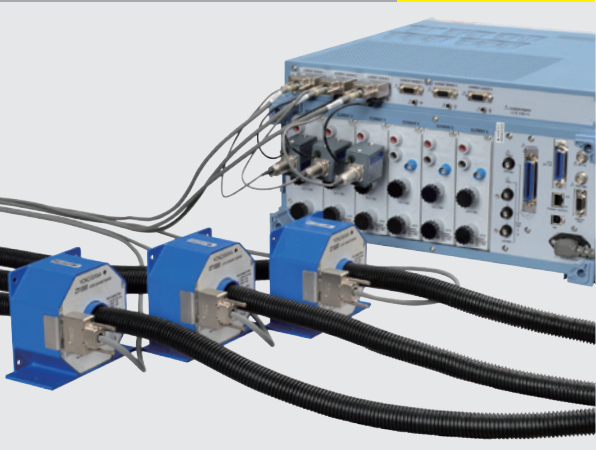


Large current power measurement

Current sensors & probes

Precision Making

Bulletin CT1000-00E



With the increasing importance of energy efficiency across industries, greater efforts are being made to generate and use power more efficiently.

However, applications such as electric vehicles, railways, etc. often need high current power measurements. Yokogawa's CT series current sensors have the ideal solution to extend the capabilities of power analyzers to support such applications.

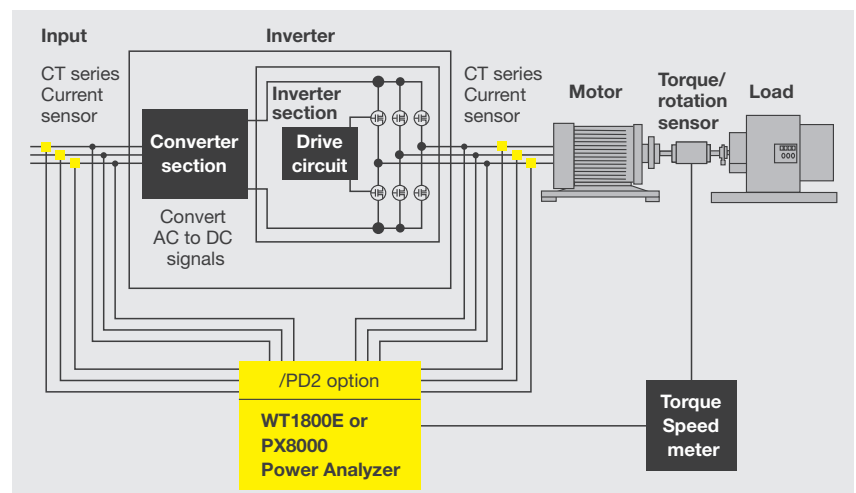
To meet stringent efficiency standards, the CT series offers a wide range of reliable current sensors optimized for multichannel measurements of large AC/DC currents.

The Yokogawa CT series delivers

Accuracy – Excellent linearity ensures precise power measurement for applications that require wide dynamic range where current levels change dramatically.

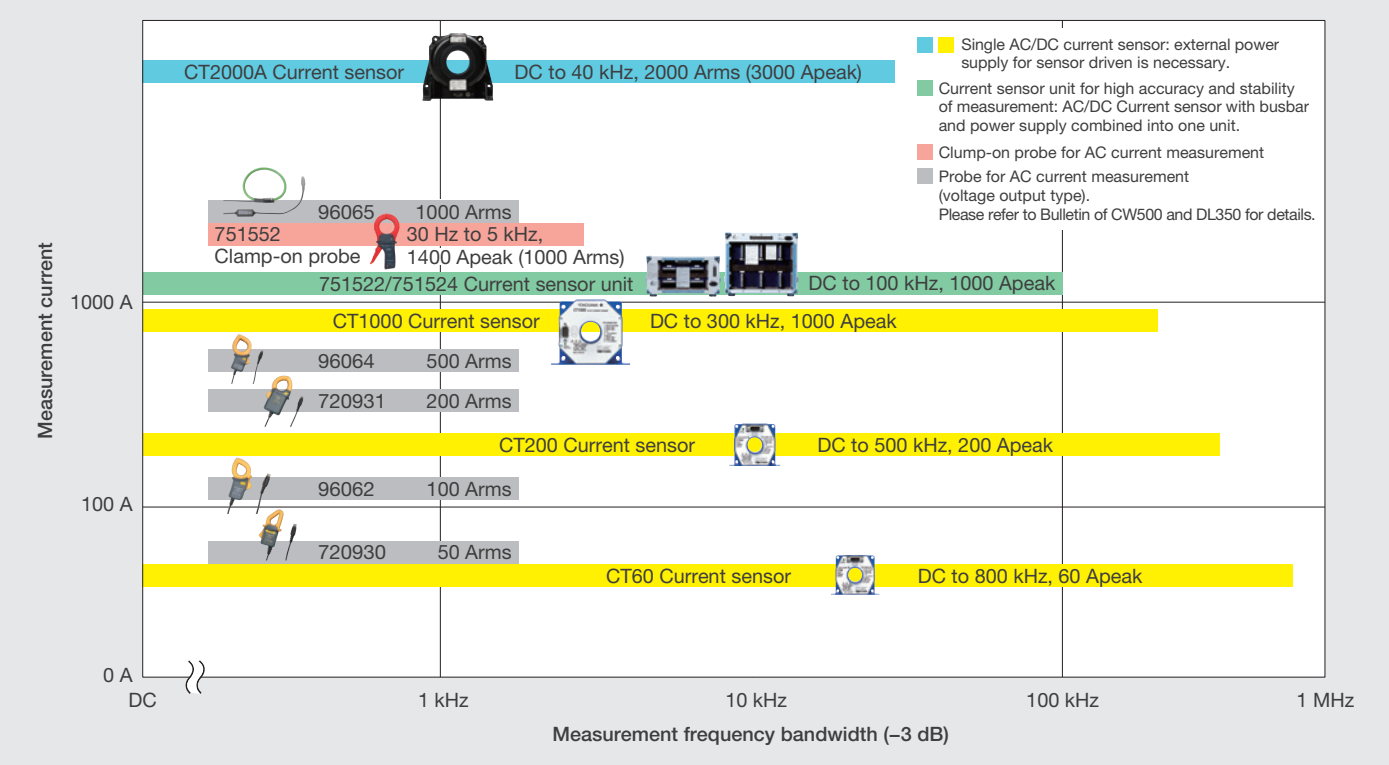
Noise immunity – High resistance to electromagnetic noise minimizes the influence on current readings and enables accurate measurements.

Versatility – Choose from a range of sensors - from 60A to 2000A that operate from DC to 40 KHz for power measurement requirements across a variety of applications.

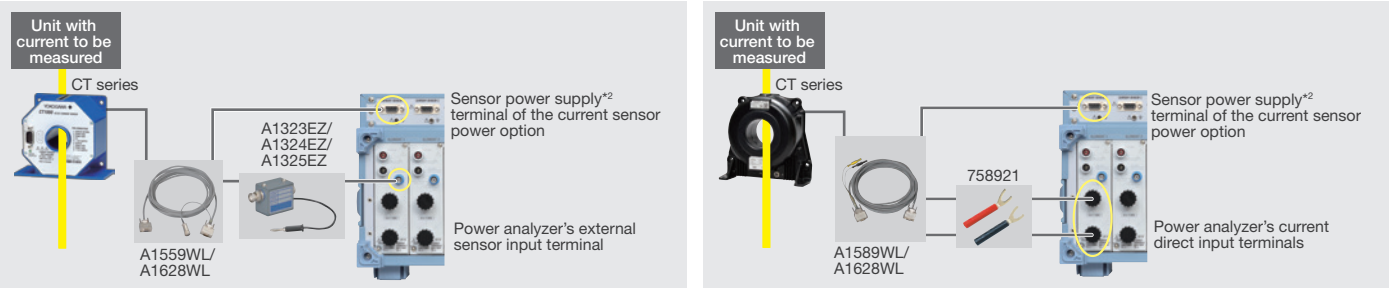


YOKOGAWA supplies many power analyzers with direct current input for precision current and power measurement. In order to measure much bigger current and power precisely, YOKOGAWA provides many current sensors and probes. These accessories support broad applications.

Current sensors & probe



Connection examples* making use of built-in DC power supply (/PD2 option)



*1: Use an insulated conductor or cable for wiring on the primary side.

*2: When connected to CT2000A current sensors, use DC power supply option (/PD2) for WT1800E or PX8000. The firmware version is Ver.3.1 or later of the WT1800E and Ver. 3.2 or later of the PX8000 for usage of /PD2 option.

Combination among CT current sensors, dedicated cables and Shunt Resistor Boxes

| Model | Current Sensor Cable for direct input, 3 m | Current Sensor Cable for direct input, 5 m | Current Sensor Cable for Shunt Resistor Box, 3 m | Current Sensor Cable for Shunt Resistor Box, 5 m | Propriety of Shunt Resistor Box |
|---------|--|--|--|--|---------------------------------|
| | A1589WL | A1628WL | A1559WL | A1560WL | – |
| CT60 | OK | OK | OK | OK | OK |
| CT200 | OK | OK | OK | OK | OK |
| CT1000 | OK | N.A. | OK | OK | OK |
| CT2000A | N.A. | OK | N.A. | N.A. | N.A. |

Current limitations of the /PD2 option when using CT2000A

When connecting the current sensor, CT2000A, to the DC power supply option (/PD2) terminals on a WT1800E or PX8000 Power Analyzer, make sure that the output current does not exceed the range shown below.

| WT1800E | PX8000 |
|---|---|
| (Total current consumption for channel 1 through 6) ≤ 6 A | (Total current consumption for channel 1 through 4) ≤ 4 A |

AC/DC Current sensor

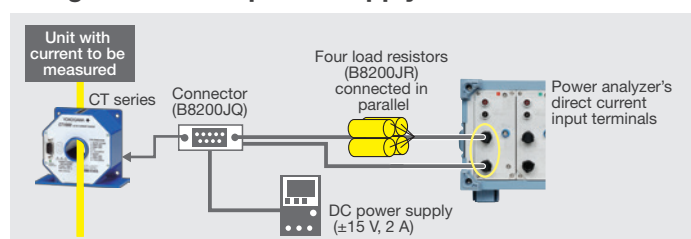
CT Series



| Model | | CT60 | CT200 | CT1000 | CT2000A |
|--|----|--|--|---|--|
| Rated Current | DC | 0 to 60 A | 0 to 200 A | 0 to 1000 A | 0 to 2000 A |
| | AC | 60 Apeak | 200 Apeak | 1000 Apeak | 2000 Arms (3000 Apeak) |
| Current transformation ratio | | 600:1 | 1000:1 | 1500:1 | 2000:1 |
| Accuracy | | DC $\pm(0.05\%$ of reading + 30 μA) 50/60 Hz $\pm(0.05\%$ of reading + 30 μA) Sine wave Basic conditions 23 $\pm 5^\circ\text{C}$ Common mode voltage: 0 V Conductor: Use a linear conductor with 25 mm diameter and 300 mm or more in length | | | |
| Guarantee accuracy period | | 12 months | | | |
| Effect of conductor position | | $\pm 0.01\%$ of reading | | | |
| Measurement range | | DC to 800 kHz (-3 dB) | DC to 500 kHz (-3 dB) | DC to 300 kHz (-3 dB) | DC to 40 kHz (-3 dB) |
| Temperature coefficient | | 0.01%/°C or less in the ranges from 10 to 18°C and 28 to 50°C | | | |
| Maximum allowable continuous input | | 60 Apeak | 200 Apeak | 1000 Apeak | 3000 Apeak |
| Maximum allowable instantaneous input | | 300 Apeak 0.1 seconds or less (reference value) | 1000 Apeak 0.1 seconds or less (reference value) | 4500 Apeak 0.1 seconds or less (reference value) | 10000 Apeak 0.1 seconds or less (reference value) |
| Load resistance (± 15 V) | | 0 to 20 Ω | 0 to 30 Ω | 2.5 to 5 Ω | 0 to 1 Ω |
| Operating temperature range | | 10 to 50°C | | | |
| Operating humidity range | | 20 to 80% RH (no condensation) | | | |
| Storage temperature range | | -20 to 60°C | | | |
| Storage humidity range | | 20 to 80% RH (no condensation) | | | |
| Dimensions | | Approx. 93 (W) \times 77 (H) \times 38 (D) mm (excluding connector, conductor guide, and projections) | | Approx. 128 (W) \times 160 (H) \times 60 (D) mm (excluding connector, conductor guide, and projections) | Approx. 230 (W) \times 220 (H) \times 76 (D) mm |
| Primary current hole diameter | | 26 mm diameter | | 30 mm diameter | 70 mm diameter |
| Secondary connector | | D-Sub-9 pin | | | |
| Weight | | Approx. 0.3 kg | | Approx. 0.8 kg | Approx. 4.2 kg |
| Power Voltage | | $\pm(15 \text{ V} \pm 5\%)$ | | | |
| Maximum rated power | | 7 VA | 11 VA | 30 VA | 35 VA |
| Consumption current (at each power voltage) | | Approx. (80 mA + output current) | | Approx. (150 mA + output current) | Approx. (225 mA + output current) |
| Recommended fixing screw and tightening torque | | M4 stainless steel screw \times 4, 2.8 Nm M5 stainless steel screw \times 2, 3.7 Nm | | M5 stainless steel screw \times 4, 3.7 Nm M6 stainless steel screw \times 2, 4.4 Nm | M6 stainless steel screw \times 8, 5.5 Nm |

Connection example*

Using external DC power supply



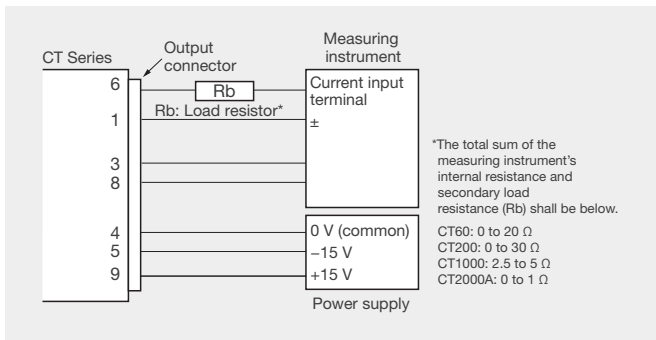
*Use conductors or cables with reinforced insulation for primary input.

*Make sure that the total load resistance including measuring instrument's internal resistance and external load resistance (R_b) is within the specification to prevent oscillation. And confirm the rated power specification of the load resistance.

Accessories and connection to the CT series

- D-Sub 9-pin connector
1 plug and 2 screws, part number B8200JQ
- Load resistor
2.5 Ω (10 $\Omega \times 4$, 4 resistors shall be connected in parallel.),
part number: B8200JR
Resistance accuracy: $\pm 0.1\%$,
Temperature coefficient: 25 ppm/ $^{\circ}\text{C}$

Connection example

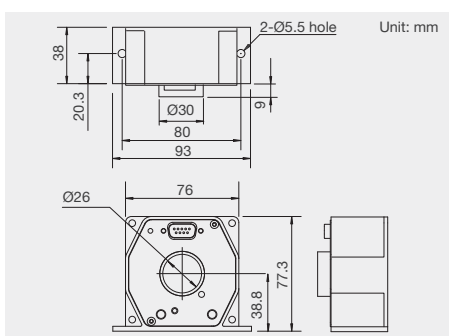


Signal assignments of secondary connector

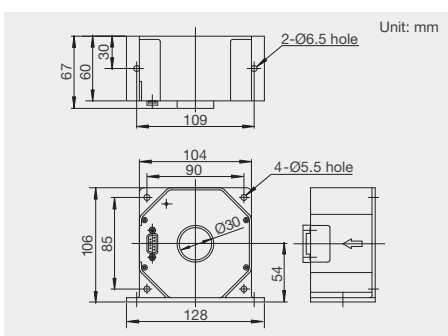
| Pin No. | Signal Name |
|---------|---|
| 1 | Output return |
| 2 | -(Do not connect) |
| 3 | Normal operating status (Internal ground) |
| 4 | Power 0 V input |
| 5 | Power -15 V |
| 6 | Signal output |
| 7 | -(Do not connect) |
| 8 | Normal operating status |
| 9 | Power +15 V input |

Dimensions

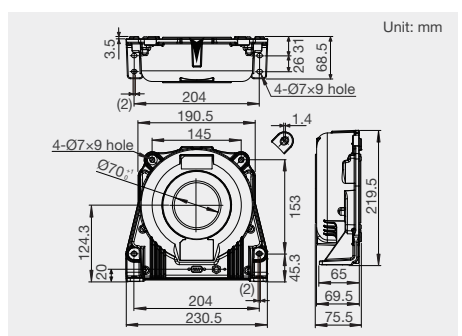
CT200/CT60



CT1000

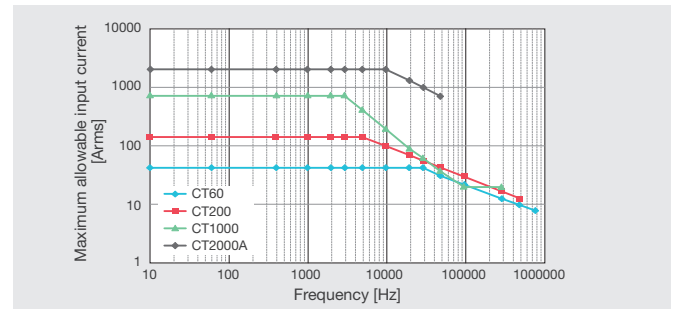


CT2000A

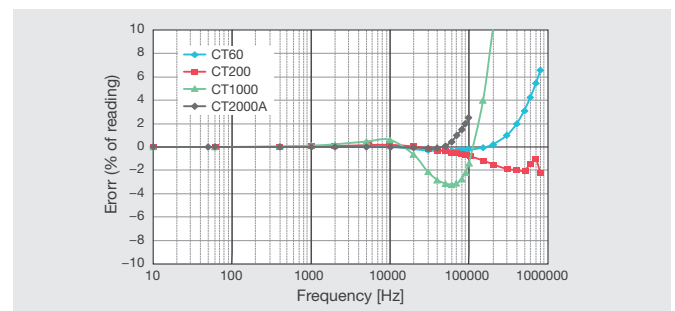


Characteristic example

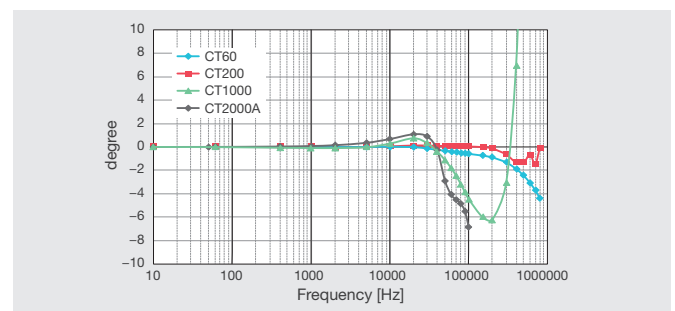
*The characteristic is a typical example, not a guaranteed one.



CT series Primary current derating by frequency example*



CT Series Frequency characteristic example*



CT Series Phase characteristic example*

Current sensor unit

751522/751524

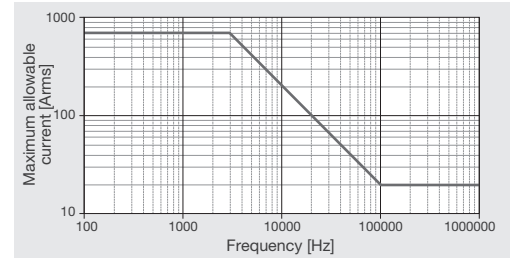


| Model | 751522/751524 |
|--|---|
| Input type | Floating input using CT(s) |
| Rated currents | DC: 0 to 1000 A AC: 1000 Apeak |
| Input/output ratio | 1500:1 |
| Guarantee accuracy period | 12 months |
| Amplitude accuracy (within three months of calibration) | $\pm(0.05\% \text{ of reading} + 40 \mu\text{A})$ DC $\pm(0.1\% \text{ of reading} + 40 \mu\text{A})$ ($30 \text{ Hz} \leq f < 45 \text{ Hz}$) $\pm(0.05\% \text{ of reading} + 40 \mu\text{A})$ ($45 \text{ Hz} \leq f \leq 66 \text{ Hz}$) $\pm(0.1\% \text{ of reading} + 40 \mu\text{A})$ ($66 \text{ Hz} < f \leq 1 \text{ kHz}$) $\pm((0.05\% + 0.08 \times f\%) \text{ of reading} + 40 \mu\text{A})$ ($1 \text{ kHz} < f \leq 40 \text{ kHz}$) $\pm((0.2\% \times f\%) \text{ of reading} + 40 \mu\text{A})$ ($40 \text{ kHz} < f \leq 100 \text{ kHz}$) Accuracy values at frequencies over 1 kHz are provided as reference values. (Unit of f: kHz) |
| Reference conditions | $23 \pm 5^\circ\text{C}$, 30 to 70% RH, AC input as sinewave Primary current: 2 to 1000 A common mode voltage: 0 V Supply voltage: rated supply voltage $\pm 5\%$ |
| Temperature coefficient | $0.01\%/^\circ\text{C}$ (10 to 18°C , 28 to 40°C) |
| Frequency range | DC to 100 kHz (-3 dB) |
| Continuous maximum allowable input | 1000 Apeak (see the diagram titled 'Primary current derating by frequency') |
| Instantaneous maximum allowable input | 4500 Apeak for 0.1 second or less (reference value) |
| Continuous maximum in-phase voltage | 1000 V rms |
| Input terminal type | M12 nuts and bolts |
| Output terminal type | Screw terminal |
| Output load resistance | 2.5 Ohm |
| Warmup time | Approx. 30 minutes |
| Operating temperature and humidity ranges | 10 to 40°C , 20 to 80% RH (no condensation) |
| Storage temperature range | 0 to 60°C (no condensation) |
| Rated supply voltage and allowable range of supply voltage fluctuation | 100 VAC to 240 VAC/90 VAC to 264 VAC |
| Rated supply frequency and allowable range of supply frequency fluctuation | 50/60 Hz/48 to 63 Hz |
| Dimensions | 751522: Approx. 426 (W) \times 221 (H) \times 401 (D) mm 751524: Approx. 426 (W) \times 355 (H) \times 401 (D) mm Note: The dimensions shown exclude projections such as input terminals and base feet. |
| Weight | 751522: Approx. 15 kg 751524: Approx. 28 kg |
| Consumed power | 751522: Approx. 30 VA 751524: Approx. 90 VA |

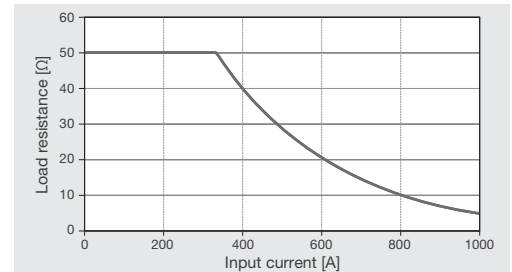
Characteristic example

*The characteristic is a typical example, not a guaranteed one.

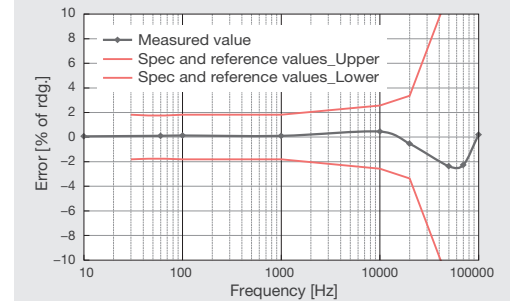
Primary current derating by frequency



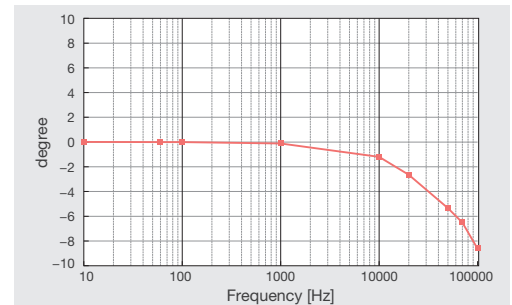
Input current derating by load resistance



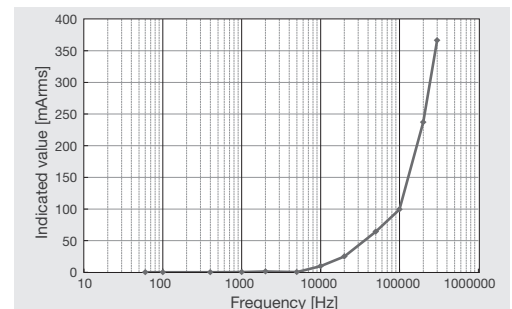
Frequency characteristic example*



Frequency characteristic example*



CMRR characteristic example*

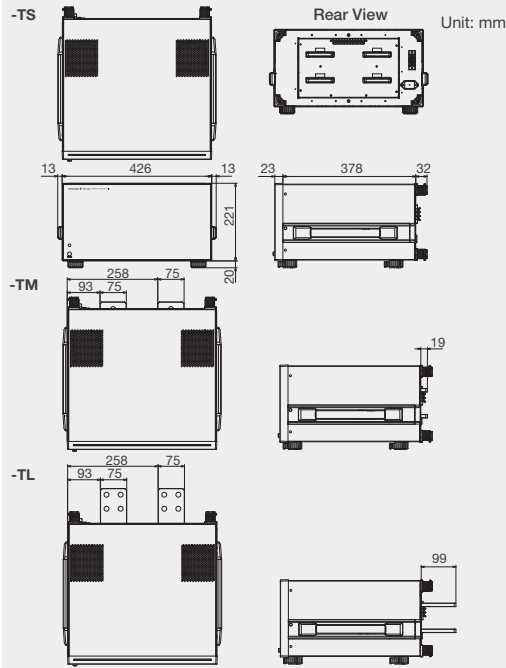


AC Clamp-on probe 751552

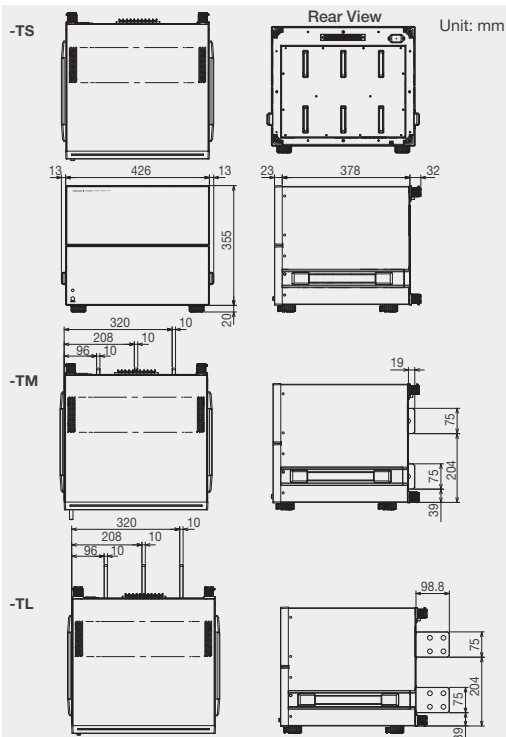


Dimensions

751522

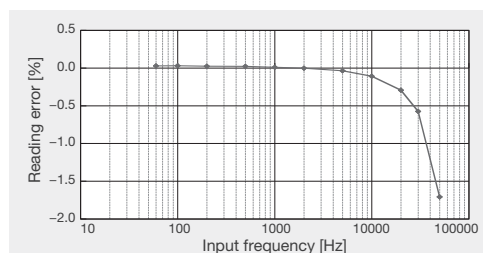


751524



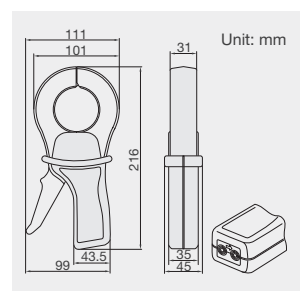
| Model | 751552 |
|---|---|
| Rated current | AC 0.001 to 1200 Arms When inputting 1000 Arms to 1200 Arms (1 kHz), a 20 minute rest is required after 40 minutes of electrical continuity. |
| Current transformation ratio | 1000:1 |
| Amplitude accuracy | Input current (I) accuracy with respect to output current 1 mA ≤ I < 100 mA: ±(3% of reading + 5 μA), phase error: no spec 100 mA ≤ I < 1 A: ±(2% of reading + 3 μA), phase error: no spec 1 A ≤ I < 10 A: ±1% of reading, phase error: 2 degree 10 A ≤ I < 100 A: ±0.5% of reading, phase error: 1 degree 100 A ≤ I ≤ 1200 A: ±0.3% of reading, phase error: 0.7 degree |
| Reference conditions | 23 ±3°C, 20 to 75% RH, 48 to 65 Hz sinewave input Input current: 0.001 to 1200 A, common mode voltage: 0 V Conductor: Clamp center Primary input: No DC current component, no AC magnetic field, external magnetic field below 40 A/m, secondary load resistance 1 Ω or less, no effects from current flowing through adjacent external conductors |
| Measurement frequency range | 30 Hz ≤ f ≤ 5 kHz 30 Hz ≤ f < 48 Hz: Add ±0.5% of output signal 65 Hz < f ≤ 1 kHz: Add ±1% of output signal 1 kHz < f ≤ 5 kHz: Add ±2% of output signal |
| Conductor position effect | Add ±0.1% of reading (400 Hz or less) |
| DC current effect | 1% of output current at superimposition of 15 Adc |
| Temperature effect | 0.02%/°C or less of the output signal |
| Maximum output voltage | 30 V peak or less |
| Continuous maximum allowable input | For a continuous frequency f of 1 kHz or less I ≤ 1000 A For an input signal of 1000 A < I ≤ 1200 A at 1 kHz, the probe can be used continuously for a maximum of 40 minutes. Do not perform measurement 20 minutes thereafter. |
| Working voltage | Maximum 600 Vrms |
| Secondary load resistance | 1 Ω or less |
| Secondary load resistance effect | 1 to 5 Ω: 0.1% of reading, add 0.2° phase error |
| Operating temperature and humidity ranges | -10 to 50°C, 0 to 90% RH (no condensation) |
| Storage temperature range | -40 to 70°C (no condensation) |
| Dimensions | Approx. 111 (W) × 216 (H) × 45 (D) mm |
| Measurable conductor diameter | Maximum 52 mm diameter |
| Output current connector | Plug-in terminal (safety terminal) |
| Weight | Approx. 620 g |

751552 frequency characteristic example*



*The characteristic is just a typical example but not guaranteed one.

Dimensions



Models and Suffix Codes

AC/DC Current Sensors and Clamp-on Probe

| Model | Product Name | Specifications |
|---------|----------------------|--|
| CT2000A | AC/DC Current sensor | Measurement range: DC to 40 kHz, basic accuracy: $\pm(0.05\%$ of reading + 30 μ A), 2000 Arms |
| CT1000 | AC/DC Current sensor | Measurement range: DC to 300 kHz, basic accuracy: $\pm(0.05\%$ of reading + 30 μ A), 1000 Apk |
| CT200 | AC/DC Current sensor | Measurement range: DC to 500 kHz, basic accuracy: $\pm(0.05\%$ of reading + 30 μ A), 200 Apk |
| CT60 | AC/DC Current sensor | Measurement range: DC to 800 kHz, basic accuracy: $\pm(0.05\%$ of reading + 30 μ A), 60 Apk |
| 751552 | Clamp-on probe | Measurement range: 30 Hz to 5 kHz, basic accuracy: $\pm 0.3\%$ of reading, 1000 Arms |

Current Sensor Unit

| Model | Suffix Code | Product Name | Description |
|-------------------|-------------|--|---|
| 751522 | | Current Sensor Unit (For Single-Phase) | |
| 751524 | -10 | Current Sensor Unit (For Three-Phase U and V) | Measurement range: DC to 100 kHz Basic accuracy: $\pm(0.05\%$ of reading + 40 μ A) |
| | -20 | Current Sensor Unit (For Three-Phase U and W) | |
| | -30 | Current Sensor Unit (For Three-Phase U, V, and W) | |
| Input Terminal | -TS | Short Terminal Model | M12 \times 1 |
| | -TM | Middle Terminal Model | M12 \times 1 |
| | -TL | Long Terminal Model | M12 \times 4 |
| Power cord | -D | UL/CSA Standard, PSE Compliant | |
| | -F | VDE Standard | |
| | -R | AS Standard | |
| | -Q | BS Standard | |
| | -H | GB Standard | |
| | -N | NBR Standard | |
| Option | /CV | Terminal Cover | *Correspond to Input Terminal "--TS" only |

*751524-10 is available for the WT3000E/WT1800E/WT500, and 751524-20 is available for the WT332E. 751522/751524 do not conform to CE Marking.

- Error for when used in conjunction with the power meter
Add the error of the power meter and that of the current sensor unit or AC/DC current sensor.
- Notes on wiring
 - Make sure the primary and secondary lines do not interfere with each other. Small currents flow through the secondary line, so it may be affected by the primary current. Make the secondary line as short as possible, allow enough space from the primary line, and make sure the secondary line is not parallel to the primary line.
 - AGW 24 or larger wire is recommended for the secondary line. A twisted-pair wire is sometimes recommended rather than a shielded wire, for example, for testing inverters.
- Since secondary output current of these current sensor units are small, please use smaller current range measurement of above power analyzers.

This is a Class A instrument based on Emission standards EN61326-1 and EN55011, and is designed for an industrial environment.
Operation of this equipment in a residential area may cause radio interference, in which case users will be responsible for any interference which they cause.

There are restrictions to some general specifications and functions. For details, see the respective product catalog.

Accessories (Sold separately)

| Model | Product Name | Specifications | Sales Unit |
|---------|----------------------------------|--|------------|
| 758917 | Measurement lead set | 75-cm long cable, 2 pieces (red and black) in set | 1 |
| 758922 | Small alligator-clip adapter set | Safety terminal-to-alligator-clip adapter, 2 pieces (black and red) in set. Rated 300 V | 1 |
| 758929 | Large alligator-clip adapter set | Safety terminal-to-alligator-clip adapter, 2 pieces (black and red) in set. Rated 1000 V | 1 |
| 758923 | Safety terminal adapter set | Spring-hold type, 2 pieces (black and red) in set | 1 |
| 758931 | Safety terminal adapter set | Spring-fastened type, 2 pieces (black and red) in set | 1 |
| 758921 | Fork terminal adapter set | 4-mm banana plug-to-fork terminal, 2 pieces (black and red) in set | 1 |
| B8200JQ | Output connector | D-Sub 9-pin connector with 2 screws (female on connector side) | 1 |
| B8200JR | Load resistor | 10 Ω /0.25 W ($\times 4$) | 1 |
| A1323EZ | Shunt Resistor Box | 5 Ω $\pm 0.05\%$, for CT1000 | 1 |
| A1324EZ | Shunt Resistor Box | 10 Ω $\pm 0.02\%$, for CT1000, Maximum 640 Apk | 1 |
| A1325EZ | Shunt Resistor Box | 20 Ω $\pm 0.02\%$, for CT60/CT200 | 1 |
| A1559WL | Current Sensor Cable | Cable length 3 m for Shunt Resistor Box | 1 |
| A1560WL | Current Sensor Cable | Cable length 5 m for Shunt Resistor Box | 1 |
| A1589WL | Direct Current Input Cable | A cable to connect with Current Input terminals through Fork Terminal Adapter 758921 or others. Burden resistor 2.7 Ω , Cable length 3 m | 1 |
| A1628WL | Direct Current Input Cable | A cable to connect with Current Input terminals through Fork Terminal Adapter 758921 or others. Without Burden resistor, Cable length 5 m | 1 |

Be careful not to touch the metal parts that are easily accessible. Doing so may cause an electric shock.



758917



758921



A1323EZ/A1324EZ/A1325EZ



A1559WL/A1560WL



A1589WL



A1628WL

NOTICE

- Before operating the product, read the user's manual thoroughly for proper and safe operation.

YOKOGAWA

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