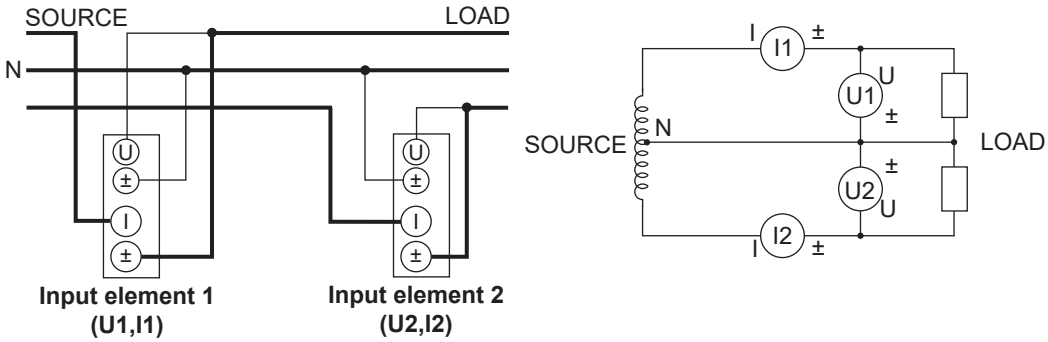
## Wiring examples of single-phase two-wire systems (1P2W)

If six input elements are available, six single-phase two-wire systems can be configured. To decide which of the wiring systems shown below you should use, see section 2.7.



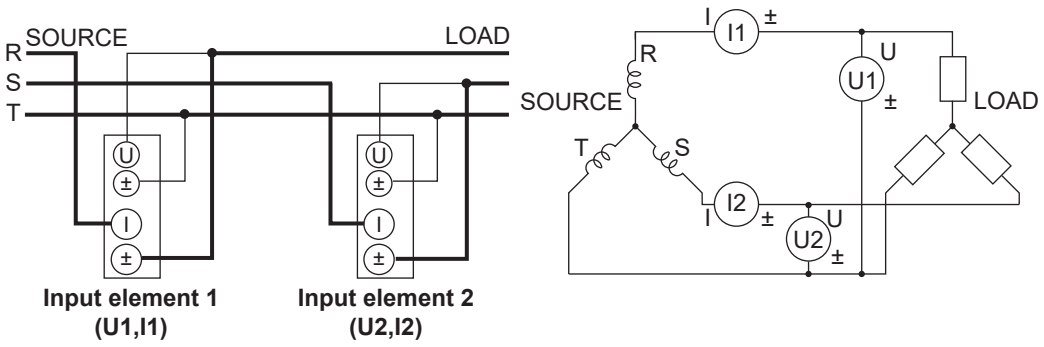

## Wiring example of a single-phase three-wire system (1P3W)

If six input elements are available, three single-phase three-wire systems can be configured.



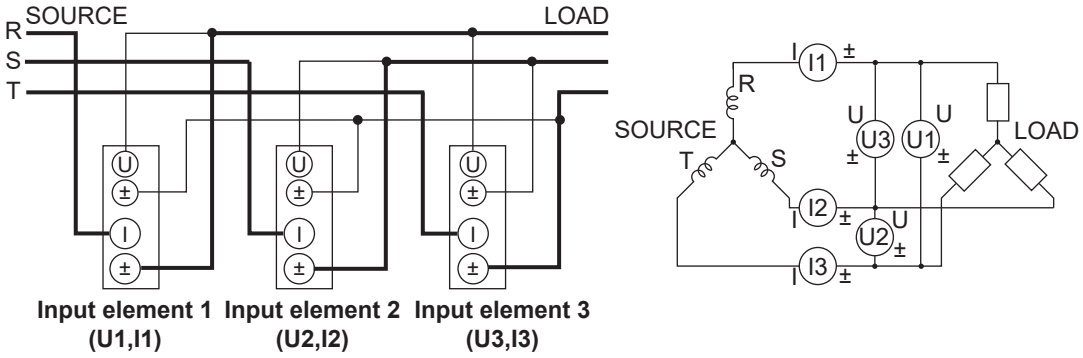
## Wiring example of a three-phase three-wire system (3P3W)

If six input elements are available, three three-phase three-wire systems can be configured.



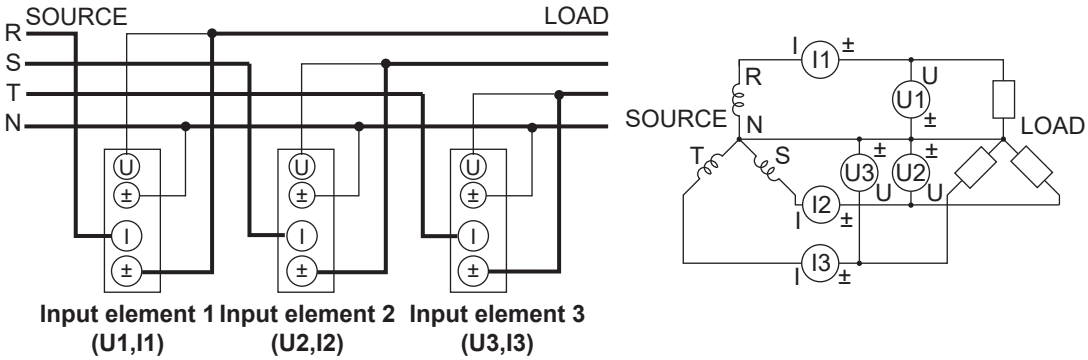

## Wiring example of a three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A)

If six input elements are available, two three-phase three-wire systems that use a three-voltage three-current method can be configured.




## Wiring example of a three-phase four-wire system (3P4W)

If six input elements are available, two three-phase four-wire systems can be configured.




### *Note*

For the relationship between the wiring system and how measurement and calculation values are determined, see appendix 1, “Symbols and Determination of Measurement Functions,” in the features guide, IM WT1801R-01EN.

# 2.10 Wiring the Circuit under Measurement When Using Current Sensors

To prevent electric shock and damage to the instrument, follow the warnings given in section 2.5, “Precautions When Wiring the Circuit under Measurement.”

If the maximum current of the circuit under measurement exceeds the maximum range of the input elements, you can measure the current of the circuit under measurement by connecting an external current sensor to the external current sensor input terminal.

- 5 A input elements: When the maximum current exceeds 5 Arms
- 50 A input elements: When the maximum current exceeds 50 Arms

## Current sensor output type

**Voltage output**

Refer to the wiring examples in this section when using a shunt-type current sensor or a clamp-type current sensor that outputs voltage.

**Current output**

If you are using a clamp-type current sensor that outputs current, see section 2.11.

## Connecting to the input terminals

### voltage input terminals

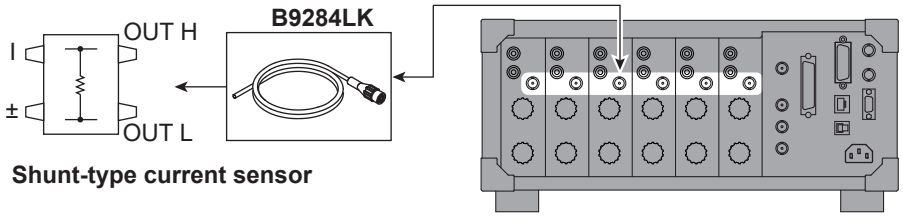
The terminals are safety banana jacks (female) that are 4 mm in diameter.

Only insert a safety terminal whose conductive parts are not exposed into a voltage input terminal.

If you are using the included 758931 Safety Terminal Adapter, see section 2.6.

### External current sensor input terminals

- The terminal is an isolated BNC connector.
- Connect an external current sensor cable with a BNC connector (B9284LK, sold separately) to an external current sensor input connector.




**Shunt-type current sensor**

**WARNING**

When connecting a measurement cable from an external current sensor to an external current sensor input terminal, remove the cables connected to the current input terminals. Because the external current sensor input terminal and the current input terminal are connected internally, connecting both terminals simultaneously not only results in measurement errors but may also cause damage to the instrument. Also, when the voltage of the circuit under measurement is being applied to the external current sensor input terminals, do not touch the current input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.

**French**

**AVERTISSEMENT**

Lors du branchement d'un câble de mesure d'un capteur de courant externe sur un connecteur d'entrée de capteur de courant externe, retirer les câbles branchés sur les bornes d'entrée de courant. Parce que la borne d'entrée de capteur de courant externe et la borne d'entrée de courant sont connectées en interne, la connexion des deux bornes simultanément, non seulement entraîne des erreurs de mesure, mais peut également endommager l'instrument. De plus, lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de capteur de courant externe, ne pas toucher les bornes d'entrée de courant, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.

***Note***

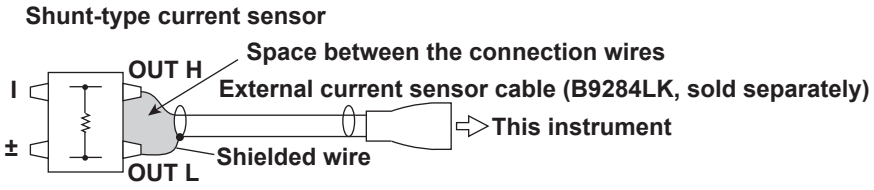
- Make sure that you have the polarities correct when you make connections. If the polarity is reversed, the polarity of the measurement current will be reversed, and you will not be able to make correct measurements. Be especially careful when connecting clamp-type current sensors to the circuit under measurement, because it is easy to reverse the connection.
- Note that the frequency and phase characteristics of the current sensor affect the measured data.
- To measure the apparent power and power factor more accurately on an unbalanced three-phase circuit, we recommend that you use a three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A).

# Notes on Using shunt-type current sensors and clamp-on probes

### Connecting an external current sensor cable

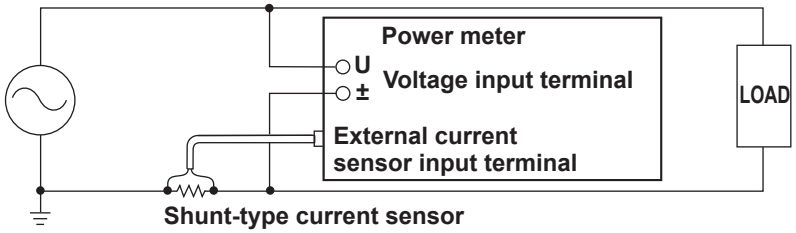
To minimize error when using shunt-type current sensors, follow the guidelines below when connecting the external current sensor cable.

- Connect the shielded wire of the external current sensor cable to the L side of the shunt output terminal (OUT).
- Minimize the area of the space between the wires connecting the current sensor to the external current sensor cable. This reduces the effects of the lines of magnetic force (which are caused by the measurement current) and the external noise that enter the space.



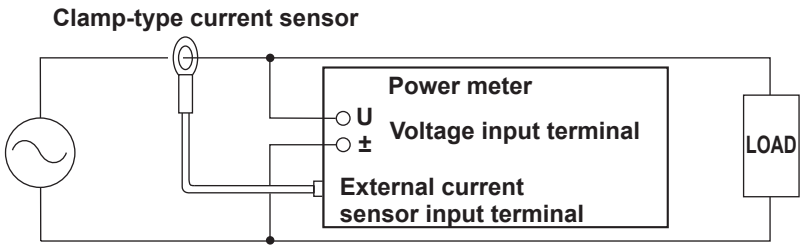

### Position on the (grounded) circuit under measurement that you should connect the shunt-type current sensor to

Connect the shunt-type current sensor to the power earth ground as shown in the figure below. If you have to connect the sensor to the non-earth side, use a wire that is thicker than AWG18 (with a conductive cross-sectional area of approximately 1 $mm^2$) between the sensor and the instrument to reduce the effects of common mode voltage. Take safety and error reduction into consideration when constructing external current sensor cables.



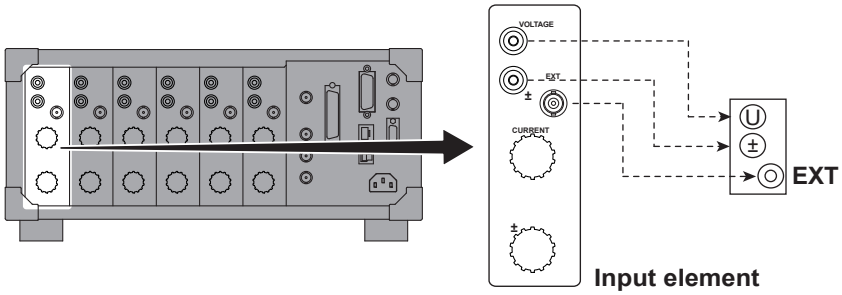

### Ungrounded measurement circuits

When the circuit under measurement is not grounded and the signal is high in frequency or large in power, the effects of the inductance of the shunt-type current sensor cable become large. In this case, use an isolation sensor (CT, DC-CT, or clamp) to perform measurements.

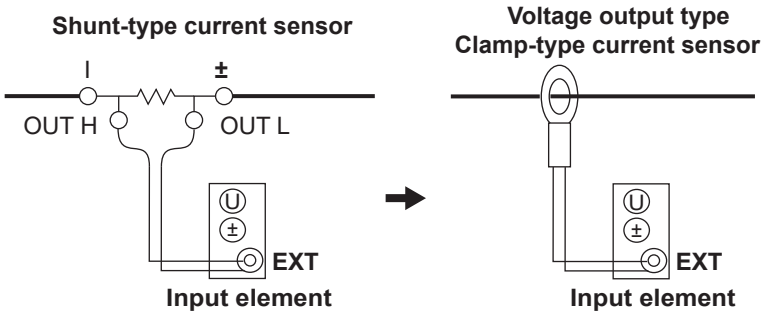


## Connecting to this instrument

In the figures on the following pages, the input elements of this instrument, voltage input terminals, and external current sensor input terminals are shown simplified as follows.




The following wiring examples are for connecting shunt-type current sensors. When connecting a clamp-type current sensor that outputs voltage, replace shunt-type current sensors with clamp-type current sensors.




The wiring examples shown below are examples of the following wiring systems in which the specified input elements have been wired. To wire other input elements, replace the numbers in the figures with the appropriate element numbers.

- Single-phase two-wire systems (1P2W): Input element 1
- Single-phase three-wire system (1P3W) and three-phase three-wire system (3P3W): Input elements 1 and 2
- Three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A) and three-phase four-wire system (3P4W): Input elements 1 to 3

**CAUTION**

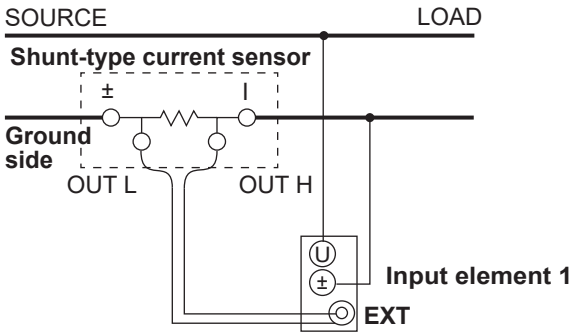
The thick lines on the wiring diagrams are the circuits where the current flows. Use wires that are suitable for the current levels.

**French**

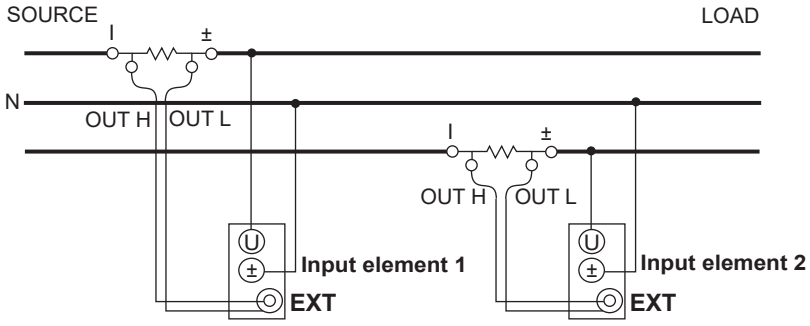
**ATTENTION**

Les lignes épaisses dans les schémas de câblage sont les circuits où circule le courant. Utilisez des fils adaptés aux niveaux de courant.

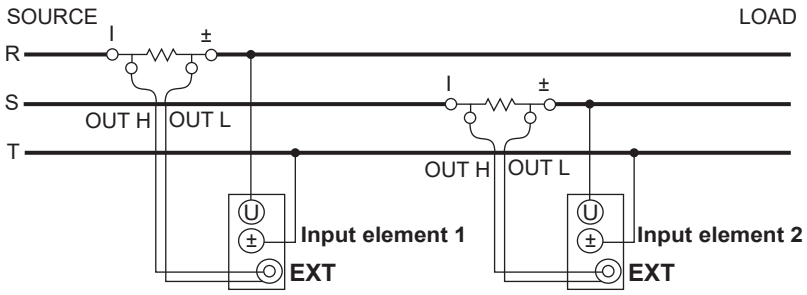
## Wiring example of a single-phase two-wire system (1P2W) with a shunt-type current sensor



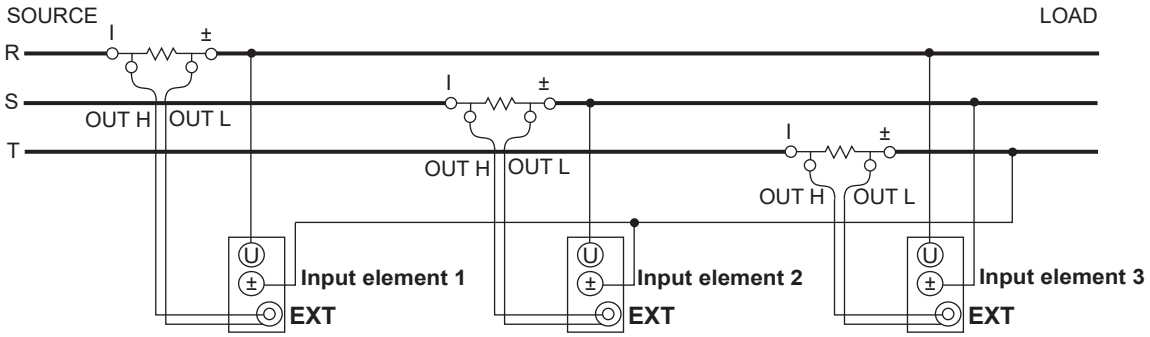

## Wiring example of a single-phase three-wire system (1P3W) with shunt-type current sensors



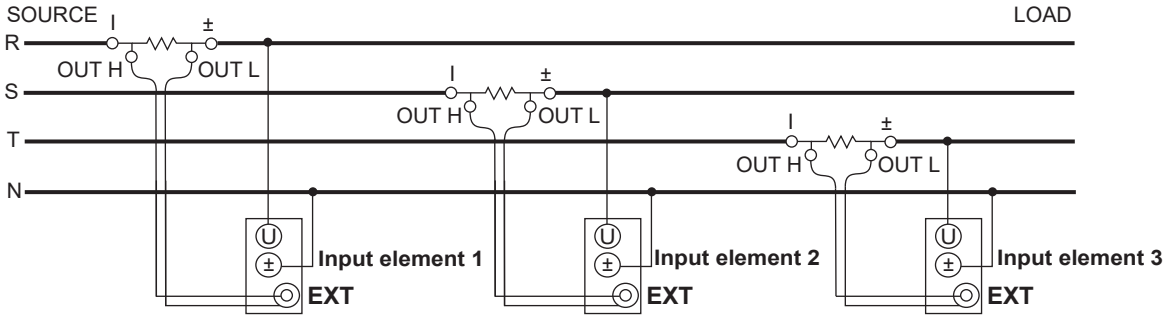
## Wiring example of a three-phase three-wire system (3P3W) with shunt-type current sensors




## Wiring example of a three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A) with shunt-type current sensors




## Wiring example of a three-phase four-wire system (3P4W) with shunt-type current sensors




### *Note*

For the relationship between the wiring system and how measurement and calculation values are determined, see appendix 1, “Symbols and Determination of Measurement Functions,” in the features guide, IM WT1801R-01EN.

# 2.11 Wiring the Circuit under Measurement When Using Voltage and Current Transformers

This section explains how to wire measurement cables from external voltage transformers (VT) or current transformers (CT) to the voltage or current input terminals of input elements. Use the wiring system in this section also when wiring clamp-type current sensors that output current.
To prevent electric shock and damage to the instrument, follow the warnings given in section 2.5, “Precautions When Wiring the Circuit under Measurement.”

## Voltage measurement

When the maximum voltage of the circuit under measurement exceeds 1000 Vrms, you can perform measurements by connecting an external VT to the voltage input terminal.

## Current measurement

If the maximum current of the circuit under measurement exceeds the maximum range of the input elements, you can measure the current of the circuit under measurement by connecting an external CT, or a clamp-type sensor that outputs current, to the current input terminal.

- 5 A input elements: When the maximum current exceeds 5 Arms
- 50 A input elements: When the maximum current exceeds 50 Arms

## Connecting to the input terminals

### Voltage input terminals

The terminals are safety banana jacks (female) that are 4 mm in diameter.
Only insert a safety terminal whose conductive parts are not exposed into a voltage input terminal.
If you are using the included 758931 Safety Terminal Adapter, see section 2.6.

### Current input terminals

- The screws used on the terminal (binding post) are M6 screws. Wind the wire around the screw, use the Fork Terminal Adapter (758921; sold separately), or pass the crimping terminal through the screw axis, and then tighten firmly with the terminal knob.
- For the dimensions of the terminal parts, see section 2.9.
- For the precautions to follow when you connect the current input terminal and the crimping terminal and after you connect these terminals, see section 2.9.

**WARNING**

- Do not connect a current transformer without protection.
- When the voltage of the circuit under measurement is being applied to the current input terminals, do not touch the external current sensor input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.
- When connecting a measurement cable from an external current sensor to an external current sensor input terminal, remove the cables connected to the current input terminals. Also, when the voltage of the circuit under measurement is being applied to the external current sensor input terminals, do not touch the current input terminals. Doing so is dangerous because the terminals are electrically connected inside the instrument.

**French**

**AVERTISSEMENT**

- Ne pas brancher de transformateur de courant sans protection.
- Lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de courant, ne pas toucher les bornes d'entrée de capteur de courant externe, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.
- Lors du branchement d'un câble de mesure d'un capteur de courant externe sur un connecteur d'entrée de capteur de courant externe, retirer les câbles branchés sur les bornes d'entrée de courant. De plus, lorsque la tension du circuit à mesurer est appliquée aux bornes d'entrée de capteur de courant externe, ne pas toucher les bornes d'entrée de courant, car elles sont connectées électroniquement à l'intérieur de l'instrument, ce qui présente un danger.

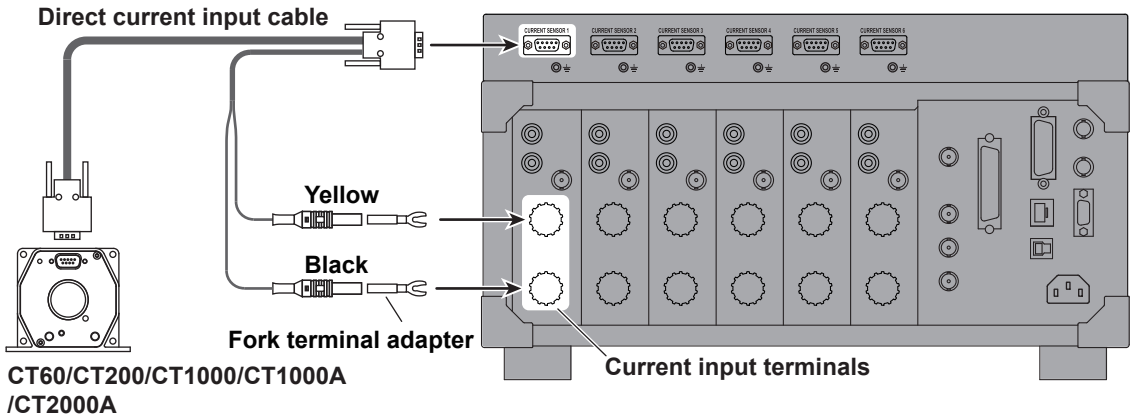
## Connecting a CT60/CT200/CT1000/CT1000A/CT2000A to the current sensor power (/PD2 option)

Models with the current sensor power option can supply power to YOKOGAWA's CT60/CT200/CT1000/CT1000A/CT2000A AC/DC current sensors.

When applying the CT60/CT200/CT1000/CT1000A/CT2000A output current to this instrument's direct current input terminals, connect the direct current input cable (sold separately) and the fork terminal adapter as shown below.

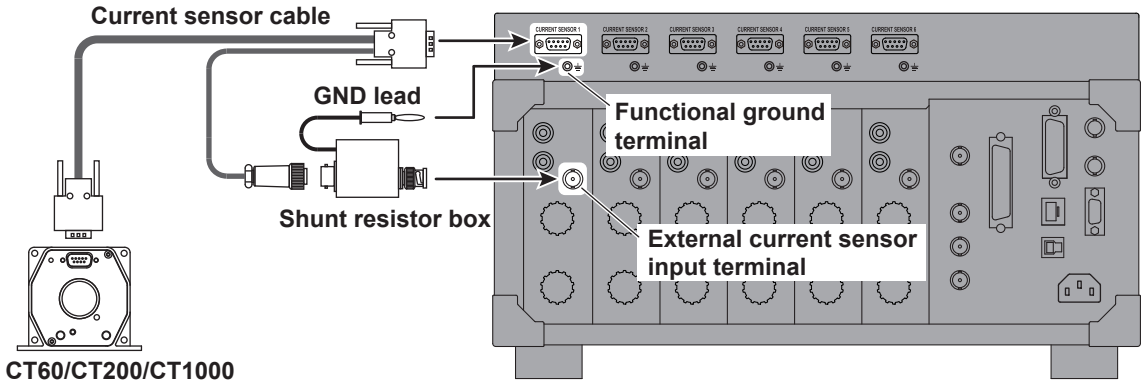
Direct current input cable: A1589WL (CT60/CT200/CT1000) (3 m)
A1628WL (CT60/CT200/CT1000A/CT2000A) (5 m)

Fork terminal adapter: 758921

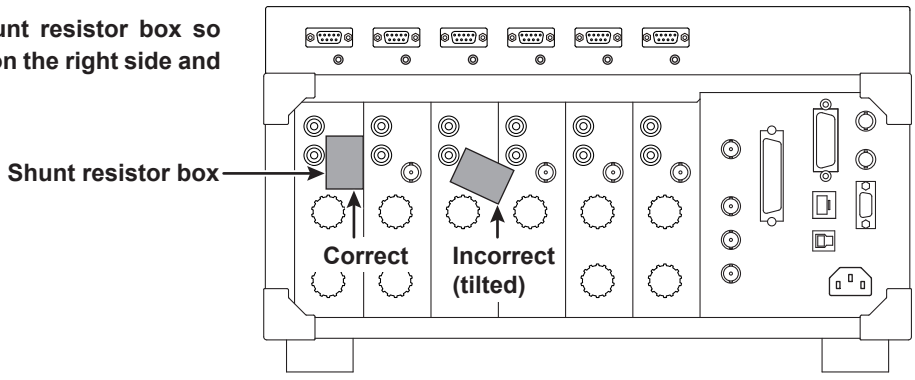



To connect the CT60/CT200/CT1000 output current to this instrument through a shunt resistor box, connect a current sensor cable (sold separately) and the shunt resistor box as shown below.

Current sensor cable: A1559WL (3 m), A1560WL (5 m)




**Connect the shunt resistor box so that the label is on the right side and vertical.**



**WARNING**

Before connecting the shunt resistor box to the CT with the current sensor cable, be sure to connect the GND lead of the shunt resistor box to the functional ground terminal on the rear panel of this instrument. Not doing so is dangerous as high voltage may appear in the BNC.

**CAUTION**

- Before connecting or disconnecting a CT from this instrument, turn this instrument off. Connecting or disconnecting the CT while the power is on can damage this instrument or the CT.
- Use the current sensor power terminal (option) on the rear panel of this instrument only as a power supply for the CT60/CT200/CT1000/CT1000A/CT2000A. Connecting other devices may damage this instrument or the connected device.

**French**

**AVERTISSEMENT**

Avant de connecter le boîtier de résistance de shunt au CT à l'aide du câble du capteur de courant, veillez à raccorder le câble de terre (GND) du boîtier de résistance de shunt à la borne de protection à la terre située sur le panneau arrière de cet instrument. Il est dangereux de ne pas effectuer cette opération, car une tension élevée risque de se manifester au niveau du connecteur BNC.

**ATTENTION**

- Avant de connecter ou de déconnecter un CT de cet instrument, mettez cet instrument hors tension. La connexion ou la déconnexion du CT alors que l'appareil est sous tension peut endommager l'instrument ou le CT.
- Utilisez la borne d'alimentation du capteur de courant (en option) sur le panneau arrière de cet instrument uniquement comme alimentation électrique pour le CT60/CT200/CT1000/CT1000A/CT2000A. La connexion d'autres appareils peut endommager l'instrument ou le dispositif connecté.

***Note***

Warm up the CT60/CT200/CT1000/CT1000A/CT2000A for at least 30 minutes without input.

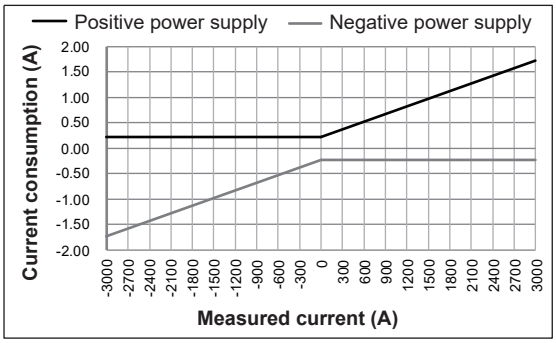
## Specifications of the current sensor power (/PD2 option)

| Item | Specifications |
|---|---|
| Number of channels | 6 |
| Connector type | D-sub9 pin (Plug) |
| Output voltage | ±15 V DC |
| Output current | 1.8 A/channel, 6 A total (6 channels) |

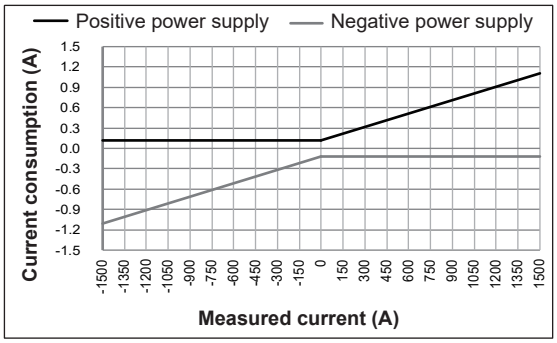
If you are connecting YOKOGAWA's CT series to the power supply terminal of this instrument's current sensor power option, make sure that the following current is not exceeded.
If exceeded, power supply to the CT series will stop due to the activation of the power supply overcurrent protection circuit of this instrument.

- 1.8 A/channel
- The total current of 6 power supply terminals is 6 A.

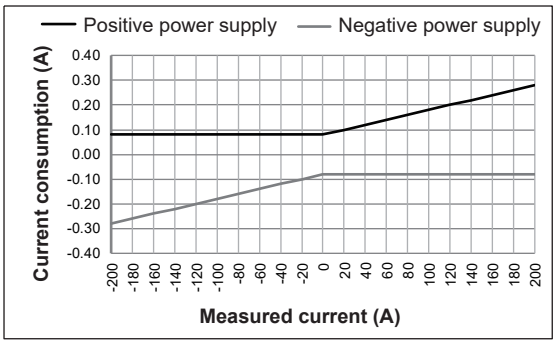
When using the CT series, the number of sensors that can be used is limited by the current generated by the device under measurement (current measured by the CT series).
The measured versus consumed current characteristics of CT series that can be connected to the instrument are indicated below.



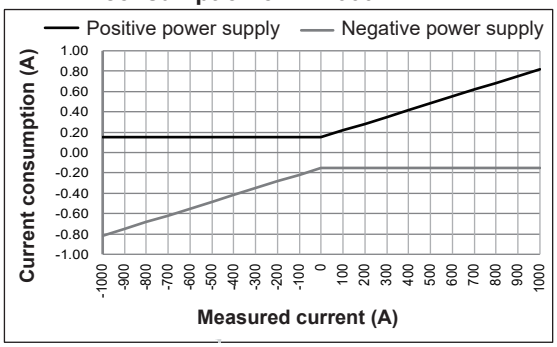

**Measured current vs. current consumption of CT2000A**



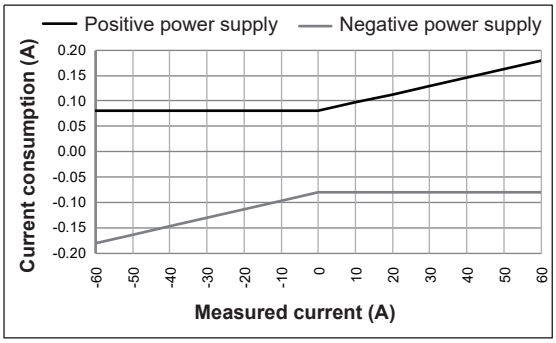

**Measured current vs. current consumption of CT1000A**




**Measured current vs. current consumption of CT200**




**Measured current vs. current consumption of CT1000**



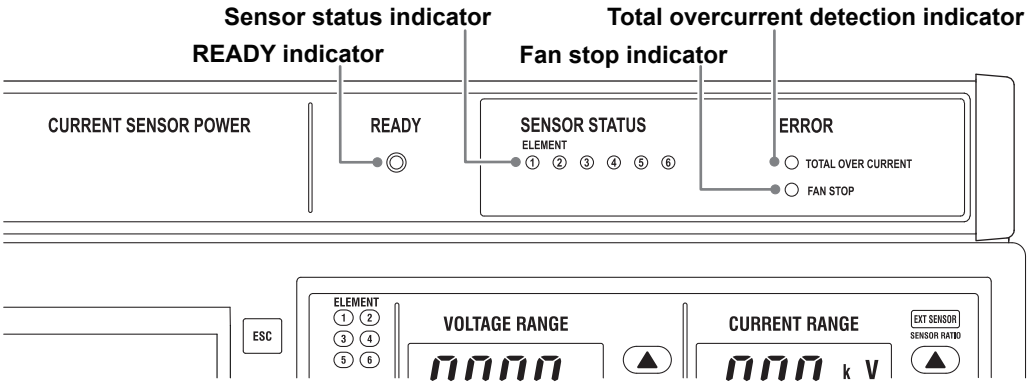

**Measured current vs. current consumption of CT60**

| Model | Current Rating | | Output Current | Current Transformation Ratio |
|---|---|---|---|---|
| | DC | AC | | |
| CT60 | 0 to 60 A | 60 Apeak | 100.0 mA when the primary current is 60 A | 600:1 |
| CT200 | 0 to 200 A | 200 Apeak | 200.0 mA when the primary current is 200 A | 1000:1 |
| CT1000 | 0 to 1000 A | 1000 Apeak | 666.6 mA when the primary current is 1000 A | 1500:1 |
| CT1000A | 0 to 1000 A | 1500 Apeak | 666.6 mA when the primary current is 1000 A | 1500:1 |
| CT2000A | 0 to 2000 A | 3000 Apeak | 1000.0 mA when the primary current is 2000 A | 2000:1 |

For details of CT specifications, refer to their manuals.

## Current sensor power status display

The current sensor power supply status is displayed with the following indicators.




### READY indicator

This indicator displays the status of the current sensor power supply (/PD2 option).

- Off: The current sensor power supply cannot be used. (Repair is necessary.)
- Green: The current sensor power supply can be used.
  Even when the READY indicator is lit in green, if the sensor status indicator, total overcurrent detection indicator, or fan stop indicator is lit in red, power supply to all CTs will stop.

### Sensor status indicator

The indicators display the CT connection status and the detection of overcurrent of elements 1 to 6.

- Off: A CT is not connected.
- Green: A CT is connected, and power is supplied to it.
  You can also check the presence of a power supply with the CT's NORMAL OPERATION indicator.
- Red: Overcurrent is detected. If overcurrent is detected on any CT, the power supply to that CT will stop.*

### Total overcurrent detection indicator

This indicator displays the detection of overcurrent in the total current of all CTs.

- Off: Overcurrent not detected.
- Red: Overcurrent is detected. The power supply to all CTs will stop.*

### Fan stop indicator

This indicator displays the detection of fan stoppage.

- Off: Fan stop not detected.
- Red: Fan stop detected. The power supply to all CTs will stop.*

* To resume the power supply, resolve the cause of the overcurrent, and then restart the instrument. If the indicator remains red even after restarting the instrument, repair is required.

When the power is turned on or off, the above indicators light for about 1 second in the following manner.

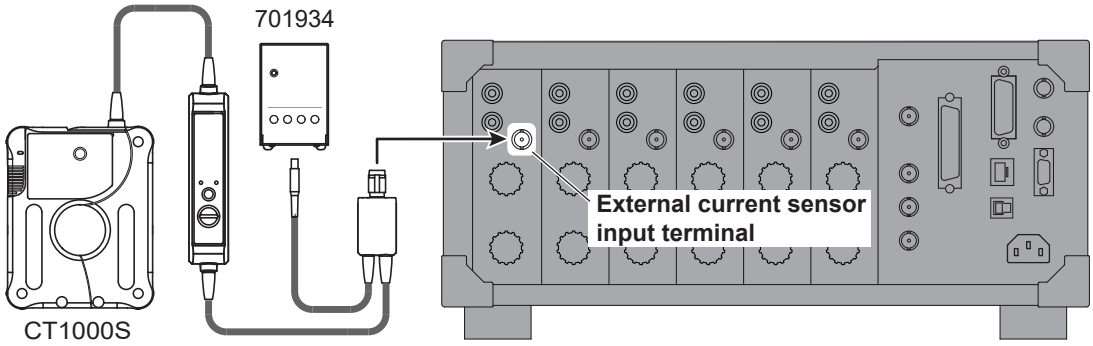
- READY indicator: Green
- Sensor status indicator: Orange
- Total overcurrent detection indicator, fan stop indicator: Red

### Configuration after connection

Set Sensor Preset and CT Preset according to the instructions in section 2.17, “Displaying the Menu for Configuring All Elements,” in the User’s Manual, IM WT1801R-02EN. If the configuration is not appropriate, readings will not be correct.

## Connecting the CT1000S using the 701934 power supply

A 701934 power supply (sold separately) can be used to supply power to YOKOGAWA’s CT1000S AC/DC split core current sensor. To do so, connect the 701934 and CT1000S to this instrument as follows:




***Note***

- Warm up the CT1000S for at least 30 minutes without input.
- When multiple CT1000Ss are used, do not allow their total current consumption to exceed the rated output current of the 701934. For detailed specifications of the CT1000S or 701934 , see their respective manuals.

## General VT and CT handling precautions

- Do not short the secondary side of a VT. Doing so may damage it.
- Do not open the secondary side of a CT that outputs current. Doing so may damage it.

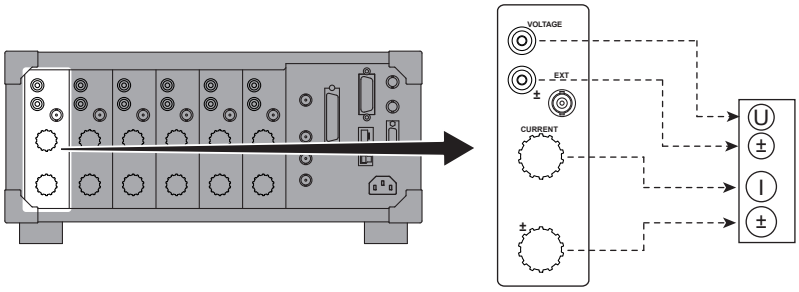
Also, follow the VT or CT handling precautions in the manual that comes with the VT or CT.

***Note***

- The thick lines on the wiring diagrams are the circuits where the current flows. Use wires that are suitable for the current levels.
- Make sure that you have the polarities correct when you make connections. If the polarity is reversed, the polarity of the measurement current will be reversed, and you will not be able to make correct measurements. Be especially careful when connecting clamp-type current sensors to the circuit under measurement, because it is easy to reverse the connection.
- Note that the frequency and phase characteristics of the VT or CT affect the measured data.
- For safety reasons, the common terminals (+/−) of the secondary side of the VT and CT are grounded in the wiring diagrams in this section. However, the necessity of grounding and the grounding location (ground near the VT or CT or ground near the power meter) vary depending on the item under measurement.
- To measure the apparent power and power factor more accurately on an unbalanced three-phase circuit, we recommend that you use a three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A).

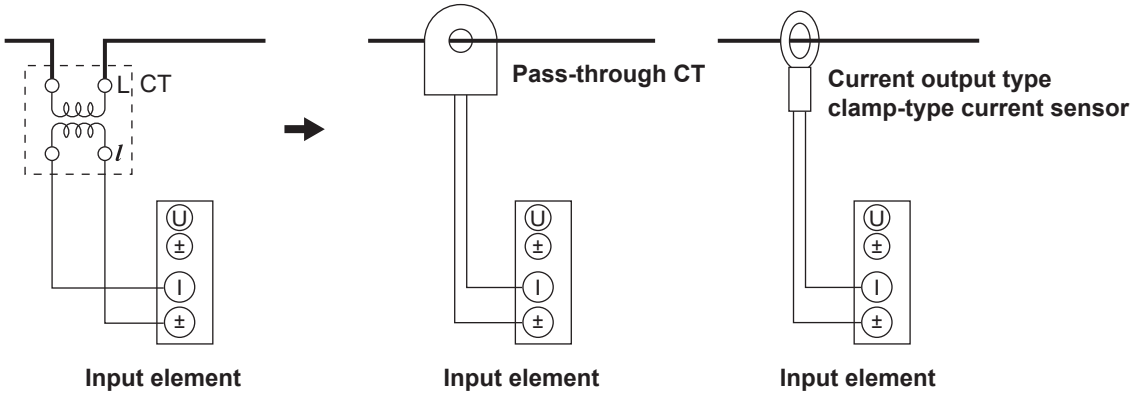
## Connecting to this instrument

In the wiring examples that follow, the input elements of this instrument, voltage input terminals, and current input terminals are shown simplified as follows.




**Input element**

Also, the wiring examples are for when a CT is connected. When connecting a pass-through CT or a clamp-type current sensor that outputs current, substitute the CT with the pass-through CT or clamp-type current sensor.




**Input element** **Input element** **Input element**

### *Note*

Some CTs (including pass-through types) require load resistance and power supplies. Check your CT's manual.

The wiring examples shown below are examples of the following wiring systems in which the specified input elements have been wired.
To wire other input elements, substitute the numbers in the figures with the appropriate element numbers.

- Single-phase two-wire systems (1P2W): Input element 1
- Single-phase three-wire system (1P3W) and three-phase three-wire system (3P3W): Input elements 1 and 2
- Three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A) and three-phase four-wire system (3P4W): Input elements 1 to 3

**CAUTION**

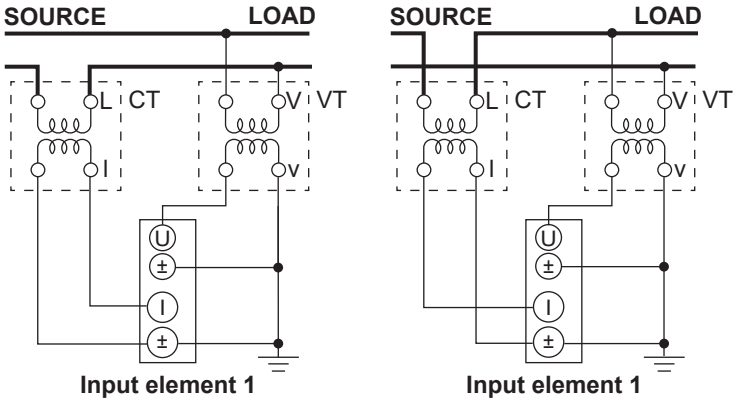
The thick lines on the wiring diagrams are the circuits where the current flows. Use wires that are suitable for the current levels.

**French**

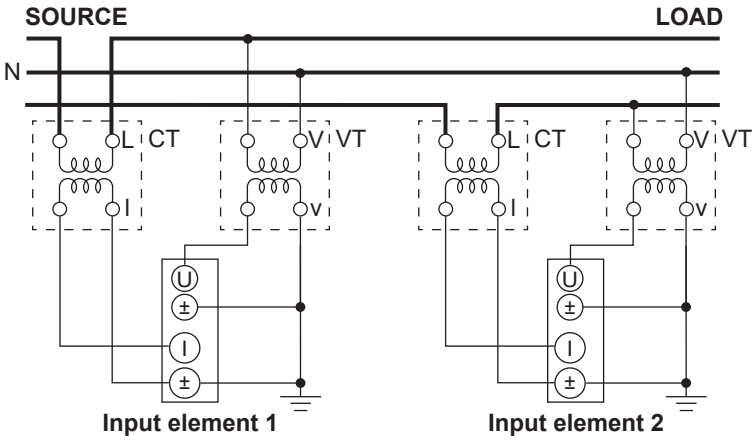
**ATTENTION**

Les lignes épaisses dans les schémas de câblage sont les circuits où circule le courant. Utilisez des fils adaptés aux niveaux de courant.

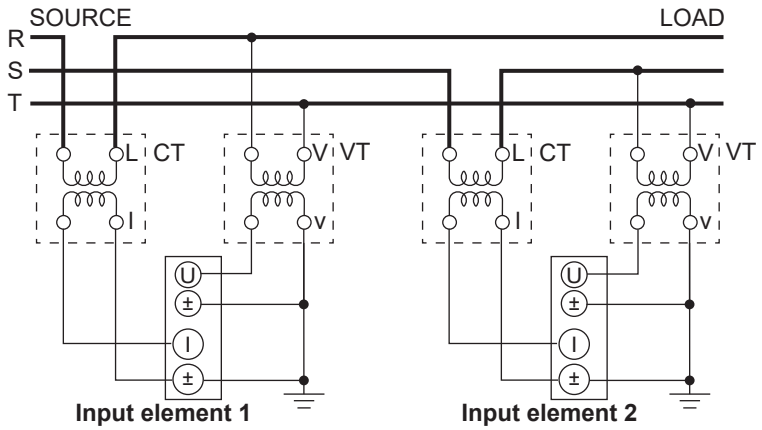
## Wiring example of single-phase two-wire systems (1P2W) with a VT and CT



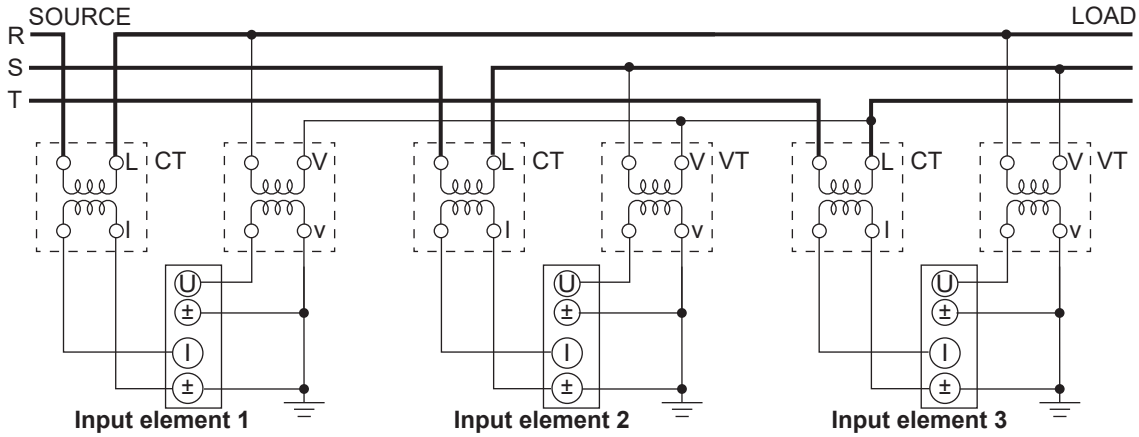

## Wiring example of a single-phase three-wire system (1P3W) with VTs and CTs



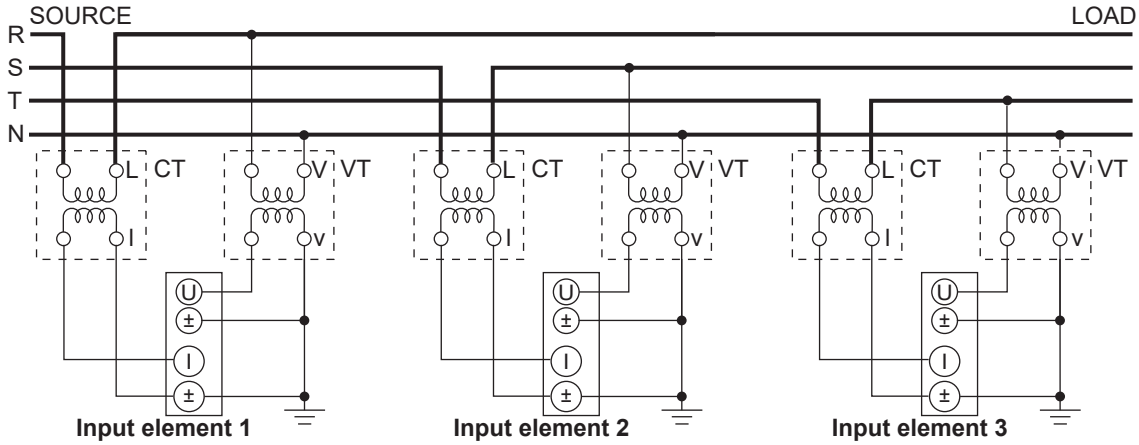
## Wiring example of a three-phase three-wire system (3P3W) with VTs and CTs




## Wiring example of a three-phase three-wire system that uses a three-voltage three-current method (3P3W; 3V3A) with VTs and CTs




## Wiring example of a three-phase four-wire system (3P4W) with VTs and CTs




### *Note*

For the relationship between the wiring system and how measurement and calculation values are determined, see appendix 1, “Symbols and Determination of Measurement Functions,” in the features guide, IM WT1801R-01EN.

# 3.1 Motor Torque and Revolution Signal Input (TORQUE/SPEED, option)

**CAUTION**

Only apply signals that meet the following specifications. Excessive voltage or the like may damage the instrument.

**French**

**ATTENTION**

Les signaux ne correspondant pas aux spécifications risquent d'endommager cet instrument, à cause de facteurs tels qu'une tension excessive.



## Torque signal input connector (TORQUE)


Apply a torque meter output signal—a DC voltage (analog) signal or pulse signal that is proportional to the motor's torque—that meets the following specifications. Use a safety BNC cable (sold separately).

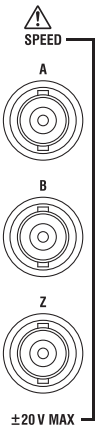
### DC voltage (analog input)

| Item | Specifications |
|---|---|
| Connector type | Isolated BNC |
| Input range | 1 V, 2 V, 5 V, 10 V, 20 V |
| Effective input range | 0 % to ±110 % of the measurement range |
| Input resistance | Approx. 1 MΩ |
| Maximum allowable input | ±22 V |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |

### Pulse input

| Item | Specifications |
|---|---|
| Connector type | Isolated BNC |
| Frequency range | 2 Hz to 1 MHz |
| Amplitude input range | ±12 Vpeak |
| Detection level | H level: approx. 2 V or more; L level: approx. 0.8 V or less |
| Pulse width | 500 ns or more |
| Input resistance | Approx. 1 MΩ |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |

# Revolution signal input connector (SPEED)




Apply a revolution sensor output signal—a DC voltage (analog) signal or pulse signal that is proportional to the motor's rotating speed—that meets the following specifications. Use a safety BNC cable (sold separately).

## DC voltage (analog input)

| Item | Specifications |
|---|---|
| Connector type | Isolated BNC |
| Input range | 1 V, 2 V, 5 V, 10 V, 20 V |
| Effective input range | 0 % to ±110 % of the measurement range |
| Input resistance | Approx. 1 MΩ |
| Maximum allowable input | ±22 V |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |

## Pulse input

| Item | Specifications |
|---|---|
| Connector type | Isolated BNC |
| Frequency range | 2 Hz to 1 MHz |
| Amplitude input range | ±12 Vpeak |
| Detection level | H level: approx. 2 V or more; L level: approx. 0.8 V or less |
| Pulse width | 500 ns or more |
| Input resistance | Approx. 1 MΩ |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |

## Terminal for analog input

Apply analog input to terminal A.

## Terminal for pulse input

- If you do not need to detect the revolution direction of a revolution signal (SPEED), apply pulse input to terminal A.
- If you need to detect the revolution direction, apply phase A and phase B of a rotary encoder signal to terminals A and B, respectively.
- If you need to measure the electrical angle, apply phase Z of a rotary encoder signal to terminal Z.

# 3.2 Auxiliary Input (AUX1/AUX2, option)

**CAUTION**

Only apply signals that meet the following specifications. Excessive voltage or the like may damage the instrument.

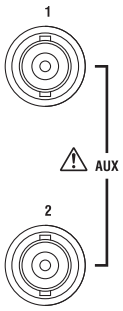
**French**

**ATTENTION**

Les signaux ne correspondant pas aux spécifications risquent d'endommager cet instrument, à cause de facteurs tels qu'une tension excessive.



## Auxiliary input connectors (AUX1/AUX2)




Apply a sensor output DC voltage signal (an analog signal) that meets the following specifications. Use a safety BNC cable (sold separately).

### DC voltage (analog input)

| Item | Specifications |
|---|---|
| Connector type | Isolated BNC |
| Input range | 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V, 20 V |
| Effective input range | 0 % to ±110 % of the measurement range |
| Input resistance | Approx. 1 MΩ |
| Maximum allowable input | ±22 V |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |

# 3.3 External Clock Input (EXT CLK IN)

**CAUTION**

Only apply signals that meet the following specifications. Excessive voltage or the like may damage the instrument.

**French**

**ATTENTION**

Les signaux ne correspondant pas aux spécifications risquent d'endommager cet instrument, à cause de facteurs tels qu'une tension excessive.

## External clock signal input connector


Apply a clock signal that meets the following specifications to the external clock input connector (EXT CLK) on the rear panel.

### Common

| Item | Specifications |
|---|---|
| Connector type | BNC |
| Input level | TTL(0 to 5 V) |

### To apply a sync source that determines the measurement period

| Item | Specifications |
|---|---|
| Frequency range | Same as the measurement ranges listed under "Frequency measurement" in section 5.5, "Features." |
| Input waveform | 50 % duty cycle rectangular wave |

### To apply a PLL source during harmonic measurement

| Item | Specifications |
|---|---|
| Frequency range | 0.5 Hz to 2.6 kHz |
| Input waveform | 50 % duty cycle rectangular wave |

### To apply a trigger source for displaying waveforms

| Item | Specifications |
|---|---|
| Minimum pulse width | 1 µs |
| Trigger delay | Within 1 µs + 3 sample cycles |

# 3.4 External Start Signal I/O (MEAS START)



**CAUTION**

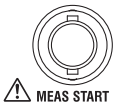
- When the instrument is set to master, do not apply external voltage to the external start signal input/output connector (MEAS. START). Doing so may damage the instrument.
- When the instrument is set to slave or when External Sync is on in high speed data capturing mode, only apply signals that meet the following specifications to the external start signal I/O connector. Excessive voltage or the like may damage the instrument.

**French**

**ATTENTION**

- Lorsque l'instrument est réglé sur maître, n'appliquez pas de tension externe au connecteur d'entrée/sortie du signal de démarrage externe (DÉMAR. MESURE). Cela pourrait endommager l'instrument.
- Si l'instrument est réglé sur esclave ou si la synchronisation externe est activée en mode de capture de données à grande vitesse, appliquez uniquement les signaux qui répondent aux spécifications suivantes au connecteur d'E/S de signal de démarrage externe. Une tension excessive, ou autre fait similaire, peut endommager l'instrument.

## External start signal I/O connector




### To apply a master/slave synchronization signal during normal measurement

Connect the external start signal I/O connectors on the rear panels of the master and slave instruments using a BNC cable (sold separately).

| Item | Specifications | Notes |
|---|---|---|
| Connector type | BNC | Same for both master and slave |
| I/O level | TTL(0 to 5 V) | Same for both master and slave |
| Output logic | Negative logic, falling edge | Apply to master |
| Output hold time | Low level, 500 ns or more | Apply to master |
| Input logic | Negative logic, falling edge | Apply to slaves |
| Minimum pulse width | Low level, 500 ns or more | Apply to slaves |
| Measurement start delay | Within 15 sample cycles | Apply to master |
| | Within 1 µs + 15 sample cycles | Apply to slaves |

### *Note*

The measurement of the master and slave units cannot be synchronized under the following conditions:

- When the data update interval differs between the master and slave
- In real-time integration mode or real-time storage mode

Follow the procedure below to hold values during synchronized measurement.

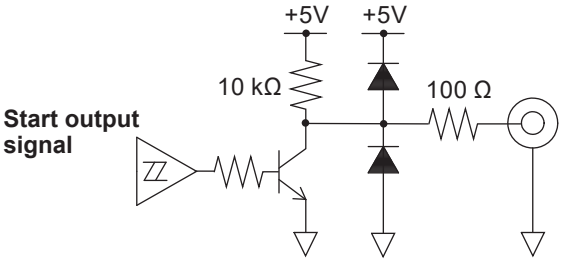
- To hold the display, hold the display on the master first.
- To release the hold, release the hold on the slaves first.

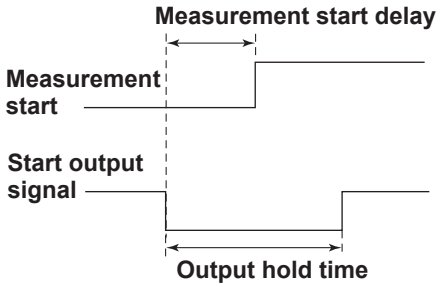
## To apply a external synchronization signal during high speed data capturing

Apply an external synchronization signal that meets the following specifications to the external start signal I/O connector (MEAS START) on the rear panel.

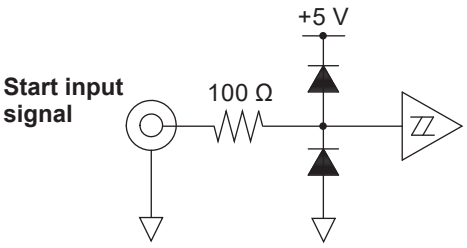
| Item | Specifications |
|---|---|
| Connector type | BNC |
| Input level | TTL(0 to 5 V) |
| Input logic | Negative logic, falling edge |
| Minimum pulse width | Low level, 500 ns or more |
| Measurement start delay | Within 1 µs + 15 sample cycles |

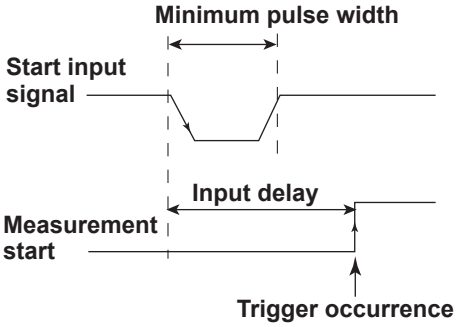
## External start signal output circuit and timing chart




## External start signal input circuit and timing chart



# 3.5 RGB Output (RGB OUT (XGA), option)

**CAUTION**

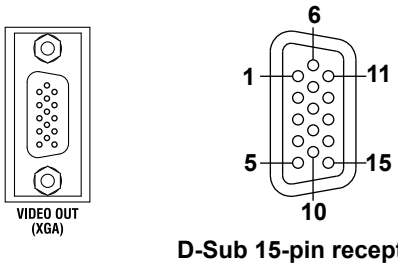
- Connect the cable after turning off this instrument and the monitor.
- Do not short the VIDEO OUT terminal or apply external voltage to it. Doing so may damage the instrument.

**French**

**ATTENTION**

- Connecter le câble après avoir mis cet instrument et le moniteur hors tension.
- Ne pas court-circuiter la borne VIDEO OUT et ne pas appliquer de tension de sortie. Cela pourrait endommager l'instrument.

## RGB output terminal




**D-Sub 15-pin receptacle**

RGB output allows the screen of this instrument to be displayed on a monitor. Any multisync monitor that supports XGA can be connected.

| Item | Specifications |
|---|---|
| Connector type | D-sub 15-pin |
| Output type | Analog RGB output |
| Output resolution | XGA output, 1024 × 768 dots, approx. 60 Hz Vsync |

| Pin No. | Signal | Specifications |
|---|---|---|
| 1 | Red | 0.7 $V_{P-P}$ |
| 2 | Green | 0.7 $V_{P-P}$ |
| 3 | Blue | 0.7 $V_{P-P}$ |
| 4 | — | |
| 5 | — | |
| 6 | GND | |
| 7 | GND | |
| 8 | GND | |
| 9 | — | |

| Pin No | Signal | Specifications |
|---|---|---|
| 10 | GND | |
| 11 | — | |
| 12 | — | |
| 13 | Horizontal sync signal | Approx. 36.4 kHz, TTL positive logic |
| 14 | Vertical sync signal | Approx. 60 Hz, TTL positive logic |
| 15 | — | |

### Connecting to a monitor

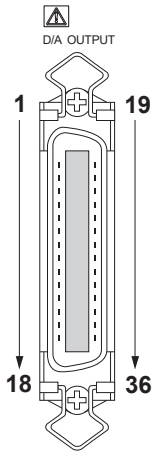
1. Turn off this instrument and the monitor.
2. Connect this instrument and the monitor using an analog RGB cable.
3. Turn on this instrument and the monitor.

# 3.6 D/A Output and Remote Control (D/A OUTPUT, option)

If you select the /DA option, 20-channel D/A output and remote control features are installed in this instrument.

## Connector pinout

The connector's pinout is explained in the table below.




| Pin No. | Signal | Pin No. | Signal |
|---|---|---|---|
| 1 | D/A CH1 | 19 | D/A CH2 |
| 2 | D/A CH3 | 20 | D/A CH4 |
| 3 | D/A CH5 | 21 | D/A CH6 |
| 4 | D/A CH7 | 22 | D/A CH8 |
| 5 | D/A CH9 | 23 | D/A CH10 |
| 6 | D/A CH11 | 24 | D/A CH12 |
| 7 | D/A CH13 | 25 | D/A CH14 |
| 8 | D/A CH15 | 26 | D/A CH16 |
| 9 | D/A CH17 | 27 | D/A CH18 |
| 10 | D/A CH19 | 28 | D/A CH20 |
| 11 | D/A COM | 29 | D/A COM |
| 12 | D/A COM | 30 | D/A COM |
| 13 | D/A COM | 31 | D/A COM |
| 14 | Not Connected | 32 | $\overline{\text{EXT RESET}}$ |
| 15 | $\overline{\text{EXT STOP}}$ | 33 | $\overline{\text{EXT START}}$ |
| 16 | $\overline{\text{EXT SINGLE}}$ | 34 | $\overline{\text{EXT HOLD}}$ |
| 17 | $\overline{\text{INTEG BUSY}}$ | 35 | EXT COM |
| 18 | EXT COM | 36 | EXT COM |

***Note***

The D/A COM and EXT COM signals are connected internally.

## D/A output (D/A OUTPUT)

You can generate numeric data as ±5 V FS DC voltage signals from the rear panel D/A output connector. You can set up to 20 items (channels).

**CAUTION**

- Do not short or apply an external voltage to the D/A output terminal. Doing so may damage the instrument.
- When connecting the D/A output to another device, do not connect the wrong signal pin. Doing so may damage this instrument or the connected instrument.

**French**

**ATTENTION**

- Ne court-circuitez pas et n'appliquez pas de tension externe à la borne de sortie D/A. Cela pourrait endommager l'instrument.
- Lors du raccordement de la sortie D/A à un autre appareil, ne connectez pas la mauvaise broche de signal. Cela pourrait endommager cet instrument ou l'instrument connecté.

| Item | Specifications |
|---|---|
| D/A conversion resolution | 16 bits |
| Output voltage | Each rated value ±5 V FS (maximum of approx. ±7.5 V) |
| Update interval | Same as the data update interval of this instrument<br>(if the waveform display is enabled and the trigger mode is set to Auto or Normal, the data update interval depends on the trigger operation) |
| Number of outputs | 20 channels (the output items can be set for each channel) |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |
| Relationship between output items and D/A output voltage | See the features guide. |

## Remote control

Through external control, you can hold values; perform single measurements; and start, stop, and reset integration.

**CAUTION**

Do not apply voltage outside the range of 0 to 5 V to the remote control input pins. Do not short or apply external voltages to the output pins. Doing so may damage the instrument.

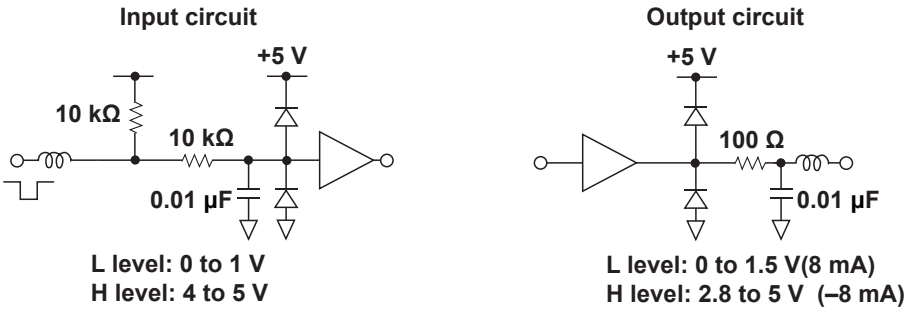
**French**

**ATTENTION**

N'appliquez pas de tension en dehors de la plage de 0 à 5 V aux broches d'entrée de la télécommande. Ne court-circuitez pas et n'appliquez pas de tensions externes aux broches de sortie. Cela pourrait endommager l'instrument.

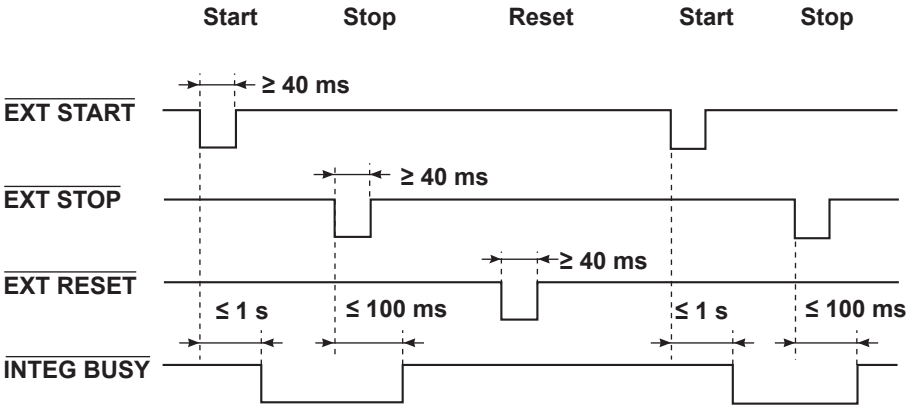
| Item | Specifications |
|---|---|
| Input signal | $\overline{\text{EXT START}}$, $\overline{\text{EXT STOP}}$, $\overline{\text{EXT RESET}}$, $\overline{\text{EXT HOLD}}$, $\overline{\text{EXT SINGLE}}$ |
| Output signal | $\overline{\text{INTEG BUSY}}$ |
| Input level | 0 to 5 V |

## Remote control I/O circuit




## Controlling integration remotely

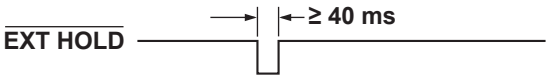
Apply signals according to the following timing chart.




**The $\overline{\text{INTEG BUSY}}$ output signal is set to low level during integration.**
Use this signal when you are observing integration.

## Holding the updating of displayed data (the same functionality as pressing HOLD)

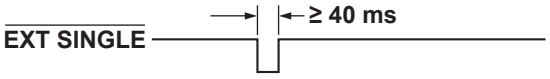
Apply an $\overline{\text{EXT HOLD}}$ signal as shown in the following figure.




When an $\overline{\text{EXT HOLD}}$ signal is input in the held state, the hold is released.

## Updating held display data (the same functionality as pressing SINGLE)

While the display is held, you can update it by applying an $\overline{\text{EXT SINGLE}}$ signal.




***Note***

If the width of the input signal's low pulse does not meet the conditions shown in the figure, the signal may not be detected by this instrument.

# 4.1 Troubleshooting

## Dealing with problems

If a message appears on the screen, see the appendix in the user's manual, IM WT1801R-02EN.
If servicing is necessary, or if the instrument does not operate properly even after you have attempted to deal with the problem according to the instructions in this section, contact your nearest YOKOGAWA dealer.

| Problems and Solutions | | Reference Section |
|---|---|---|
| Nothing appears on the screen when the power is turned on. | | |
| | Securely connect the power cord to the instrument and to the power outlet. | 2.3 |
| | Set the supply voltage to within the permitted range. | 2.3 |
| | Check the screen settings. | 21.2[1] |
| | The built-in power supply fuse may have blown. Servicing is required. | 4.2 |
| The displayed data is not correct. | | |
| | Confirm that the ambient temperature and humidity are within their specified ranges. | 2.2 |
| | Ensure that noise is not producing any adverse effects. | 2.1, 2.5 |
| | Check the measurement cable wiring. | 2.8 to 2.11 |
| | Check the wiring system. | 2.8 to 2.11, 2.1[1] |
| | Confirm that the line filter is off. | 2.13[1] |
| | Check the measurement period settings. | 2.12[1] |
| | Turn the power off and then on again. | 2.4 |
| Keys do not work. | | |
| | Check the REMOTE indicator. If the REMOTE indicator is lit, press LOCAL to turn it off. | — |
| | Confirm that keys are not locked. | 21.8[1] |
| | Perform a key test. If the test fails, servicing is required. | 21.5[1] |
| Triggering does not work. | | |
| | Check the trigger conditions. | 10.1[1] |
| | Confirm that the trigger source is being applied. | 10.1[1] |
| Unable to make harmonic measurements. | | |
| | Check the PLL source settings. | 3.1[1] |
| | Confirm that the input signal that you selected for the PLL source meets the specifications. | 3.1[1] |
| Unable to recognize a storage device. | | |
| | Check the storage device format. If necessary, format the storage device. | — |
| | The storage device may be damaged. | — |
| Unable to save data to the selected storage device. | | |
| | Check the free space on the storage device. Remove files or use a different storage device as necessary. | — |
| | If necessary, format the storage device. | — |
| Unable to configure or control the instrument through the communication interface. | | |
| | Confirm that the GP-IB address and the IP address settings meet the specifications. | —[2] |
| | Confirm that the interface meets the electrical and mechanical specifications. | —[2] |

1 See the User's Manual, IM WT1801R-02EN.
2 See the Communication Interface User's Manual, IM WT1801R-17EN.

## 4.2 Power Supply Fuse

Because the power supply fuse used by this instrument is inside the case, you cannot replace it yourself. If you suspect that the power supply fuse inside the case has blown, contact your nearest YOKOGAWA dealer.

## 4.3 Recommended Replacement Parts

The life and replacement period for expendable items varies depending on the conditions of use. Refer to the table below as a general guideline.
For part replacement and purchase, contact your nearest YOKOGAWA dealer.

### Consumable parts

We recommend replacement at the following cycles.

| Part Name | Recommended Replacement Cycle |
|---|---|
| Cooling fan | 3 years |
| Backup battery (lithium battery) | 3 years |

# 5.1 Input

| Item | Specifications |
|---|---|
| Input terminal type | Voltage<br>Plug-in terminal (safety terminal)<br>Current<br>• Direct input: large binding post<br>• External current sensor input: isolated BNC connector |
| Input type | Voltage<br>Floating input through resistive voltage divider<br>Current<br>Floating input through shunt |
| Measurement range | Voltage<br>1.5/3/6/10/15/30/60/100/150/300/600/1000 V (crest factor CF3)<br>0.75/1.5/3/5/7.5/15/30/50/75/150/300/500 V (crest factor CF6 or CF6A)<br>Current<br>• Direct input<br>50 A input element<br>1/2/5/10/20/50 A (crest factor CF3)<br>500 m/1/2.5/5/10/25 A crest factor (CF6 or CF6A)<br>5 A input element<br>10 m/20 m/50 m/100 m/200 m/500 m/1/2/5 A (crest factor CF6/CF3)<br>5 m/10 m/25 m/50 m/100 m/250 m/500 m/1/2.5 A (crest factor CF6 or CF6A)<br>• External current sensor input<br>50 m/100 m/200 m/500 m/1/2/5/10 V (crest factor CF6/CF3)<br>25 m/50 m/100 m/250 m/500 m/1/2.5/5 V (crest factor CF6 or CF6A) |
| Instrument loss | Voltage<br>Input resistance: approx. 2 MΩ; input capacitance: approx. 10 pF<br>Current<br>• Direct input<br>50 A input element: approx. 2 mΩ + approx. 0.07 μH<br>5 A input element: approx. 100 mΩ + approx. 0.07 μH<br>• External current sensor input: approx. 1 MΩ |
| Instantaneous maximum allowable input (within 20 ms) | Voltage<br>Peak value of 4 kV or rms value of 2 kV, whichever is less.<br>Current<br>• Direct input (50 A input element): peak value of 450 A or rms value of 300 A, whichever is less<br>• Direct input (5 A input element): peak value of 30 A or rms value of 15 A, whichever is less<br>• External current sensor input: peak value less than or equal to 10 times the range |
| Instantaneous maximum allowable input (within 1 s) | Voltage<br>Peak value of 3 kV or rms value of 1.5 kV, whichever is less.<br>Current<br>• Direct input (50 A input element): peak value of 150 A or rms value of 55 A, whichever is less<br>• Direct input (5 A input element): peak value of 10 A or rms value of 7 A, whichever is less<br>• External current sensor input: peak value less than or equal to 10 times the range |
| Continuous maximum allowable input | Voltage<br>Peak value of 2 kV or rms value of 1.1 kV, whichever is less.<br>If the frequency of the input voltage exceeds 100 kHz, (1200 − f) Vrms or less<br>f is the frequency of the input voltage in units of kHz.<br>Current<br>• Direct input (50 A input element): peak value of 150 A or rms value of 55 A, whichever is less<br>• Direct input (5 A input element): peak value of 10 A or rms value of 7 A, whichever is less<br>• External current sensor input: peak value less than or equal to 5 times the range |
| Continuous maximum common-mode voltage (50/60 Hz) | Voltage input terminals: 1000 Vrms<br>Current input terminals:<br>with /EX1 to /EX6 option*: 1000 Vrms (maximum allowable voltage that can be measured)<br>600 Vrms (rated voltage as specified by the safety standard)<br>without /EX1 to /EX6 option: 1000 Vrms<br>External current sensor input connector: 600 Vrms |

| Item | Specifications |
|---|---|
| Influence of common-mode voltage | When 1000 Vrms is applied between the input terminal and case with the voltage input terminals shorted, current input terminals open and external current sensor input terminals shorted.<br>• 50/60 Hz: ±0.01 % of range or less.<br>• Reference value for up to 100 kHz:<br>±{(maximum rated range)/(rated range) × 0.001 × f % of range} or less<br>For the external current sensor input, add maximum range rating/range rating × {0.0125 × log(f × 1000) - 0.021} % of range to the above. 0.01 % or greater.<br>The unit of f is kHz. The maximum rated range in the formula is 1000 V, 50 A, 5 A, or 10 V. |
| Line filter | Select from OFF, 100 Hz to 100 kHz (in steps of 100 Hz), 300 kHz, and 1 MHz. |
| Frequency filter | Select from OFF, 100 Hz, and 1 kHz. |
| Frequency filter when the data update interval is Auto | Select from OFF, 100 Hz, 200 Hz, 400 Hz, 800 Hz, 1.6 kHz, 3.2 kHz, 6.4 kHz, 12.8 kHz, and 25.6 kHz. |
| A/D converter | Converts voltage and current inputs simultaneously<br>Resolution: 16 bits<br>Conversion rate (sampling interval): approx. 500 ns. For the values when displaying harmonics, see the sections on harmonic measurement. |
| Range switching | The range can be set for each input element. |
| Auto range feature | Range increase<br>• When Urms or Irms exceeds 110 % of the measurement range (220 % for crest factor CF6).<br>• When the peak value of the input signal exceeds approximately 330 % (approximately 660 % for crest factor CF6 or CF6A) of the range.<br>Range decrease<br>The range is decreased when all the following conditions are met.<br>• The measured Urms or Irms value is less than or equal to 30 % of the range.<br>• The measured Urms or Irms is less than or equal to 105 % of the next lower range.<br>• The measured Upk or Ipk value is less than or equal to 300 % (approximately 600 % when the crest factor is set to CF6 or CF6A) of the lower range. |
| Rated voltage to ground | Voltage input terminals: 1000 V<br>Current input terminals:<br>with /EX1 to /EX6 option*: 1000 V (maximum allowable voltage that can be measured)<br>600 V (rated voltage as specified by the safety standard)<br>without /EX1 to /EX6 option: 1000 V<br>External current sensor input connector: 600 V |

* Do not touch the inside of the external current sensor input BNC connector.

# 5.2 Display

| Item | Specifications |
|---|---|
| Display | 8.4-inch color TFT LCD |
| Resolution of the entire screen* | 1024 × 768 dots (H × V) |
| Display update interval | Same as the data update interval<br>However,<br>1) When only the numeric display is in use and the data update interval is 50 ms, 100 ms, or 200 ms, the display update interval is a value in the range of 200 ms to 500 ms (the interval varies depending on the number of displayed items).<br>2) When a display other than the numeric display (including the Custom display) is in use and the data update interval is 50 ms, 100 ms, 200 ms, or 500 ms, the display update interval is 1 s.<br>3) If the measurement mode display is set to Normal Mode (Trg), measurement takes place from when a trigger is detected over the data update interval. The following amount of time is required for the instrument to calculate the measured data, process it for displaying, and so on, and become ready for the next trigger.<br>• When the data update interval is 50 ms to 500 ms: approx. 1 s<br>• When the data update interval is 1 s to 5 s: data update interval + 500 ms<br>In this case, storage, communication output, and D/A output operate in sync with the triggers.<br>If the measurement mode display is set to Normal Mode, storage, communication output, and D/A output operate in sync with the data update interval.<br>4) When the data update interval is Auto, the numeric display update interval is 200 ms or more. The interval is 1 s or more for displays other than the numeric display, including the Custom display. |

* About 0.002 % of the pixels on the LCD screen may be defective.

# 5.3 Displayed Items

## Numeric display

### Measurement functions determined for each input element

For how measurement functions are obtained and details on formulas, see appendix 1 in the Features Guide, IM WT1801R-01EN.

| Item | Symbols and Meanings |
|---|---|
| Voltage (V) | Urms: true rms value, Umn: rectified mean value calibrated to the rms value, Udc: simple average, Urmn: rectified mean value, Uac: AC component |
| Current (A) | Irms: true rms value, Imn: rectified mean value calibrated to the rms value, Idc: simple average, Irmn: rectified mean value, Iac: AC component |
| Active power (W) | P |
| Apparent power (VA) | S |
| Reactive power (var) | Q |
| Power factor | λ |
| Phase difference (°) | Φ |
| Frequency (Hz) | fU (FreqU): voltage frequency, fI (FreqI): current frequency<br>Simultaneously measures all fU and fI of element 1 to 6 |
| Voltage max. and min. (V) | U+pk: maximum voltage, U-pk: minimum voltage |
| Current max. and min. (A) | I+pk: maximum current, I-pk: minimum current |
| Power max. and min. (W) | P+pk: maximum power, P-pk: minimum power |
| Crest factor (peak-to-rms ratio) | CfU: voltage crest factor, CfI: current crest factor |
| Corrected Power (W) | Pc Applicable standards: IEC76-1 (1976), IEC76-1 (2011) |
| Integration | Time: integration time<br>WP: sum of positive and negative watt hours<br>WP+: sum of positive P (consumed watt hours)<br>WP−: sum of negative P (watt hours returned to the power supply)<br>q: sum of positive and negative ampere hours<br>q+: sum of positive I (ampere hours)<br>q−: sum of negative I (ampere hours)<br>WS: volt-ampere hours*<br>WQ: var hours*<br>By using the current mode setting, you can select to integrate the ampere hours using Irms, Imn, Idc, Irmn, or Iac. |

* Not calculated when the data update interval is Auto.

### Measurement functions (σ functions) determined for each wiring unit (ΣA, ΣB, ΣC)

For how Σ functions are obtained and details on formulas, see appendix 1 in the Features Guide, IM WT1801R-01EN.

| Item | Symbols and Meanings |
|---|---|
| Voltage (V) | UrmsΣ: true rms value, UmnΣ: rectified mean value calibrated to the rms value, UdcΣ: simple average, UrmnΣ: current rectified mean value, UacΣ: AC component |
| Current (A) | IrmsΣ: true rms value, ImnΣ: rectified mean value calibrated to the rms value, IdcΣ: simple average, IrmnΣ: current rectified mean value, IacΣ: AC component |
| Active power (W) | PΣ |
| Apparent power (VA) | SΣ |
| Reactive power (var) | QΣ |
| Power factor | λΣ |
| Phase difference (°) | ΦΣ |
| Corrected Power(W) | PcΣ Applicable standards: IEC76-1 (1976), IEC76-1 (2011) |
| Integration | WPΣ: sum of positive and negative watt hours<br>WP+Σ: sum of positive P (consumed watt hours)<br>WP−Σ: sum of negative P (watt hours returned to the power supply)<br>qΣ: sum of positive and negative ampere hours<br>q+Σ: sum of positive I (ampere hours)<br>q−Σ: sum of negative I (ampere hours)<br>WSΣ: integrated value of SΣ*<br>WQΣ: integrated value of QΣ* |

* Not calculated when the data update interval is Auto.

# Harmonic measurement (option)

## Measurement functions determined for each input element

| Item | Symbols and Meanings | |
|---|---|---|
| Voltage (V) | U(k): rms voltage value of harmonic order k[1] | U: total rms voltage[2] |
| Current (A) | I(k): rms current value of harmonic order k | I: total rms current[2] |
| Active power (W) | P(k): active power of harmonic order k | P: total active power[2] |
| Apparent power (VA) | S(k): apparent power of harmonic order k | S: total apparent power[2] |
| Reactive power (var) | Q(k): reactive power of harmonic order k | Q: total reactive power[2] |
| Power factor | λ(k): power factor of harmonic order k | λ: total power factor[2] |
| Phase difference (°) | Φ(k): phase difference between the voltage and current of harmonic order k, Φ: total phase difference<br>ΦU(k): phase difference between harmonic voltage U(k) and the fundamental wave U(1)<br>ΦI(k): phase difference between harmonic current I(k) and the fundamental wave I(1) | |
| Load circuit impedance (Ω) | Z(k): impedance of the load circuit in relation to harmonic order k | |
| Load circuit resistance and reactance (Ω) | Rs(k): resistance of the load circuit in relation to harmonic order k when resistor R, inductor L, and capacitor C are connected in series<br>Xs(k): reactance of the load circuit in relation to harmonic order k when resistor R, inductor L, and capacitor C are connected in series<br>Rp(k): resistance of the load circuit in relation to harmonic order k when R, L, and C are connected in parallel<br>Xp(k): reactance of the load circuit in relation to harmonic order k when R, L, and C are connected in parallel | |
| Harmonic distortion factor (%) | Uhdf(k): ratio of harmonic voltage U(k) to U(1) or U<br>Ihdf(k): ratio of harmonic current I(k) to I(1) or I<br>Phdf(k): ratio of harmonic active power P(k) to P(1) or P | |
| Total harmonic distortion (%) | Uthd: ratio of the total harmonic voltage to U(1) or U[3]<br>Ithd: ratio of the total harmonic current to I(1) or I[3]<br>Pthd: ratio of the total harmonic active power to P(1) or P[3] | |
| Telephone harmonic factor (applicable standard: IEC 34-1 (1996)) | Uthf: voltage telephone harmonic factor, Ithf: current telephone harmonic factor | |
| Telephone influence factor (applicable standard: IEEE Std 100 (1996)) | Utif: voltage telephone influence factor, Itif: current telephone influence factor | |
| Harmonic voltage factor[4] | hvf: harmonic voltage factor | |
| Harmonic current factor[4] | hcf: harmonic current factor | |
| K-factor | Ratio of the sum of squares whose harmonic components are weighted to the sum of squares of the electric current harmonics | |

1 Harmonic order k is an integer from 0 to the upper limit of harmonic analysis. The 0th order is the DC component. The upper limit is determined automatically according to the PLL source frequency. It can go up to the 500th harmonic order.
2 The total value is determined according to the formula in Appendix 1 of the User's Manual, IM WT1801R-01EN, from the fundamental wave (1st harmonic) and all harmonic components (2nd harmonic to the upper limit of harmonic analysis). The DC component can also be included.
3 Total harmonic values are determined from all harmonic components (the 2nd harmonic to the upper limit of harmonic analysis) according to the formulas in Appendix 1 of the User's Manual, IM WT1801R-01EN,.
4 The expression may vary depending on the definitions in the standard. For details, see the corresponding standard.

### Measurement functions that indicate fundamental voltage and current phase differences between input elements

These measurement functions indicate the phase differences between the fundamental voltage U(1) of the smallest numbered input element in a wiring unit and the fundamental voltages U(1) or currents I(1) of other input elements. The following table indicates the measurement functions for a wiring unit that combines elements 1, 2, and 3.

| Item | Symbols and Meanings |
|---|---|
| Phase angle U1-U2 (°) | ΦU1-U2: phase angle between the fundamental voltage of element 1, which is expressed as U1(1), and the fundamental voltage of element 2, which is expressed as U2(1) |
| Phase angle U1-U3 (°) | ΦU1-U3: phase angle between U1(1) and the fundamental voltage of element 3, U3(1) |
| Phase angle U1-I1 (°) | ΦU1-I1: phase angle between U1(1) and the fundamental current of element 1, I1(1) |
| Phase angle U2-I2 (°) | ΦU2-I2: phase angle between U2(1) and the fundamental current of element 2, I2(1) |
| Phase angle U3-I3 (°) | ΦU3-I3: phase angle between U3(1) and the fundamental current of element 3, I3(1) |
| EaU1 to EaU6 (°), EaI1 to EaI6(°) | Phase angles of the fundamental waves of U1 to I6 relative to the rising edge of the signal received through the Z terminal of the motor evaluation function |

### Measurement functions (σ functions) determined for each wiring unit (ΣA, ΣB, ΣC)

| Item | Symbols and Meanings | |
|---|---|---|
| Voltage (V) | UΣ(1): rms voltage of harmonic order 1 | UΣ: total rms voltage[1] |
| Current (A) | IΣ(1): rms current of harmonic order 1 | IΣ: total rms current[1] |
| Active power (W) | PΣ(1): active power of harmonic order 1 | PΣ: total active power[1] |
| Apparent power (VA) | SΣ(1): apparent power of harmonic order 1 | SΣ: total apparent power[1] |
| Reactive power (var) | QΣ(1): reactive power of harmonic order 1 | QΣ: total reactive power[1] |
| Power factor | λΣ(1): power factor of harmonic order 1 | λΣ: total power factor[1] |

1 The total value is determined according to the formula in Appendix 1 of the User's Manual, IM WT1801R-01EN, from the fundamental wave (1st harmonic) and all harmonic components (2nd harmonic to the upper limit of harmonic analysis). The DC component can also be included.

## Delta calculation

| Item | Delta calculation settings | Symbols and Meanings |
|---|---|---|
| Voltage (V) | difference | ΔU1: differential voltage between u1 and u2 determined through calculation |
| | 3P3W->3V3A | ΔU1: unmeasured line voltage calculated in a three-phase three-wire system |
| | DELTA->STAR | ΔU1, ΔU2, ΔU3: phase voltage calculated in a three-phase three-wire (3V3A) system<br>ΔUΣ=(ΔU1+ΔU2+ΔU3)/3 |
| | STAR->DELTA | ΔU1, ΔU2, ΔU3: line voltage calculated in a three-phase four-wire system<br>ΔUΣ=(ΔU1+ΔU2+ΔU3)/3 |
| Current (A) | difference | ΔI: differential current between i1 and i2 determined through calculation |
| | 3P3W->3V3A | ΔI: unmeasured phase current |
| | DELTA->STAR | ΔI: neutral line current |
| | STAR->DELTA | ΔI: neutral line current |
| Power (W) | difference | ——— |
| | 3P3W->3V3A | ——— |
| | DELTA->STAR | ΔP1, ΔP2, ΔP3: phase power calculated in a three-phase three-wire (3V3A) system<br>ΔPΣ=ΔP1+ΔP2+ΔP3 |
| | STAR->DELTA | ——— |

## Waveforms

| Item | Specifications |
|---|---|
| Waveform display items | Voltage, current, torque, speed, AUX1, and AUX2 for elements 1 to 6 |

## Bar graphs and vectors (option)

| Item | Specifications |
|---|---|
| Bar graph display | Displays a bar graph of the amplitude of each harmonic |
| Vector display | Displays the phase difference between the fundamental voltage signal and fundamental current signal as a vector. |

## Trend

| Item | Specifications |
|---|---|
| Number of measurement channels | Up to 16 items |
| Trend display | Displays a line graph of measurement function numeric data trends |

# 5.4 Accuracy

## Voltage and current

| Item | Specifications |
|---|---|
| Accuracy (6 months) | Conditions<br>Temperature: 23 °C ± 5 °C. Humidity: 30 % RH to 75 % RH. Input waveform: sine wave. λ (power factor): 1. Common-mode voltage: 0 V. Crest factor: CF3. Line filter: off. Frequency filter: up to 1 kHz After the warm-up time has elapsed. Wired condition after zero-level compensation or measurement range change. The unit of f in the accuracy formula is kHz. |

Voltage {frequency bandwidth 5 MHz (–3 dB, typ.)}

| Frequency | Accuracy<br>±(reading error + measurement range error) |
|---|---|
| DC | ±(0.05 % of reading + 0.05 % of range) |
| 0.1 Hz≤f<10 Hz | ±(0.03 % of reading + 0.05 % of range) |
| 10 Hz≤f<45 Hz | ±(0.03 % of reading + 0.05 % of range) |
| 45 Hz≤f≤66 Hz | ±(0.03 % of reading + 0.05 % of range)<br>* Add 0.02 % of reading for the 1000 V range. |
| 66 Hz<f≤1 kHz | ±(0.1 % of reading + 0.1 % of range) |
| 1 kHz<f≤50 kHz | ±(0.3 % of reading + 0.1 % of range) |
| 50 kHz<f≤100 kHz | ±(0.6 % of reading + 0.2 % of range) |
| 100 kHz<f≤500 kHz | ±{(0.006×f) % of reading + 0.5 % of range} |
| 500 kHz<f≤1 MHz | ±{(0.022×f−8) % of reading + 1 % of range} |
| Frequency bandwidth | 5 MHz(–3 dB, typ.) |

Current {frequency bandwidth 5 MHz (–3 dB, typ.) external current sensor input of 5 A input element or 50 A input element}

| Frequency | Accuracy<br>±(reading error + measurement range error) |
|---|---|
| DC | ±(0.05 % of reading + 0.05 % of range) |
| 0.1 Hz≤f<10 Hz | ±(0.03 % of reading + 0.05 % of range) |
| 10 Hz≤f<45 Hz | ±{(0.03 % of reading + 0.05 % of range)+(2 μA*)} |
| 45 Hz≤f≤66 Hz | ±{(0.03 % of reading + 0.05 % of range)+(2 μA*)}<br>* Do not add for external current sensors. |
| 66 Hz<f≤1 kHz | ±(0.1 % of reading + 0.1 % of range)<br>Direct input of a 50 A input element<br>±(0.2 % of reading + 0.1 % of range) |
| 1 kHz<f≤50 kHz | ±(0.3 % of reading + 0.1 % of range)<br>50 mV, 100 mV, or 200 mV range of an external current sensor input<br>±(0.5 % of reading + 0.1 % of range)<br>Direct input of a 50 A input element<br>±{(0.1×f+0.2) % of reading + 0.1 % of range} |
| 50 kHz<f≤100 kHz | ±(0.6 % of reading + 0.2 % of range)<br>Direct input of a 50 A input element<br>±{(0.1×f+0.2) % of reading + 0.1 % of range} |
| 100 kHz<f≤200 kHz | ±{(0.006×f) % of reading + 0.5 % of range}<br>Direct input of a 50 A input element<br>±{(0.05×f+5) % of reading + 0.5 % of range} |
| 200 kHz<f≤500 kHz | ±{(0.006 × f) % of reading + 0.5 % of range}<br>Direct input of a 50 A input element: accuracy not defined |
| 500 kHz<f≤1 MHz | ±{(0.022 × f – 8) % of reading + 1 % of range}<br>Direct input of a 50 A input element: accuracy not defined |

# Power

| Item | Specifications | |
|---|---|---|
| Accuracy (6 months) | Conditions: same as the conditions for the voltage and current accuracies | |
| | Frequency | Accuracy<br>±(reading error + measurement range error) |
| | DC | ±(0.05 % of reading + 0.05 % of range) |
| | 0.1 Hz≤f<10 Hz | ±(0.08 % of reading + 0.1 % of range) |
| | 10 Hz≤f<45 Hz | ±(0.08 % of reading + 0.1 % of range)+(2 μA×U)*} |
| | 45 Hz≤f≤66 Hz | ±(0.05 % of reading + 0.05 % of range)+(2 μA×U)*}<br>* Do not add for external current sensors. U is the voltage reading. |
| | 66 Hz<f≤1 kHz | ±(0.2 % of reading + 0.1 % of range) |
| | 1 kHz<f≤50 kHz | ±(0.3 % of reading + 0.2 % of range)<br>50 mV, 100 mV, or 200 mV range of an external current sensor input<br>±(0.5 % of reading + 0.2 % of range)<br>Direct input of a 50 A input element<br>±{(0.1×f+0.2) % of reading + 0.2 % of range} |
| | 50 kHz<f≤100 kHz | ±(0.7 % of reading + 0.3 % of range)<br>Direct input of a 50 A input element<br>±{(0.3×f−9.5) % of reading + 0.3 % of range} |
| | 100 kHz<f≤200 kHz | ±{(0.008×f) % of reading + 1 % of range)}<br>Direct input of a 50 A input element<br>±{(0.09×f+11) % of reading + 1 % of range} |
| | 200 kHz<f≤500 kHz | ±{(0.008 × f) % of reading + 1 % of range}<br>Direct input of a 50 A input element: accuracy not defined |
| | 500 kHz<f≤1 MHz | ±{(0.048 × f – 20) % of reading + 2 % of range}<br>Direct input of a 50 A input element: accuracy not defined |

- For the external current sensor range, add the following values to the accuracies listed above:
  DC current accuracy: 50 μV
  DC power accuracy: (50 μV/rated value of the external current sensor range) × 100 % of range* × U
  * Current range
- For the direct current input range, add the following values to the accuracies listed above:
  50 A input elements:
  DC current accuracy: 1.5 mA
  DC power accuracy: (1 mA/rated value of the direct current input range) × 100 % of range* × U
  5 A input elements:
  DC current accuracy: 15 μA
  DC power accuracy: (10 μA/rated value of the direct current input range) × 100 % of range* × U
  * Current range
- For the accuracies of waveform display data functions Upk and Ipk:
  Add the following values (reference values) to the accuracies listed above. The effective input range is within ±300 % (±600 % when the crest factor is set to CF6 or CF6A) of the range.
  Voltage input: {1.5 × √(15/range) + 0.5} % of range
  Direct current input range:
  50 A input element: 3 × √(1/range) % of range + 10 mA
  5 A input element: {10 × √(0.01/range) + 0.5} % of range
  External current sensor input range:
  50 mV to 200 mV range: 10 × √(0.01/range) + 0.5 % of range
  500 mV to 10 V range: 10 × √(0.05/range) + 0.5 % of range

- Influence of temperature changes after zero-level compensation or range change
  Add the following values to the accuracies listed above.
  DC voltage accuracy: 0.02 % of range/°C
  Direct current input DC accuracy
  50 A input element: 1 mA/°C
  5 A input element: 10 µA/°C
  External current sensor input DC accuracy: 50 µV/°C
  DC power accuracy: the product of the voltage influence and the current influence
- Influence of self-generated heat caused by voltage input
  Add the following values to the voltage and power accuracies:
  AC input signal: 0.0000001 × $U^2$ % of reading
  DC input signal: 0.0000001 × $U^2$ % of reading + 0.0000001 × $U^2$ % of range
  U is the voltage reading (V).
  Even if the voltage input decreases, the influence from self-generated heat continues until the temperature of the input resistor decreases.
- Influence of self-generated heat caused by current input
  Add the following values to the current and power accuracies of the 50 A input element:
  AC input signal: 0.00006 × $I^2$ % of reading
  DC input signal: 0.00006 × $I^2$ % of reading +0.004 × $I^2$ mA
  Add the following values to the current and power accuracies of the 5 A input element:
  AC input signal: 0.006 × $I^2$ % of reading
  DC input signal: 0.006 × $I^2$ % of reading +0.004 × I % of reading
  I is the current reading (A).
  Even if the current input decreases, the influence from self-generated heat continues until the temperature of the shunt resistor decreases.
- Guaranteed accuracy ranges for frequency, voltage, and current
  All accuracy figures for 0.1 Hz to 10 Hz are reference values.
  The voltage and power accuracy figures for 30 kHz to 100 kHz when the voltage exceeds 750 V are reference values.
  The current and power accuracy figures for DC, 10 Hz to 45 Hz, and 400 Hz to 100 kHz when the current exceeds 20 A are reference values.
- The accuracy when the crest factor is CF6 or CF6A is the same as that when the crest factor is CF3 after doubling the measurement range.

| Item | Specifications |
|---|---|
| Power factor (λ) influence | When λ = 0<br>Apparent power reading × 0.07 % in the range of 45 Hz to 66 Hz.<br>For other frequency ranges, see below. However, be aware that these figures are reference values.<br>5 A input element and external current sensor input: apparent power reading × (0.07 + 0.05 × f) %<br>50 A input element and direct input: apparent power reading × (0.07 + 0.3 × f) %<br>When 0 < λ < 1<br>(Power reading) × [(power reading error %) + (power range error %) × (power range/indicated apparent power value) + {tan Φ × (influence when λ = 0) %}]<br>where Φ is the phase angle between the voltage and current. |
| Line filter influence | When the cutoff frequency (fc) is 100 Hz to 100 kHz<br>Voltage and current<br>Up to (fc/2) Hz: Add 2 × [1 − √{1/(1 + (f/fc)$^4$)}] × 100 + (20 × f/300k) % of reading<br>Applies to frequencies less than or equal to 30 kHz<br>Power<br>Up to (fc/2) Hz: Add 4 × [1 − √{1/(1 + (f/fc)$^4$)}] × 100 + (40 × f/300k) % of reading<br>Applies to frequencies less than or equal to 30 kHz<br>When the cutoff frequency (fc) is 300 kHz to 1 MHz<br>Voltage and current<br>Up to (fc/10) Hz: Add (20 × f/fc) % of reading<br>Power<br>Up to (fc/10) Hz: Add (40 × f/fc) % of reading |
| Lead and lag detection (Phase angle Φ's D (lead) and G (lag)) | The lead and lag of the voltage and current inputs can be detected correctly for the following:<br>• Sine wave<br>• When the measured value is 50 % or more (100 % or more when the crest factor is CF6 or CF6A) of the measurement range<br>• Frequency: 20 Hz to 10 kHz<br>• Phase difference: ±(5° to 175°) |
| Symbol s in the reactive power QΣ calculation | s is the sign for the lead and lag of each element. It is negative when the voltage leads the current. |
| Temperature coefficient | Add ±0.03 % of reading/°C within the range of 5 °C to 18 °C or 28 °C to 40 °C. |
| Effective input range | Udc, Idc: 0 % to ±110 % of the measurement range<br>Urms, Irms: 1 % to ±110 % of the measurement range<br>Umn, Imn: 10 % to 110 % of the measurement range<br>Urmn, Irmn: 10 % to 110 % of the measurement range<br>Power:<br>DC measurement: 0 % to ±110 %<br>AC measurement: 1 % to 110 % of the voltage and current ranges; up to ±110 % of the power range<br>However, the sync source level must meet the frequency measurement input signal level. When the crest factor is set to CF6 or CF6A, the upper and lower limits are doubled. |
| Maximum display | 140 % of the rated voltage or current range 280 % or more of the rated voltage or current range when the crest factor is CF6A. |
| Minimum display | Depending on the measurement range, the following are the minimum values that are displayed:<br>• Urms, Uac, Irms, and Iac: 0.3 % (0.6 % when the crest factor is set to CF6 or CF6A)<br>• Umn, Urmn, Imn, and Irmn: 2 % (4 % when the crest factor is set to CF6 or CF6A)<br>When input level is lower than above, the display shows zero if zero-suppress setting is on, otherwise measured value will be shown. Current integration value q depends on the current value. |
| Lower limit of measurement frequency | Data update interval: 50 ms \| 100 ms \| 200 ms \| 500 ms \| 1 s \| 2 s \| 5 s \| 10 s \| 20 s \| Auto<br>Lower limit of measurement frequency: 45 Hz \| 25 Hz \| 12.5 Hz \| 5 Hz \| 2.5 Hz \| 1.25 Hz \| 0.5 Hz \| 0.2 Hz \| 0.1 Hz \| 0.1 Hz |
| Accuracy of apparent power S | Voltage accuracy + current accuracy |
| Accuracy of reactive power Q | Accuracy of apparent power + (√(1.0004 - λ$^2$) - √(1 - λ$^2$)) × 100 % of range |
| Accuracy of power factor λ | ±[(λ – λ/1.0002) + \|cosΦ – cos{Φ + sin$^{-1}$((influence from the power factor when λ = 0) %/100)}\|] ± 1 digit.<br>The voltage and current must be within their rated ranges. |
| Phase angle Φ accuracy | ±[\|Φ – {cos – 1(λ/1.0002)}\| + sin$^{-1}$((influence from the power factor when λ = 0) %/100}] deg ± 1 digit<br>The voltage and current must be within their rated ranges. |
| Accuracy at 1 year | 1.5 times the reading errors for the accuracy at 6 months |

# 5.5 Features

## Measurement features and measurement conditions

| Item | Specifications |
|---|---|
| Crest factor | 300 for the minimum effective input<br>CF3: 3 (relative to the rated values of the measurement range)<br>CF6/CF6A: 6 (relative to the rated values of the measurement range) |
| Measurement period | Period used to determine and calculate measurement functions.<br>• Except for watt hours (Wp) and DC ampere hours (q), the measurement period is set using the reference signal (sync source).<br>Timing of data update is different (minimum time resolution is 50 ms) among elements with different reference signals (sync sources) when the data update interval is set to Auto. The timeout period can be to 1 s, 5 s, 10 s, or 20 s. When at least one cycle of the sync source does not fit within the timeout period, the measurement period is the entire interval.<br>• When displaying harmonics<br>The measurement period is the first 1024 or 8192 points from the beginning of the data update interval at the harmonic sampling frequency.<br>• Measurement period detection method<br>When the data update interval is not set to Auto, analog signal zero cross detection method<br>When the data update interval is set to Auto, sampled data level detection method. Detection level can be set as desired. |
| Wiring system | 1P2W (single-phase two-wire), 1P3W (single-phase three-wire), 3P3W (three-phase three-wire), 3P4W (three-phase four-wire), and 3P3W (3V3A) (three-phase three wire system that uses a three-voltage three-current method)<br>The selectable wiring systems vary depending on the number of input elements that are installed. |
| Scaling | Set the current sensor conversion ratio, VT ratio, CT ratio, and power coefficient in the range of 0.0001 to 99999.9999 when applying the external current sensor, VT, or CT output to the instrument.<br>• CT ratio can be set automatically by selecting a model name of CT series.<br>• Current sensor conversion ratio can be set automatically by selecting a model name of dedicated shunt resistor. |
| Averaging | • Using one of the following methods, perform averaging on the normal measurement items: voltage U, current I, power P, apparent power S, or reactive power Q. Power factor λ and phase difference angle Φ are determined from the averaged P and S values.<br>• Select either exponential averages or moving averages.<br>  • Exponential average<br>  Select the attenuation constant in the range of 2 and 64.<br>  • Moving average<br>  Select the average count in the range of 8 and 64.<br>• Harmonic measurement<br>Only exponential averaging is valid. |
| Data update interval | Select from 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 20 s, and Auto.<br>Period detection method is different depending on update interval.<br>• 50 ms, 100 ms, 200 ms, 500 ms, 1 s, 2 s, 5 s, 10 s, 20 s:<br>• Analog signal zero-crossing detection method<br>• Auto: sampling data level detection method |
| Response time | Data update interval × 2 or less (only during numeric display)<br>When data update interval is set to Auto, response time is signal cycle plus 50 ms. |
| Hold | Holds the data display |
| Single | Executes a single measurement while measurements are held<br>* When the data update interval is set to Auto, single measurement is not possible. |
| Zero-level compensation/ Null | Performs zero-level compensation. Null compensation range: ±10 % of range<br>You can configure the null setting individually for each of the following input signals:<br>• Each input element's voltage and current<br>• Rotating speed and torque<br>• AUX1, AUX2 |

# Frequency measurement

| Item | Specifications |
|---|---|
| DUT | Measures the frequency of the voltage or current applied to all input elements |
| Measurement system | Reciprocal method |
| Measurement range | |

| Data update interval | Measurement range |
|---|---|
| 50 ms | 45 Hz≤f≤1 MHz |
| 100 ms | 25 Hz≤f≤1 MHz |
| 200 ms | 12.5 Hz≤f≤500 kHz |
| 500 ms | 5 Hz≤f≤200 kHz |
| 1 s | 2.5 Hz≤f≤100 kHz |
| 2 s | 1.25 Hz≤f≤50 kHz |
| 5 s | 0.5 Hz≤f≤20 kHz |
| 10 s | 0.25 Hz≤f≤10 kHz |
| 20 s | 0.15 Hz≤f≤5 kHz |
| Auto | 0.1 Hz≤f≤500 kHz |

| | |
|---|---|
| Accuracy | ±0.06 % of reading±0.1 mHz<br>When the input signal level is 30 % or more (60 % or more when the crest factor is set to CF6 or CF6) of the measurement range<br>• For input greater than or equal to 50 % of the range when:<br>  • The input signal is less than or equal to twice the frequency lower limit indicated above.<br>  • The range is 10 mA (5 A element).<br>  • The range is 1 A (50 A element).<br>• When the data update interval is not set to Auto, the 100 Hz frequency filter is on from 0.15 Hz to 100 Hz, and the 1 kHz frequency filter is on from 100 Hz to 1 kHz.<br>• When the data update interval is set to Auto, the 100 Hz frequency filter is on from 0.1 Hz to 100 Hz, and the 1.6 kHz frequency filter is on from 100 Hz to 1 kHz. |
| Number of displayed digits (display resolution) | 5 (99999) |
| Minimum frequency resolution | 0.0001 Hz |
| Frequency measurement filter | • When the data update interval is not set to Auto: Select OFF, 100 Hz, or 1 kHz.<br>• When the data update interval is set to Auto: Select OFF, 100 Hz, 200 Hz, 400 Hz, 800 Hz, 1.6 kHz, 3.2 kHz, 6.4 kHz, 12.8 kHz, or 25.6 kHz. |

# Integration

| Item | Specifications |
|---|---|
| Mode | Manual, normal, continuous, real-time normal, and real-time continuous<br>* When the data update interval is set to Auto, integration operates only in manual or normal mode. Other modes are not used. |
| Integration timer | Integration can be stopped automatically by a timer that can be set to:<br>0000h00m00s to 10000h00m00s |
| Count overflow | When the maximum integration time (10000 hours) arrives or when an integrated value reaches the maximum or minimum displayable integrated value,[1] the integration time and value at that point are held and integration stops.<br>1 WP: ±999999MWh<br>q: ±999999MAh<br>WS: ±999999MVAh<br>WQ: ±999999Mvarh |
| Integration resume operation at power failure recovery | When the integration resume function at power failure recovery is set, the integration operation can be resumed if a power failure occurs and recovers while integration is in progress.<br>* This function is not available when the data update mode is Auto. Integration results in error and cannot be continued. |
| Auto range | Voltage and current: auto range is available (when the data update interval is not set to Auto).<br>Motor input signal, auxiliary input signal: not available<br>When independent element configuration is on: not available<br>When the apparent power or reactive power calculation type is Type3: not available |
| Accuracy | ±(normal measurement accuracy + 0.02 % of reading) |
| Timer accuracy | ±0.02 % of reading |

# 5.6 Harmonic Measurement (option)

| Item | Specifications |
|---|---|
| DUT | All installed elements |
| Method | PLL synchronization method (no external sampling clock) |
| Frequency range | When the data update interval is not set to Auto or when the data update interval is set to Auto and the FFT data length is set to 8192<br>Fundamental frequency of the PLL source is in the range of 0.5 Hz to 2.6 kHz.<br>When the data update interval is set to Auto and the FFt data length is set to 1024<br>Fundamental frequency of the PLL source is in the range of 0.1 Hz to 2.6 kHz. |
| PLL source | • Select the input element's voltage or current or an external clock.<br>• On models with the /G6 option, when the data update interval is not Auto, you can select two PLL sources and perform dual harmonic measurement. On models with the /G5 option, you can select one PLL source.<br>• Input level<br>With voltage input, 15 V range or higher<br>With direct current input, 50 mA range or higher<br>With external current sensor input, 200 mV range or higher<br>50 % or more of the rated measurement range when the crest factor is CF3.<br>100 % or more of the rated measurement range when the crest factor is CF6 or CF6A.<br>20 Hz to 1 kHz for 1 A and 2 A ranges of 50 A elements<br>• The conditions in which frequency filters are turned on are the same as those for frequency measurements. |
| FFT data length | 1024 when the data update interval is 50 ms, 100 ms, or 200 ms.<br>8192 when the data update interval is 500 ms, 1 s, 2 s, 5 s, 10 s, or 20 s.<br>Select 1024 or 8192 when the data update interval is Auto |
| Window function | Rectangular |
| Anti-aliasing filter | Set using the line filter |

Sample rate, window width, and upper limit of harmonic analysis

Number of FFT points: 1024 (when the data update interval is 50 ms, 100 ms, or 200 ms)

| Fundamental frequency | Sample rate | Window width | Upper limit of harmonic analysis | |
|---|---|---|---|---|
| | | | U, I, P, Φ, ΦU, ΦI | Other measured values |
| 15 Hz to 600 Hz | f×1024 | 1 | 500 | 100 |
| 600 Hz to 1200 Hz | f×512 | 2 | 255 | 100 |
| 1200 Hz to 2600 Hz | f×256 | 4 | 100 | 100 |

When the data update interval is 50 ms or Auto, the maximum measurable harmonic order is 100.

Number of FFT points: 8192 (when the data update interval is 500 ms, 1 s, 2 s, 5 s, 10 s, or 20 s)

| Fundamental frequency | Sample rate | Window width | Upper limit of harmonic analysis | |
|---|---|---|---|---|
| | | | U, I, P, Φ, ΦU, ΦI | Other measured values |
| 0.5 Hz to 1.5 Hz | f×8192 | 1 | 500 | 100 |
| 1.5 Hz to 5 Hz | f×4096 | 2 | 500 | 100 |
| 5 Hz to 10 Hz | f×2048 | 4 | 500 | 100 |
| 10 Hz to 600 Hz | f×1024 | 8 | 500 | 100 |
| 600 Hz to 1200 Hz | f×512 | 16 | 255 | 100 |
| 1200 Hz to 2600 Hz | f×256 | 32 | 100 | 100 |

Number of FFT points: 1024 (when the data update interval is Auto)

| Fundamental frequency | Sample rate | Window width | Upper limit of harmonic analysis | |
|---|---|---|---|---|
| | | | U, I, P, Φ, ΦU, ΦI | Other measured values |
| 0.1 Hz to 75 Hz | f×1024 | 1 | 100 | 100 |
| 75 Hz to 600 Hz | f×1024 | 1 | 100 | 100 |
| 600 Hz to 1200 Hz | f×512 | 2 | 100 | 100 |
| 1200 Hz to 2600 Hz | f×256 | 4 | 100 | 100 |

Number of FFT points: 8192 (when the data update interval is Auto)

| Fundamental frequency | Sample rate | Window width | Upper limit of harmonic analysis | |
|---|---|---|---|---|
| | | | U, I, P, Φ, ΦU, ΦI | Other measured values |
| 0.5 Hz to 75 Hz | f×1024 | 8 | 100 | 100 |
| 75 Hz to 600 Hz | f×1024 | 8 | 100 | 100 |
| 600 Hz to 1200 Hz | f×512 | 16 | 100 | 100 |
| 1200 Hz to 2600 Hz | f×256 | 32 | 100 | 100 |

| Item | Specifications |
|---|---|
| Accuracy | Add the following accuracy values to the normal measurement accuracy values. |

• The line filter is off and the data update interval is Auto

| Frequency | Voltage | Current | Power |
|---|---|---|---|
| 0.5 Hz≤f<10 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 10 Hz≤f<45 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 45 Hz≤f≤66 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 66 Hz<f≤440 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 440 Hz<f≤1 kHz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 1 kHz<f≤10 kHz | 0.5 % of reading +0.25 % of range | 0.5 % of reading +0.25 % of range | 1 % of reading +0.5 % of range |
| 10 kHz<f≤100 kHz | 0.5 % of range | 0.5 % of range | 1 % of range |
| 100 kHz<f≤260 kHz | 1 % of range | 1 % of range | 2 % of range |

• The line filter is off and the data update interval is not Auto

| Frequency | Voltage | Current | Power |
|---|---|---|---|
| 0.1 Hz≤f<10 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 10 Hz≤f<45 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 45 Hz≤f≤66 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 66 Hz<f≤440 Hz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 440 Hz<f≤1 kHz | 0.05 % of reading +0.25 % of range | 0.05 % of reading +0.25 % of range | 0.1 % of reading +0.5 % of range |
| 1 kHz<f≤10 kHz | 0.5 % of reading +0.25 % of range | 0.5 % of reading +0.25 % of range | 1 % of reading +0.5 % of range |
| 10 kHz<f≤100 kHz | 0.5 % of range | 0.5 % of range | 1 % of range |
| 100 kHz<f≤260 kHz | 1 % of range | 1 % of range | 2 % of range |

• When line filters are turned on
  Add the line filter accuracy values to the accuracy values when the line filters are turned off.

The items listed below apply to the tables in this section.

- When the crest factor is set to CF3
- When λ (the power factor) is 1.
- Power figures that exceed 2.6 kHz are reference values.
- Add the following values when a voltage range is being used:
  Voltage accuracy: 25 mV
  Power accuracy: (25 mV/rated voltage range) × 100 % of range
- Add the following values when direct current input is being used:
  5 A input elements
    Current accuracy: 50 μA
    Power accuracy: (50 μA/current range rating) × 100 % of range
  50 A input elements
    Current accuracy: 4 mA
    Power accuracy: (4 mA/rated current range) × 100 % of range
- Add the following values when an external current sensor range is being used:
  Current accuracy: 2 mV
  Power accuracy: (2 mV/rated external current sensor range) × 100 % of range

- Add (n/500) % of reading to the nth component of the voltage and current. Add (n/250)% of reading to the nth component of the power.
- The accuracy when the crest factor is CF6 or CF6 is the same as that when the crest factor is CF3 after doubling the measurement range.
- The guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for ordinary measurement.
- The neighboring harmonic orders may be affected by the side lobes from the input harmonic order.
- When the data update interval is set not to Auto or when the data update interval is set to Auto and the number of FFT points is set to 8192
  - When the frequency of the PLL source is 2 Hz or greater, for $n^{th}$ order component input, add ({n/(m+1)}/50)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the voltage and current, and add ({n/(m+1)}/25)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the power.
  - When the frequency of the PLL source is less than 2 Hz, for nth order component input, add ({n/(m + 1)}/20)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the voltage and current, and add ({n/(m + 1)}/10)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the power.
- When the data update interval is set to Auto and the number of 50 points is set to 1024
  - When the frequency of the PLL source is 75 Hz or greater, for $n^{th}$ order component input, add ({n/(m+1)}/50)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the voltage and current, and add ({n/(m+1)}/25)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the power.
  - When the frequency of the PLL source is less than 75 Hz, for $n^{th}$ order component input, add ({n/(m + 1)}/10)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the voltage and current, and add ({n/(m + 1)}/5)% of (the $n^{th}$ order reading) to the n + $m^{th}$ order and n − $m^{th}$ order of the power.

# 5.7 Motor Evaluation Function (option)

| Item | Specifications |
|---|---|
| Input terminal | TORQUE, SPEED (A, B, Z) |
| Input resistance | Approx. 1 MΩ |
| Input connector type | Isolated BNC |

## Analog input

(SPEED is being applied to terminal A.)

| Item | Specifications |
|---|---|
| Range | 1/2/5/10/20 V |
| Input range | ±110 % |
| Line filter | OFF/100 Hz/1 kHz |
| Continuous maximum allowable input | ±22 V |
| Maximum common-mode voltage | ±42 Vpeak |
| Sampling interval | Approx. 200 kS/s |
| Resolution | 16 bits |
| Accuracy | ±(0.03 % of reading + 0.03 % of range) |
| Temperature coefficient | ±0.03 % of range/°C |

## Pulse input

(If you do not need to detect the direction, apply SPEED to terminal A. If you need to detect the direction, apply phase A and phase B of a rotary encoder to terminals A and B, respectively. If you are measuring the electrical angle, apply phase Z of a rotary encoder to terminal Z.)

| Item | Specifications |
|---|---|
| Input range | ±12 Vpeak |
| Frequency measurement range | 2 Hz to 1 MHz |
| Maximum common-mode voltage | ±42 Vpeak |
| Accuracy | ±(0.03+f/10000) % of reading±1 mHz  The unit of f is kHz.<br>However, the waveform display data accuracy is<br>±(0.03+f/500 ) % of reading±1 mHz  The unit of f is kHz. |
| Z terminal input fall time and electrical angle measurement start time | Within 500 ns |
| Detection level | H level: approx. 2 V or more<br>L level: approx. 0.8 V or less |
| Pulse width | 500 ns or more |

To measure electrical angles, you need the harmonic measurement option (/G5 or /G6).

# 5.8 Auxiliary Input (option)

| Item | Specifications |
|---|---|
| Input terminal | AUX1/AUX2 |
| Input type | Analog |
| Input resistance | Approx. 1 MΩ |
| Input connector type | Isolated BNC |
| Range | 50 m, 100 m, 200 m, 500 m, 1, 2, 5, 10, 20 V |
| Input range | ±110 % |
| Line filter | OFF/100 Hz/1 kHz |
| Continuous maximum allowable input | ±22 V |
| Maximum common-mode voltage | ±42 Vpeak |
| Sampling interval | Approx. 200 kS/s |
| Resolution | 16 bits |
| Accuracy | ±(0.03 % of reading + 0.03 % of range)<br>• Add 20 µV/°C for temperature changes after zero-level compensation or range change. |
| Temperature coefficient | ±0.03 % of range/°C |

# 5.9 D/A Output and Remote Control (option)

## D/A output

| Item | Specifications |
|---|---|
| D/A conversion resolution | 16 bits |
| Output voltage | Each rated value ±5 V FS (maximum of approx. ±7.5 V) |
| Update interval | Same as the data update interval of this instrument<br>(if the waveform display is enabled and the trigger mode is set to Auto or Normal, the data update interval depends on the trigger operation)<br>* When data update interval is set to Auto, response time is signal cycle plus 50 ms. |
| Number of outputs | 20 channels (the output items can be set for each channel) |
| Accuracy | ±(each measurement function's accuracy + 0.1 % of FS); FS = 5 V |
| Minimum load | 100 kΩ |
| Temperature coefficient | ±0.05 % of FS/°C |
| Continuous maximum common-mode voltage | ±42 Vpeak or less |

## Remote control

| Item | Specifications |
|---|---|
| Signal | $\overline{\text{EXT START}}$, $\overline{\text{EXT STOP}}$, $\overline{\text{EXT RESET}}$, $\overline{\text{INTEG BUSY}}$, $\overline{\text{EXT HOLD}}$, $\overline{\text{EXT SINGLE}}$ |
| Input level | 0 to 5 V |

# 5.10 High Speed Data Capturing

| Item | Specifications |
|---|---|
| Data capture interval | • 5 ms when External Sync is off<br>• 1 ms to 100 ms when External Sync is on, synchronized to the external signal applied to the MEAS START terminal |
| Display update interval | 1 s (the last data acquired in a 1 s interval is displayed) |
| Measurement functions | • Voltage, current, and power (all elements, Σ)<br>Select rms, mean, dc, or r-mean.<br>• Torque, speed, and motor output (option) or AUX1 and AUX2 (option) |
| Wiring system | 1P2W (single-phase two-wire) (for DC input), 3P4W (three-phase four-wire), 3P3W(3V3A)(three-voltage three-current measurement method) |
| Line filter | Always on<br>Cutoff frequency: 100 Hz to 100 kHz (in steps of 100 Hz) or 300 kHz |
| Peak over-range status | The indicator lights if a peak over-range occurs even once from start to stop. |
| Data output destination | • Storage device, internal RAM disk, internal memory, USB memory device<br>• Communication interface: GP-IB, Ethernet, or USB-PC interface<br>The captured data for each second is output together. |
| Data capture start | Data capturing starts after Start is pressed on the HS Settings menu or this instrument receives a communication command, and the trigger conditions are met. |
| HS filter | Off, 1 Hz to 1000 Hz (in steps of 1 Hz) |

# 5.11 Computations and Event Feature

| Item | Specifications |
|---|---|
| User-defined functions | Used to calculate equations that are created by combining measurement function symbols and operators (up to 20 equations can be created). |
| Efficiency formula | Up to four efficiencies can be displayed by setting the items to measure with the efficiency formula. |
| User-defined events | Event: Set conditions for measured values.<br>Storage and D/A output can be performed as the result of an event occurring. |

# 5.12 Display

## Numeric display

| Item | Specifications |
|---|---|
| Number of displayed digits (display resolution) | If the value is less than or equal to 60000: Five digits<br>If the value is greater than 60000: Four digits |
| Number of displayed items | Select from 4, 8, 16, Matrix, ALL, Hrm List Single, Hrm List Dual, and Custom. |

## Waveform display

| Item | Specifications |
|---|---|
| Display format | Peak-to-peak compressed data<br>If the time axis is set so that there are not enough sampled data, the missing data values are filled using the previous data value. |
| Time axis | 0.05 ms to 2 s when the update mode is not Auto given that the time axis is set less than 1/10 of the data update interval.<br>0.05 ms to 5 ms/div range when the data update interval is Auto. |
| Trigger | • Trigger type  Edge<br>• Trigger mode<br>Select from off, auto, and normal.<br>Triggering is automatically switched off during integration.<br>Triggering is automatically switched off when the data update interval is Auto.<br>• Trigger source<br>Can be set to an external clock signal or to a voltage or current applied to an input element.<br>• Trigger slope  Select from rising, falling, and rising and falling.<br>• Trigger level<br>• When the trigger source is set to the voltage or current applied to an input element, the trigger level can be set to a value that is within the range defined by the middle of the screen ± 100 % (to the top and bottom edges of the screen). Resolution: 0.1 %<br>• When the trigger source is Ext Clk (external clock): TTL level |
| Time axis zoom feature | Not available |

# 5.13 Data Storage Feature

| Item | Specifications |
|---|---|
| Storage | Binary data: save to internal RAM disk, internal memory, or USB memory device<br>ASCII data: save to internal RAM disk, internal memory, USB memory device, or network drive |
| Maximum file size | 1 GB |
| Storage interval | 50 ms (when waveforms are turned off) to 99 hours 59 minutes 59 seconds<br>(if the waveform display is enabled and the trigger mode is set to Auto or Normal, the data update interval depends on the trigger operation) |

# 5.14 File Feature

| Item | Specifications |
|---|---|
| Saving | Save setup data, waveform display data, numeric data, and screen image data to the internal RAM disk, internal memory, USB memory device, or network drive |
| Loading | Load saved setup data from a storage device |

# 5.15 Auxiliary I/O Section

## External start signal I/O connector

### To apply a master/slave synchronization signal during normal measurement

| Item | Specifications | |
|---|---|---|
| Connector type | BNC | (Same for both master and slave) |
| I/O level | TTL | (Same for both master and slave) |
| Output logic | Negative logic, falling edge | (Applies to the master) |
| Output hold time | Low level, 500 ns or more | (Applies to the master) |
| Input logic | Negative logic, falling edge | (Applies to slaves) |
| Minimum pulse width | Low level, 500 ns or more | (Applies to slaves) |
| Measurement start delay | Master: within 15 sample cycles<br>Slave: within 1 µs + 15 sample cycles | |

### To apply a external synchronization signal during high speed data capturing

| Item | Specifications |
|---|---|
| Connector type | BNC |
| Input level | TTL |
| Input logic | Negative logic, falling edge |
| Minimum pulse width | Low level, 500 ns or more |
| Measurement start delay | Within 1 µs + 15 sample cycles |

## External clock input section

### Common

| Item | Specifications |
|---|---|
| Connector type | BNC |
| Input level | TTL |

### To apply the sync source during normal measurement as Ext Clk

| Item | Specifications |
|---|---|
| Frequency range | Same as the measurement ranges listed under “Frequency measurement” |
| Input waveform | 50 % duty cycle rectangular wave |

### To apply the PLL source during harmonic measurement as Ext Clk

| Item | Specifications |
|---|---|
| Frequency range | Harmonic measurement option (/G5 or /G6): 0.5 Hz to 2.6 kHz |
| Input waveform | 50 % duty cycle rectangular wave |

### To apply triggers

| Item | Specifications |
|---|---|
| Minimum pulse width | 1 µs |
| Trigger delay | Within 1 µs + 15 sample cycles |

## RGB output section (option)

| Item | Specifications |
|---|---|
| Connector type | D-sub 15 pin (receptacle) |
| Output type | Analog RGB output |

# 5.16 Computer Interface

## GP-IB interface (-C01)*

| Item | Specifications |
|---|---|
| Usable devices | National Instruments Corporation<br>• PCI-GPIB and PCI-GPIB+<br>• PCIe-GPIB and PCIe-GPIB+<br>• PCMCIA-GPIB or PCMCIA-GPIB+<br>• GPIB-USB-HS<br>• GPIB-USB-HS+<br>Use driver NI-488.2M Ver. 1.60 or later. |
| Electrical and mechanical specifications | Complies with IEEE St'd 488-1978 (JIS C 1901-1987) |
| Functional specifications | SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0 |
| Protocol | IEEE St'd 488.2-1992 |
| Code | ISO (ASCII) codes |
| Mode | Addressable mode |
| Address | 0 to 30 |
| Clearing remote mode | Press LOCAL to clear remote mode (except during Local Lockout). |

* Only models with the GP-IB interface

## Ethernet interface

| Item | Specifications |
|---|---|
| Ports | 1 |
| Connector type | RJ-45 connector |
| Electrical and mechanical specifications | IEEE802.3 compliant |
| Transmission system | Ethernet1000Base-T/100BASE-TX/10BASE-T |
| Communication Protocol | TCP/IP |
| Supported services | FTP server, DHCP, DNS, remote control (VXI-11), SNTP, FTP client, Modbus/TCP server, and Web server |

## USB PC interface

| Item | Specifications |
|---|---|
| Connector type | Type B connector (receptacle) |
| Ports | 1 |
| Electrical and mechanical specifications | Conforms to USB 3.0 |
| Supported transfer modes | SS (SuperSpeed) mode (5 Gbps), HS (High Speed) mode (480 Mbps), FS (Full Speed) mode( 12 Mbps) |
| Supported protocols | USBTMC-USB488 (USB Test and Measurement Class Ver.1.0) |
| PC system requirements | A PC running Windows 10 or Windows 11 with a standard USB port<br>(A separate device driver is required for connection to a PC.) |

# 5.17 USB Ports for Peripherals

| Item | Specifications |
|---|---|
| Number of ports | 2 |
| Connector type | USB type A (receptacle) |
| Electrical and mechanical specifications | USB Rev. 2.0 compliant |
| Supported transfer modes | HS (High Speed; 480 Mbps) and FS (Full Speed; 12 Mbps),<br>LS (Low Speed) mode (1.5 Mbps) |
| Compatible devices | Mass storage devices that comply with USB Mass Storage Class Ver. 1.1<br>Available space: 2 TB, partition format: MBR/GPT, format type: FAT32/FAT16<br>104 or 109 keyboards that comply with USB HID Class Ver. 1.1<br>Mouse devices that comply with USB HID Class Ver. 1.1 |
| Power supply | 5 V, 500 mA (for each port). You cannot connect devices whose maximum current consumption exceeds 100 mA to two different ports on this instrument at the same time. |

# 5.18 Current Sensor Power (option)

| Item | Specifications |
|---|---|
| Number of channels | 6 |
| Connector type | D-Sub 9-pin (plug) |
| Output voltage | ±15 V DC |
| Output current | PD2: 1.8 A/channel, 6 A total (6 channels) |

# 5.19 Safety Terminal Adapter

| Item | Specifications |
|---|---|
| Maximum allowable current | 36 A |
| Withstand voltage | 1000 V CATIII |
| Contact resistance | 10 mΩ or less |
| Contact section | Nickel plating on brass or bronze |
| Insulator | Polyamide |
| Core wire | Maximum diameter 1.8 mm |
| Insulation | Maximum diameter 3.9 mm |

# 5.20 System Maintenance Processing

## Alarm generation and operation

| Item | Specifications |
|---|---|
| Fan stop | Fan stop alarm indication<br>After approx. 60 seconds, emergency operation stop after generating approx. 10 seconds of beep sound.* |
| Internal temperature error | Emergency operation stop after generating approx. 10 seconds of beep sound* |

* Stops the internal power supply of this instrument

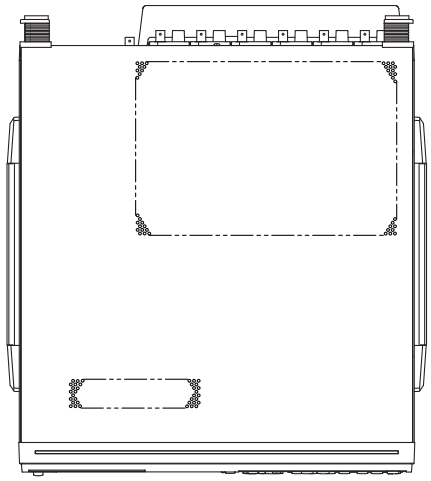
# 5.21 General Specifications

| Item | Specifications |
|---|---|
| Warm-up time | Approx. 30 minutes |
| Operating environment | Temperature: 5 °C to 40 °C<br>Humidity: 20 % RH to 80 % RH (no condensation) |
| Operating altitude | 2000 m or less |
| Installation location | Indoor use |
| Storage environment | Temperature: –25 °C to 60 °C<br>Humidity: 20 % RH to 80 % RH (no condensation) |
| Rated supply voltage | 100 to 240 VAC |
| Permitted supply voltage range | 90 to 264 VAC |
| Rated supply frequency | 50/60 Hz |
| Permitted supply frequency range | 48 to 63 Hz |
| Maximum power consumption | 150 VA<br>450 VA (when using current sensor power) |
| External dimensions (See the external dimensions figure.) | Approx. 426 mm (W) × 177 mm (H) × 459 mm (D)<br>Approx. 426 mm (W) × 221 mm (H) × 459 mm (D) (when the current sensor power supply (/PD2) option is installed)<br>(excluding the handles and protrusions) |
| Weight | Approx. 14 kg<br>(main unit with six input elements and options except the current sensor power supply (/PD2) option)<br>Approx. 16 kg<br>(main unit with six input elements and the current sensor power supply (/PD2) option) |
| Battery backup | Setup data and the internal clock are backed up with a lithium battery. |
| Safety standards | Compliant standards: EN 61010-1, EN IEC 61010-2-030<br>Overvoltage category II[1]<br>Measurement category CAT II[2]<br>Pollution degree2[3] |
| Emissions | Compliant standards<br>EN 61326-1, EN IEC 61326-1 Class A Group 1[4], EN 61000-3-2, EN IEC 61000-3-2, EN 61000-3-3, EN IEC 61000-3-3<br>EMC Regulatory Arrangement in Australia and New Zealand EN 61326-1, EN IEC 61326-1 Class A, Group 1<br>Korea Electromagnetic Conformity Standard ( 한국 전자파적합성기준 )<br>This product is classified as Class A (for use in industrial environments). Operation of this product in a residential area may cause radio interference, in which case the user will be required to correct the interference.<br>Cable conditions<br>• EXT CLK/MEAS. START: Use a BNC cable.[5]<br>• Motor evaluation function terminals, AUX input terminals: Use shielded BNC cables.[5]<br>• GP-IB interface connector: Use a shielded GP-IB cable.[5]<br>• RGB output connector: Use a shielded D-sub 15 pin VGA cable.[5]<br>• USB port (PC): Use a shielded USB cable.[5]<br>• USB port (for peripheral devices): Use a USB keyboard that has a shielded cable.[5]<br>• Ethernet port: Use category 5 or better Ethernet cables (STP).[6]<br>• Current sensor cable: Use the dedicated cable. |
| Immunity | Compliant standards<br>EN 61326-1, EN IEC 61326-1 Table 2 (for use in industrial locations)<br>EMC Regulatory Arrangement in Australia and New Zealand EN 61326-1, EN IEC 61326-1 Table 2<br>Influence in the immunity environment<br>Measurement input: within ±20 % of range<br>(when the crest factor is set to CF6 or CF6A, within ±40 % of range)<br>External current sensor input: within ±300 mV<br>D/A output: within ±20 % of FS; FS = 5 V<br>Cable conditions<br>The same as the cable conditions listed above for emissions |
| Environmental standards[7] | EU RoHS Directive compliant |

If you obtained this manual separately from the product, the specifications in this manual may differ from those of the product.

1 The overvoltage category is a value used to define the transient overvoltage condition and includes the rated impulse withstand voltage. Overvoltage category II applies to electrical equipment that is powered through a fixed installation, such as a wall outlet wired to a distribution board.
2 This instrument is a measurement category II product. Do not use it for measurement categories III and IV.
Measurement category O applies to measurement of other types of circuits that are not directly connected to a main power source.
Measurement Category II applies to electrical equipment that is powered through a fixed installation, such as a wall outlet wired to a distribution board, and to measurement performed on such wiring.
Measurement category III applies to measurement of facility circuits, such as distribution boards and circuit breakers.
Measurement category IV applies to measurement of power source circuits, such as entrance cables to buildings and cable systems, for low-voltage installations.
3 Pollution Degree applies to the degree of adhesion of a solid, liquid, or gas that deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).
4 Group 1: Equipment that does not intentionally generate or use radio-frequency (RF) energy
5 Use cables of length 3 m or less.
6 Use cables of length 30 m or less.
7 For conformity to environmental regulations and/or standards other than EU, contact your nearest YOKOGAWA office (PIM 113-01Z2).

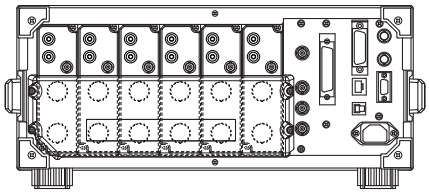
# External dimensions

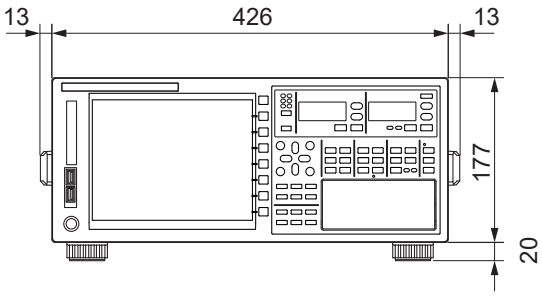


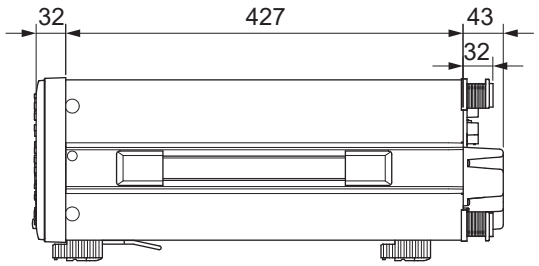
**Unit: mm**

**Unless otherwise specified, tolerances are ±3% (however, tolerances are ±0.3 mm when below 10 mm).**

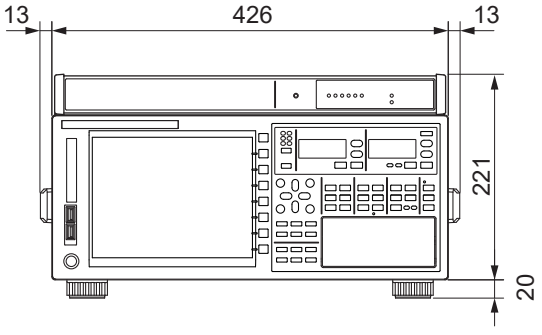
**Rear view**

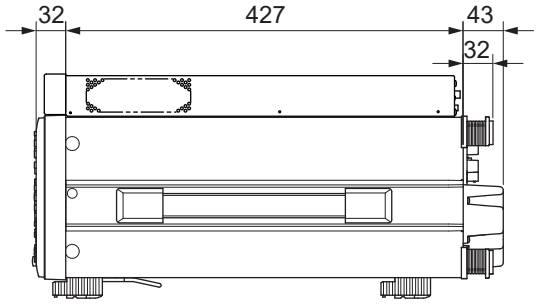




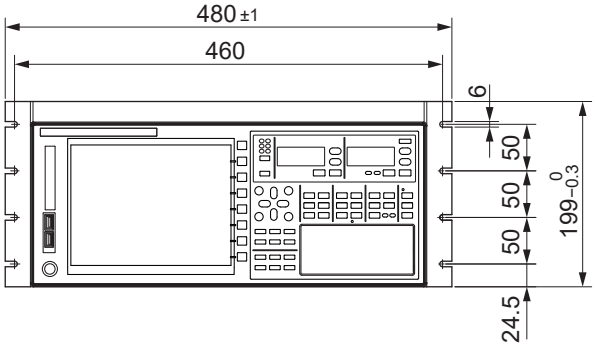

**Models with the current sensor power (/PD2) option**

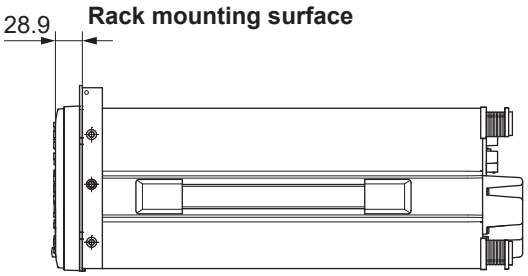


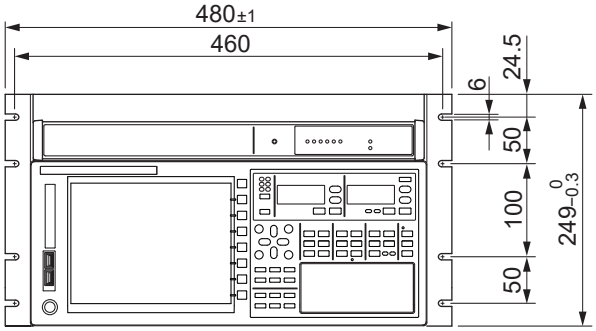
## JIS rack mount dimensions

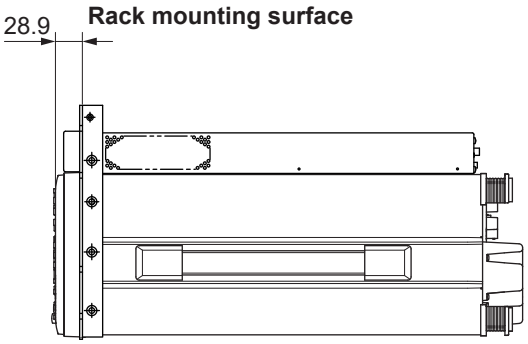
Unit: mm



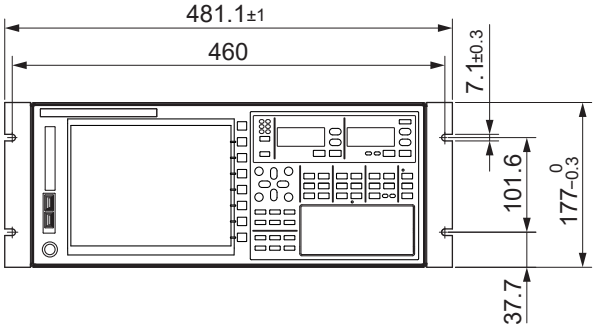



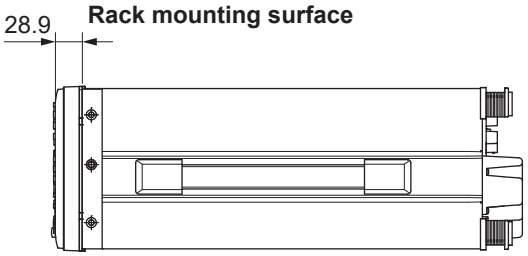

### Models with the current sensor power (/PD2) option



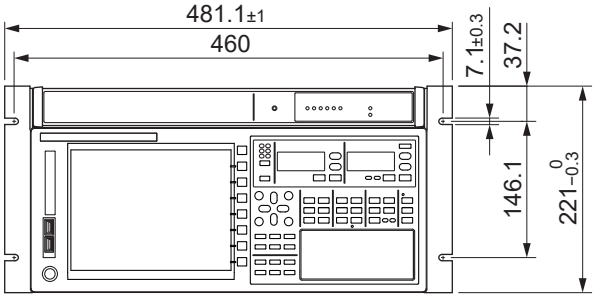



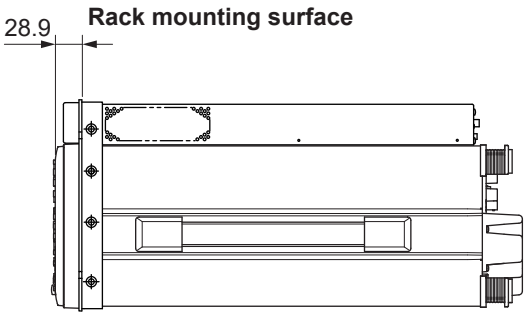

## EIA rack mount dimensions




### Models with the current sensor power (/PD2) option




**Unless otherwise specified, tolerances are ±3% (however, tolerances are ±0.3 mm when below 10 mm).**

# User's Manual

# WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R Precision Power Analyzer Getting Started Guide

# Notice of Alterations

This document describes changes to the Getting Started Guide IM WT1801R-03EN. Please review them before using the manual.

## ■ Page vi "Checking the Contents of the Package"

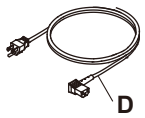
Make a change as shown in the underlined section.

### Standard accessories

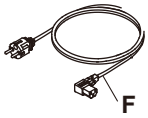
.....

**Power cord (one cord that matches the suffix code is included) [1]**

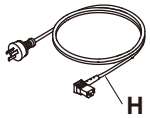
**UL/CSA standard and PSE compliant**
**A1006WD**



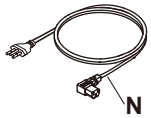

**VDE/Korean standard**
**A1009WD**



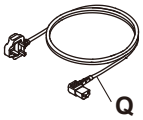

**Chinese standard**
**A1064WD**




**Brazilian standard**
**A1103WD or A1088WD**




**British standard**
**A1054WD**

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## ■ Page vii "Checking the Contents of the Package"

### Optional accessories (sold separately)

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**Group 1**

Compliance with EN standards is achieved by using the following in combination with the instrument.

| Item | Model or Part No. | Maximum Rated Voltage to Ground Measurement category | Notes | Manual No. |
|---|---|---|---|---|
| ..... | ..... | ..... | ..... | ..... |
| ..... | ..... | ..... | ..... | ..... |
| Power Adapter for Current Sensor | 761961 | | INPUT: ±15 V, 1.8 A<br>OUTPUT: ±12 V, 0.8 A | IM 761961-01 |

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## ■ Page viii "Checking the Contents of the Package"

Add the area enclosed by the broken line.

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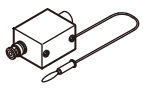
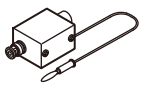
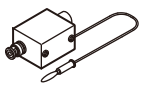
**Shunt resistor box (5 Ω)**
**A1323EZ**



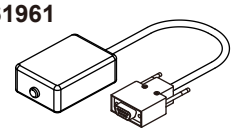
**Shunt resistor box (10 Ω)**
**A1324EZ**



**Shunt resistor box (20 Ω)**
**A1325EZ**



**Power Adapter for Current Sensor**
**761961**



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## ■ Page xvi "Regulations and Sales in Various Countries and Regions"

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### Compliance with the Radio Waves Act (Republic of Korea)

This product complies with the Radio Waves Act (Republic of Korea).

1) Trade Name: Yokogawa Test & Measurement Corporation

2) Model & Model Name: See the table below.

3) Date of Manufacture: Listed on the instrument

4) Manufacturer: Yokogawa Test & Measurement Corporation

5) Country of origin: Korea

| Model | Model Name | Registration Website URL |
|---|---|---|
| WT1801R, WT1802R, WT1803R, WT1804R, WT1805R, WT1806R | Precision Power Analyzer | http://www.rra.go.kr/selform/IMY-EEN537-1 |

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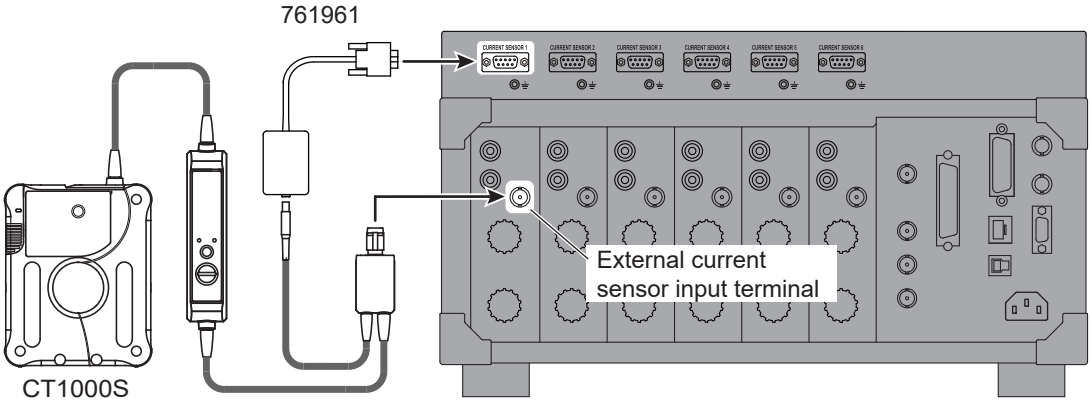
## ■ Page 2-39 "2.11 Wiring the Circuit under Measurement When Using Voltage and Current Transformers"

### Connecting a CT1000S to the current sensor power (/PD2 option)

On models with the current sensor power supply option, power can be supplied to the CT1000S AC/DC Split Core Current Sensor using the 761961 Power Adapter for Current Sensor. When applying the output signal from the CT1000S into this instrument's external current sensor input terminal (option), connect the CT1000S and the separately sold 761961 as shown below.

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**CAUTION**

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  .....
- Use the current sensor power terminal (option) on the rear panel of this instrument only as a power supply for the CT60/CT200/CT1000/CT1000A/CT2000A/CT1000S. .....
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## ATTENTION

- ……
  ……
- Utilisez la borne d’alimentation du capteur de courant (en option) sur le panneau arrière de cet instrument uniquement comme alimentation électrique pour le CT60/CT200/CT1000/CT1000A/CT2000A/CT1000S. ……
  ……

***Note***

Warm up the CT60/CT200/CT1000/CT1000A/CT2000A/CT1000S for at least 30 minutes without input.