Test&Measurement

YOKOGAWA

Versatile current sensing

CT1000S
Split core current sensor

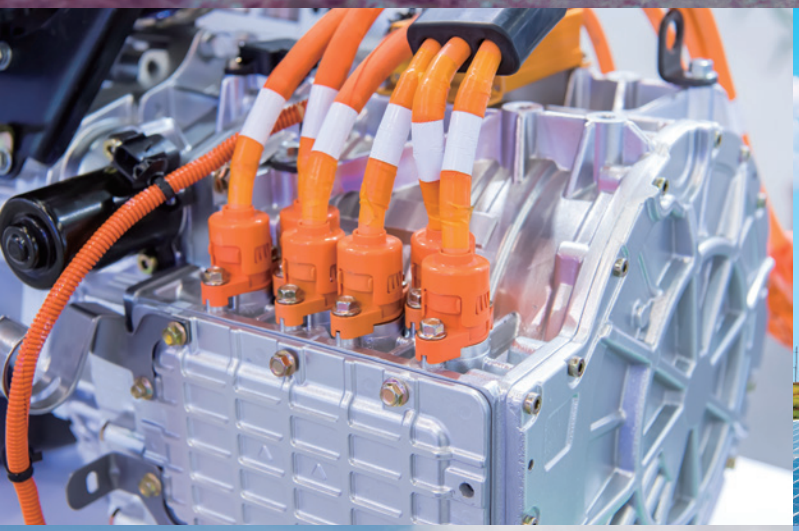
Precision Making

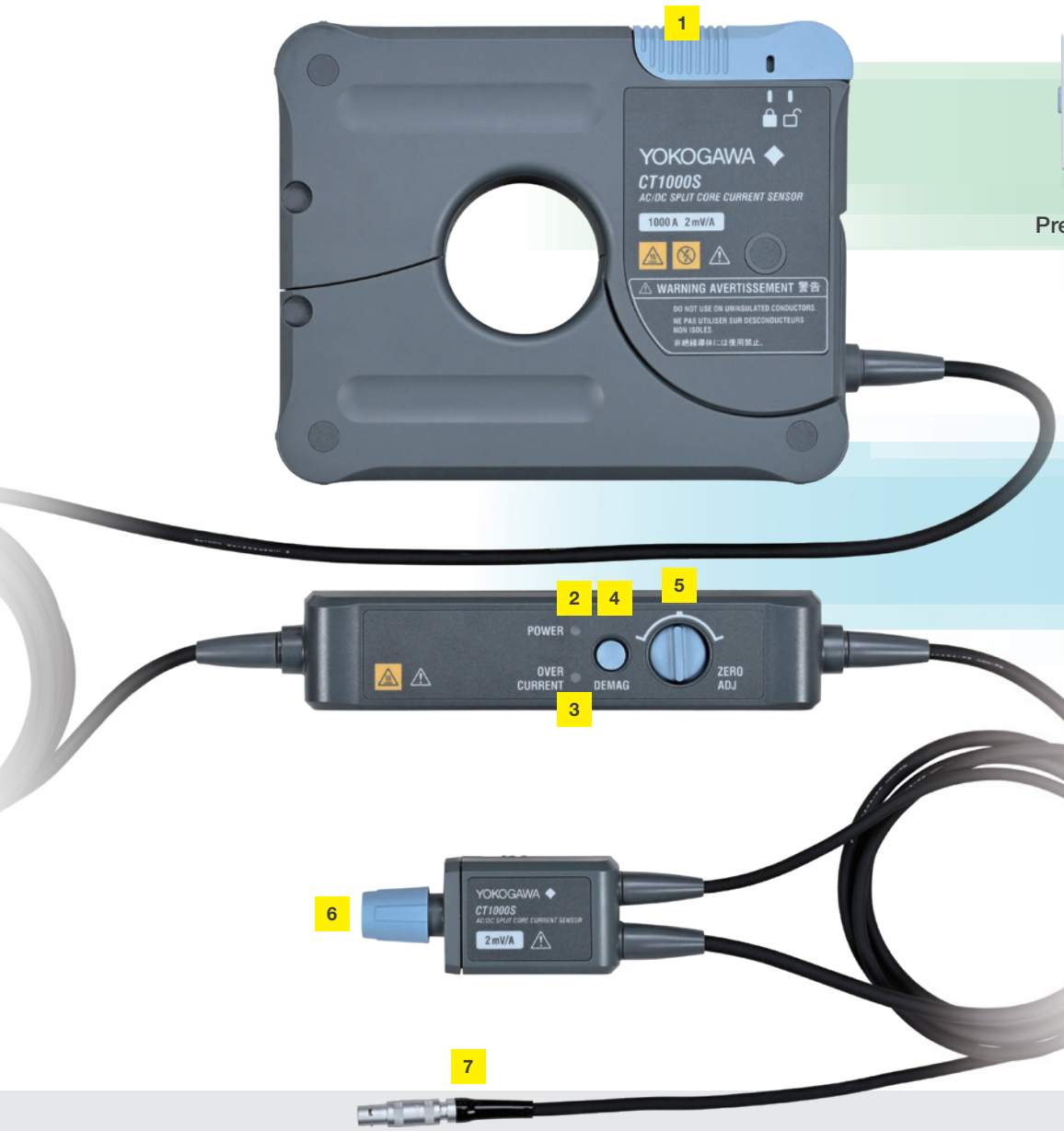
Bulletin CT1000S-01EN

As energy efficient technologies for sectors as energy generation, transportation home and industrial appliances becomes wider adopted. The requirements for high precision measurements make an onwards journey. Besides the needs for low uncertainty measurement setups in laboratory environments, the demands for field measurements and testing becomes larger. This requires sensors to deliver high performance in a more demanding environment and wider temperature operating range. Especially in the field of EVs and renewable energy, the need for high accurate current sensors is vital due to the large currents.
The Split-core current sensor provides reliable power and efficiency measurements as well as and simplicity of use maximizing the valuable time of engineers.

Reproducibility – Inheriting the conventional through-hole type CT shape, the CT1000S improves measurement reproducibility in limited environments by fixing and locking the axis position of the main unit and measurement cable.

Noise immunity – Performance shielding technology used in through hole type CT is employed to improve noise immunity. High-precision measurement is realized even in measurement environments with noisy inverters, motors, etc.





Precision power analyzer **WT5000**

Scopecorder **DL950**

Play an and wa

Large Current

Main unit

1 Lock lever

Sub unit

2 Power LED

3 Overcurrent LED

4 Demag button

5 Offset adjust knob

IV unit

6 Output connector

Power supply

7 Power connector

CT1000S

AC/DC Split Core Current Sensor

Power measurement

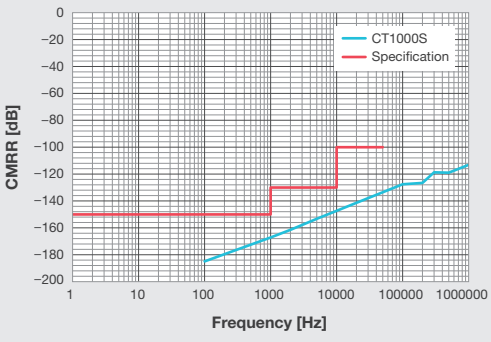
Waveform measurement

important role in both power veform measurement

1000 A Wide Bandwidth 300 kHz

Stable measurement at high bandwidth

As the power factor decreases in high-frequency measurements, the effect of phase error on power values increases. Accurate and stable measurement of devices such as inverters that use high-frequency switching to control their operation requires current sensors capable of measuring up to high bandwidths.

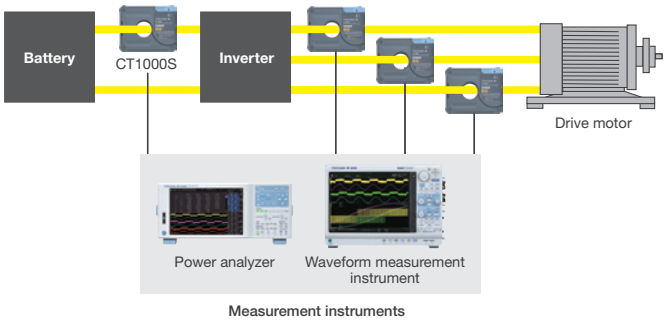


Excellent noise immunity enables high-precision measurement even in severe noise environments.

The axis position fixing jig suppresses the shaking of the measurement line and reduces the influence on measured values.

The main unit can be fixed with screws. Stable measurement improves reproducibility.

Application

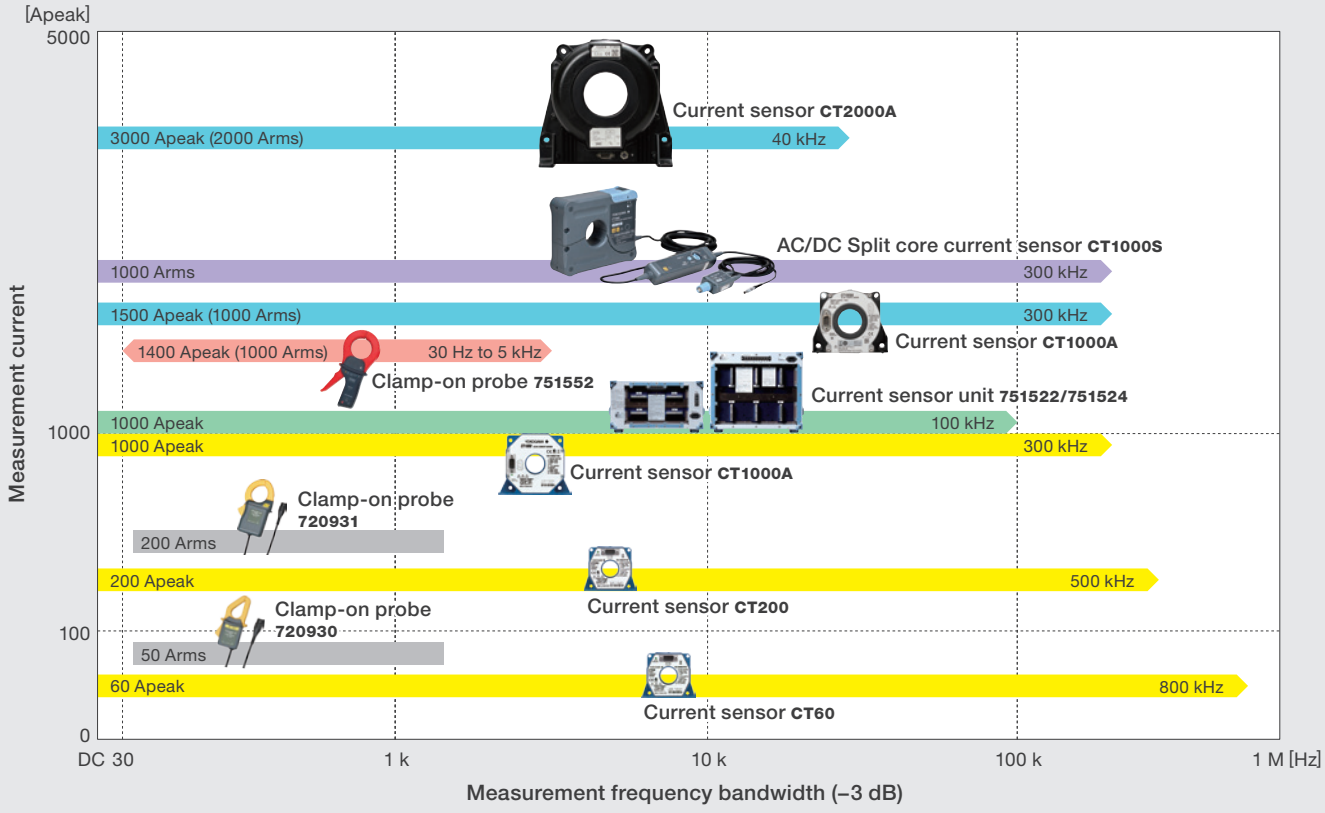


Large current and wide bandwidth measurement

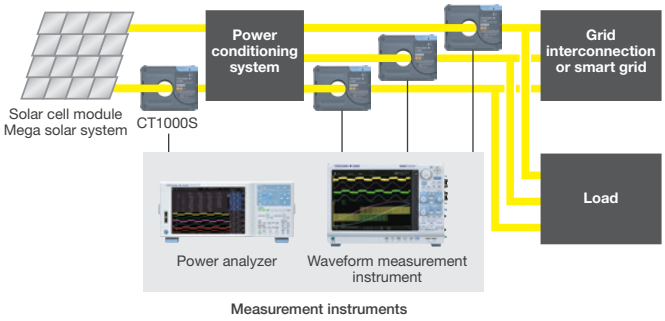
Mechanisms that convert the output of a DC power source to AC using an inverter are utilized in a variety of industrial fields, including EVs. As decarbonization is now being promoted, increasing the efficiency of inverters is an important target. Inverter output with PWM control contains harmonic components and requires a current sensor capable of measuring a wide bandwidth.

Current Sensor

For power measurement



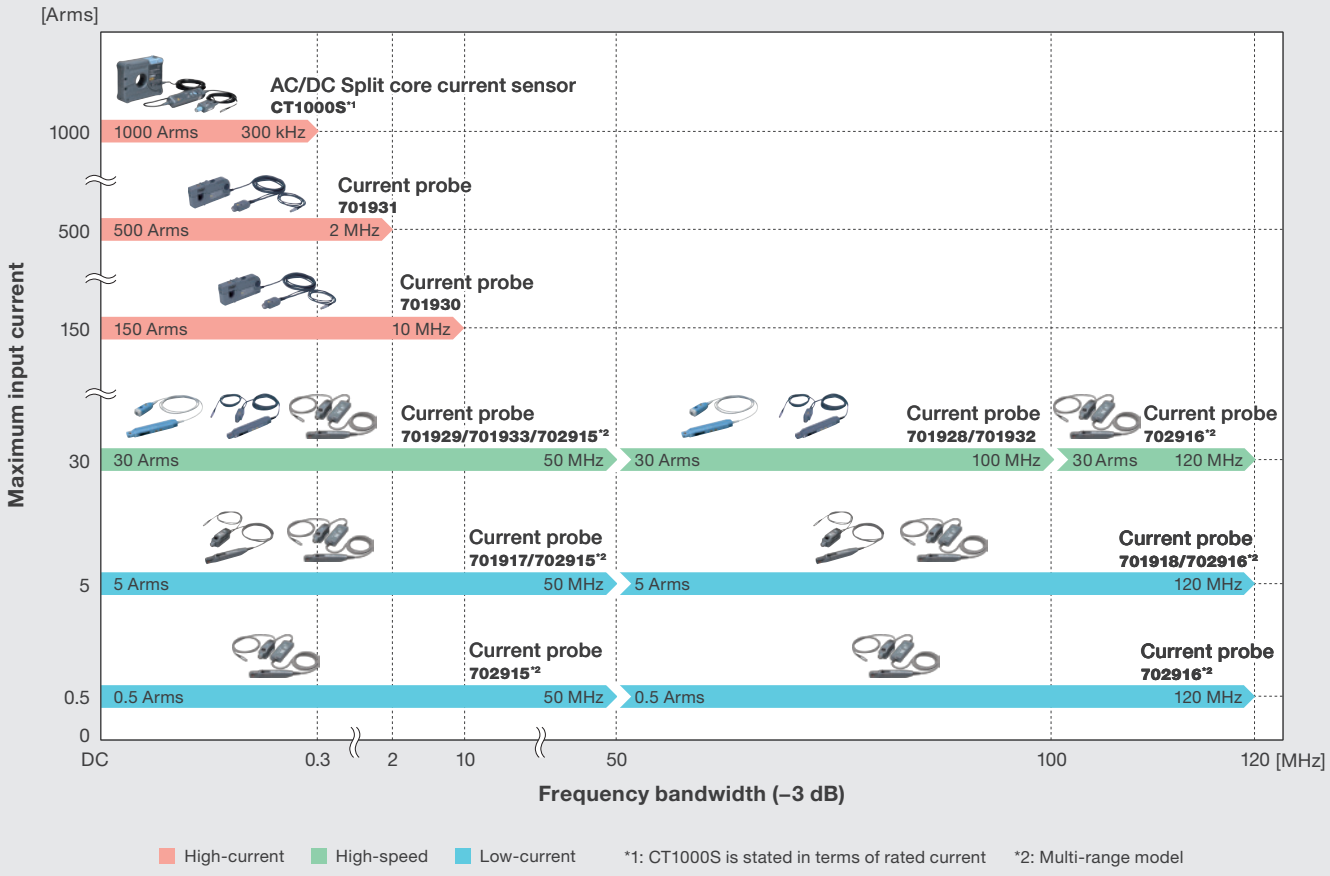
- AC/DC Split core current sensor: Power supply (±12 V) required to drive sensor
- Single AC/DC current sensor: external power supply for sensor driven is necessary.
- Current sensor unit for high accuracy and stability of measurement: AC/DC Current sensor with busbar and power supply combined into one unit.
- Clump-on probe for AC current measurement
- Probe for AC current measurement (voltage output type). Please refer to Bulletin of CW500 and DL350 for details.



Large current measurement without cutting the measuring cable

Energy generated by photovoltaic cell modules is converted from DC to AC by a power conditioning system. Minimizing the losses during these conversions leads to higher efficiency of power conditioning systems with a 0.1% improvement in conversion efficiency require highprecision measurement instruments and current sensors. The AC/DC split core current sensor enables large current measurement without cutting the target cable and reduces the workload.

For waveform measurement



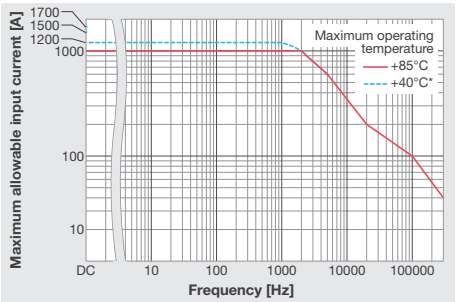
Current sensor list




Model	CT1000S	CT1000A	CT1000	701931*
Rated Current	1000 Arms	1000 Arms	1000 Apeak	500 Arms
Accuracy (50/60 Hz)	±(0.2% of reading + 0.01% of f.s.)	±(0.04% of reading + 30 µA)	±(0.05% of reading + 30 µA)	To 500 A: ±1% of reading ±5 mV 500 A to 700 Apeak: ±2% of reading (Amplitude accuracy)
Bandwidth (–3 dB)	DC to 300 kHz			DC to 2 MHz
Operating temperature range	Main unit: –40°C to 85°C Sub unit: 5°C to 40°C IV unit: 5°C to 40°C	–40°C to 85°C	10°C to 50°C	0°C to 40°C
Operating humidity range	20 to 80% RH (no condensation)			80% RH (no condensation)
Dimensions (W × H × D) mm	Main unit: 190 × 153 × 52 Sub unit: 177.5 × 33 × 41 IV unit: 60 × 24 × 40	128 × 106 × 54	128 × 106 × 60	Sensor: 176 × 69 × 27 Terminator: 27 × 55 × 18
Primary current hole diameter	52 mm diameter	38.2 mm diameter	30 mm diameter	20 mm diameter
Supply voltage	±12 V	±15 V	±15 V	±12 V
Supply current	±0.8 A (Maximum)	Approx. (120 mA + output current)	Approx. (150 mA + output current)	580 mA (Maximum)
Output	2 mV/A	Primary rated current at 1000 A is 666.6 mA		0.01 V/A
Connector type	BNC	D-sub 9 pin		BNC

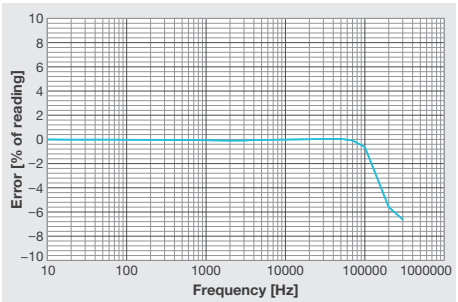
*For waveform measurement

Characteristic example

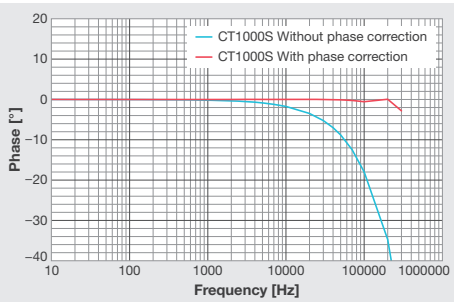


No external magnetic fields, defined at conductor position center
*At the maximum operating temperature of +40°C, 1500 ADC (continuous) and 1700 ADC (1 minute) are allowed.

Frequency characteristic example



Input current derating example

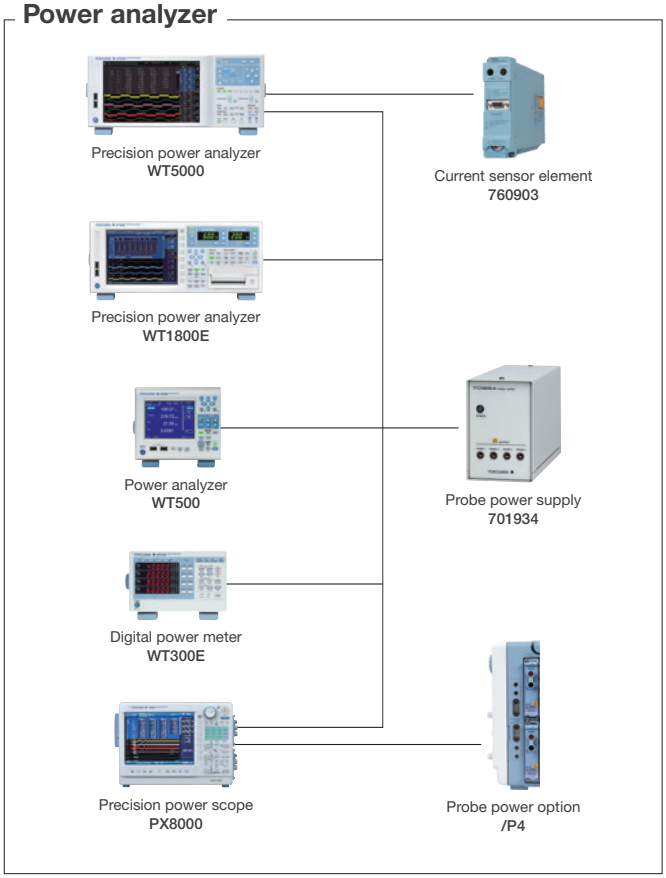


Phase characteristic example

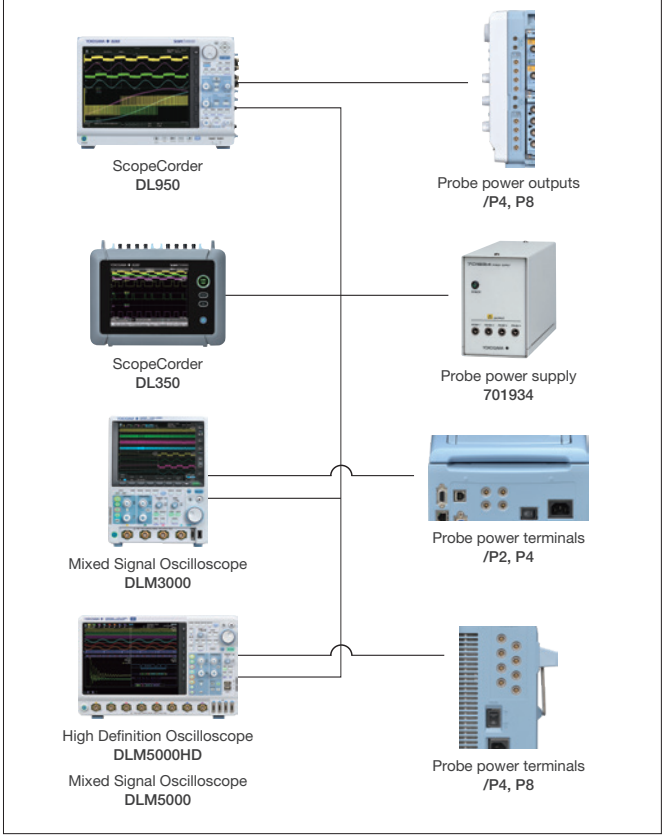
Combination with measurement instrument

Examples of a combination of a measurement instrument and a power supply when using the AC/DC split current sensor

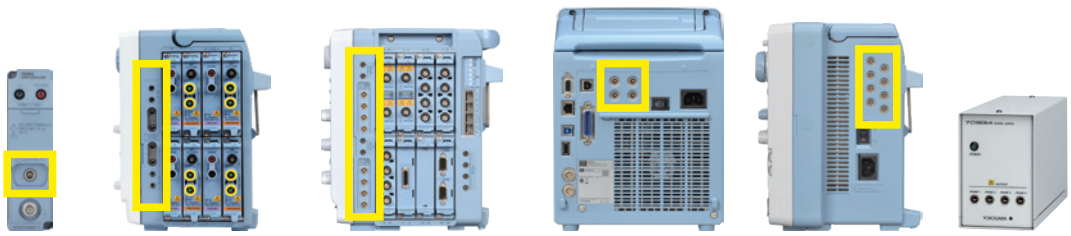
Power analyzer



Waveform measurement instrument



Power supply and number of available sensors



Model	760903	PX8000 /P4	DL950 /P4	DL950 /P8	DLM3000 /P2, /P4	DLM5000HD/ DLM5000 /P4, /P8	701934
Rated current	±12 V ±0.8 A	±12 V ±1A 4 ch total	±12 V ±2.4 A 4 ch total	±12 V ±2.4 A × 2 4 ch total × 2	±12 V ±1.2 A 4 ch total	±12 V ±2.0 A 8 ch total	±12 V ±2.5 A 4 ch total
Number of CT1000S available *±0.8 A (Maximum supply)	× 1	× 1	× 3	× 3 × 3	× 1	× 2	× 3

Specifications

Error indication
% of full scale: Full scale is the rated current of this instrument. % of reading: Reading is the reading on the measuring instrument that this instrument is connected to. % of range: Range is the measurement range of the measuring instrument that this instrument is connected to.

General Specifications			
Warm-up time	Approx. 30 minutes		
Operating environment	Temperature	Main unit	–40°C to 85°C
		Sub unit	5°C to 40°C
		IV unit	5°C to 40°C
	Humidity	20 to 80% RH (no condensation)	
	Operating altitude	2000 m or less	
	Installation location	Indoor use	
Storage environment	Temperature	–40°C to 85°C	
	Humidity	20 to 80% RH (no condensation)	
Supply voltage	Supply voltage: ±12 V ±0.5 V		
Supply current	Maximum supply current: ±0.8 A		
Maximum rated power	7.5 VA (1000 A, 60 Hz measurement using ±12 V power supply)		
Dimensions (excluding cables and protrusions)			
	Main unit	153 (H) × 190 (W) × 52 (D) mm	
	Sub unit	33 (H) × 177.5 (W) × 41 (D) mm	
	IV unit	24 (H) × 60 (W) × 40 (D) mm	
Measurable conductors	50 mm diameter or less		
Cable length	Main unit to sub unit	-L03	Approx. 3 m
		-L05	Approx. 5 m
		-L10	Approx. 10 m
	Sub unit to IV unit	Approx. 1 m	
	IV unit to power connector	Approx. 1 m	
Weight	-L03	Approx. 2.0 kg	
	-L05	Approx. 2.1 kg	
	-L10	Approx. 2.3 kg	
Mounting screw holes	6 locations (M4 screws)		
Connector type	Output	BNC connector	
	Power supply	Probe power supply connector	
Safety standards	Compliant standards: EN 61010-1, EN IEC 61010-2-032 Type D*1 Measurement category O*2, pollution degree 2*3		
EMC standards*3	Emissions	Compliant standards: EN 61326-1 ClassA*5 Group1*6	
	Immunity	Compliant standards: EN61326-1 Table 2 (for use in industrial locations) Influence in the immunity environment: ≤ ±5% of full scale*7	
Environmental standards	EU RoHS Directive compliant*8		
Withstand voltage	4300 VAC, 50 Hz between measurement feed-through hole and output terminal. Conducted as factory withstanding voltage test		
Device to be connected	YOKOGAWA measuring instrument, accessories, or equivalent		

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

*1: This current sensor is designed to be mounted around or removed from insulated conductors or energy-limited circuit conductors.

*2: This instrument is a measurement category O product. Do not use this instrument to make measurements in Measurement Categories II, 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: Ensure that the cabling of the conductor under test and this instrument, including its cables, do not interfere with each other. Otherwise, the output value of this instrument may be affected. There is also a possibility of electromagnetic interference to other equipment via the cables of this instrument.

*5: 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.

*6: Group 1:
Equipment that does not intentionally generate or use radio frequency (RF) energy

*7: Accurate measurement may not be possible in locations where there are very strong magnetic or electric fields in addition to the magnetic field generated by the current to be measured.

*8: For conformity to environmental regulations and/or standards other than EU, contact your nearest YOKOGAWA office (PIM 113-01Z2).

Electrical Specifications	
Rated current	AC/DC 1000 A
Frequency bandwidth	300 kHz –3 dB Typical
Delay	485 ns Typical
Output voltage	2 mV/A
Output resistance	50 Ω ±10 Ω
Non-linearity error	±20 ppm Typical*1, *2
Output noise	1 mVpp typical (1 MHz or less)
Temperature coefficient	Main unit: Add the following to the ranges outside the 0 to 40°C accuracy guaranteed temperature range (–40 to 0°C, 40 to 85°C) Amplitude accuracy: ±0.005% of reading/°C Offset voltage: ±0.005% of full scale/°C
Influence of the conductor location	≤ ±0.2% of reading (1000 A input, 50 Hz/60 Hz, using wire with 30 mm outer diameter) If conductor position adjuster (for 30 mm outer diameter) is used: ≤ ±0.1% of reading
Influence of the external magnetic field	≤150 mA (input conversion value, in a magnetic field of 400 A/m, DC, or 60 Hz)
Influence of magnetization	≤150 mA (input conversion value, after 1000 ADC input)
Influence of common mode voltage	DC to 1 kHz: ≥150 dB (0.0016% of full scale or less) 1 kHz to 10 kHz: ≥130 dB (0.016% of full scale or less) 10 kHz to 50 kHz: ≥100 dB (0.5% of full scale or less)
Guaranteed accuracy period	1 year
Clamping durability	≤10000 operations
Demagnetization feature	Available
Offset adjustment	Approx. ±2 mV
Overcurrent indicator	Overcurrent LED (red) lit
Power-on indicator	Power LED (green) lit

*1: Measure input current (DC) at 200 A intervals for +1000 A → 0 A → –1000A → 0 A → +1000 A. Defined as the difference between the regression line calculated from the measurement results and the point of measurement.

*2: ppm defined at rated current.

Accuracy specifications (1 year accuracy)

Conditions

Temperature:
Main unit: 0 to 40°C, sub unit: 5 to 40°C, IV unit: 5 to 40°C
Humidity: 20 to 80% RH
Warm-up time: At least 30 minutes
Input waveform: Sine wave or DC
Voltage to ground: 0 V
External magnetic fields: None
Conductor position: Center
Input resistance: Measuring instrument with 1 MΩ ±10% or more
Demagnetization: After execution
Offset voltage: After adjusting within ±0.2 mV
Number of clamping operations ≤10000 operations
Power supply:
Probe power supply from the measuring instrument that this instrument is connected to or the 701934 probe power supply
Absolute accuracy, phase accuracy:
≤150% input of DC rating ≤110% input of AC rating and within the derating range (except values for 0.1 Hz ≤ f ≤ 10 Hz are references)

Amplitude

DC	± (0.2% of reading + 0.02% of full scale)
0.1 Hz ≤ f ≤ 100 Hz	± (0.2% of reading + 0.01% of full scale)
100 Hz < f ≤ 500 Hz	± (0.5% of reading + 0.02% of full scale)
500 Hz < f ≤ 1 kHz	± (1.0% of reading + 0.02% of full scale)
1 kHz < f ≤ 10 kHz	± (2.0% of reading + 0.02% of full scale)
10 kHz < f ≤ 50 kHz	± (3.0% of reading + 0.02% of full scale)
50 kHz < f ≤ 100 kHz	± (5.0% of reading + 0.02% of full scale)

Phase

	Without phase correction	With phase correction*1
0.1 Hz ≤ f ≤ 100 Hz	±0.1°	±0.1°
100 Hz < f ≤ 500 Hz	±0.2°	±0.1°
500 Hz < f ≤ 1 kHz	±0.4°	±0.1°
1 kHz < f ≤ 5 kHz	±2.0°	±0.1°
5 kHz < f ≤ 10 kHz	±4.0°	±0.1°
10 kHz < f ≤ 20 kHz	±8.0°	±0.5°
20 kHz < f ≤ 50 kHz	±20°	±1.0°
50 kHz < f ≤ 70 kHz	±28°	±2.0°
70 kHz < f ≤ 100 kHz	±40°	±5.0°

*1: When the phase error value at 10 kHz shown in the test certificate of this instrument is set using the "sensor correction setting" feature of the WT series

Add the following to the amplitude accuracy and phase accuracy for 10 m cable.

Amplitude accuracy ±(0.1 + 0.005 × f kHz)% of reading

Phase accuracy Without sensor correction: ±(0.035 × f kHz)°

With sensor correction: ±(0.01 × f kHz)°

Except, 1 kHz < f, where the unit of f in the above equations is kHz.

Add the following to the absolute accuracy when the input current (Ip) is with the following range.

DC 1000 A < Ip ≤ 1100 A: ±0.02% of reading

DC 1100 A < Ip ≤ 1500 A: ±0.05% of reading

AC 1000 A < Ip ≤ 1100 A: ±0.03% of reading

Accuracy in combination with the measuring instrument

WT5000(760901,760902,760903)

Accuracy of the measuring instrument + accuracy of this instrument

Add the following when the measuring instrument's external current sensor input is in use.

50 mV range	0.8% of range
100 mV range	0.4% of range
200 mV range	0.1% of range

WT1800E

Accuracy of the measuring instrument + accuracy of this instrument

Add the following when the measuring instrument's external current sensor inputs /EXT1 to /EXT6 are in use.

50 mV range	0.8% of range
100 mV range	0.4% of range
200 mV range	0.1% of range

WT500

Accuracy of the measuring instrument + accuracy of this instrument

Add the following when the measuring instrument's external current sensor inputs /EXT1, /EXT2, and /EXT3 are in use.

50 mV range	0.1% of reading + 0.8% of range
100 mV range	0.1% of reading + 0.4% of range
200 mV range	0.1% of reading + 0.1% of range
Other ranges	0.1% of reading

WT300E

Accuracy of the measuring instrument + accuracy of this instrument

Add the following when the measuring instrument's external current sensor input /EXT1 is in use.

50 mV range	0.1% of reading + 0.8% of range
100 mV range	0.1% of reading + 0.4% of range
200 mV range	0.1% of reading + 0.1% of range
Other ranges	0.1% of reading

Add the following when the measuring instrument's external current sensor input /EXT2 is in use.

50 mV range	0.5% of reading + 0.8% of range
100 mV range	0.5% of reading + 0.4% of range
200 mV range	0.5% of reading + 0.1% of range
Other ranges	0.5% of reading

PX8000

Accuracy of the measuring instrument + accuracy of this instrument

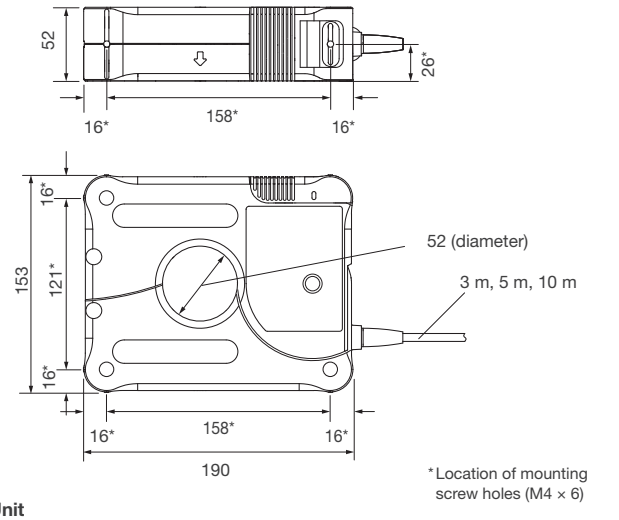
Add the following when the 760812 current module's external current sensor input is in use.

50 mV range	0.8% of range
100 mV range	0.4% of range
200 mV range	0.1% of range

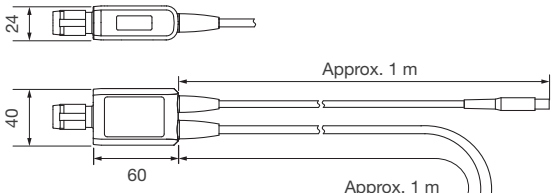
External dimensions

Unit: mm

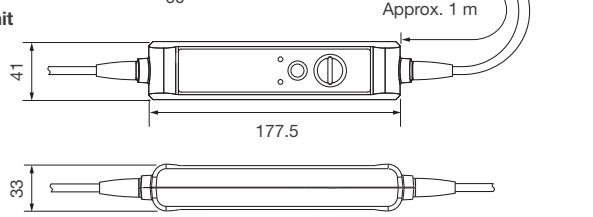
Main Unit



IV Unit



Sub Unit



Model and Suffix Code

Model	Suffix Code	Description
CT1000S		AC/DC Split core current sensor
	-L03	Cable length 3 m
	-L05	Cable length 5 m
	-L10	Cable length 10 m

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: ±(0.05% of reading + 30 µA), 2000 Arms (3000 Apeak)
CT1000A	AC/DC Current sensor	Measurement range: DC to 300 kHz, basic accuracy: ±(0.04% of reading + 30 µA), 1000 Arms (1500 Apeak)
CT1000	AC/DC Current sensor	Measurement range: DC to 300 kHz, basic accuracy: ±(0.05% of reading + 30 µA), 1000 Apeak
CT200	AC/DC Current sensor	Measurement range: DC to 500 kHz, basic accuracy: ±(0.05% of reading + 30 µA), 200 Apeak
CT60	AC/DC Current sensor	Measurement range: DC to 800 kHz, basic accuracy: ±(0.05% of reading + 30 µA), 60 Apeak
751552	Clamp-on probe	Measurement range: 30 Hz to 5 kHz, basic accuracy: ±0.3% of reading, 1000 Arms

Current probe

Model	Product	Description
701917	Current probe	DC to 50 MHz, 5 Arms, high-sesitivity
701918	Current probe	DC to 120 MHz, 5 Arms, high-sesitivity
701928	Current probe	DC to 100 MHz, 30 Arms, probe I/F
701929	Current probe	DC to 50 MHz, 30 Arms, probe I/F
701930	Current probe	DC to 10 MHz, 150 Arms
701931	Current probe	DC to 2 MHz, 500 Arms
701932	Current probe	DC to 100 MHz, 30 Arms
701933	Current probe	DC to 50 MHz, 30 Arms
701934	Power supply	Number of connectors: 4
701936	Deskew correction signal source	For voltage to current skew adjustment
702915	Current probe	DC to 50 MHz, 30 Arms, 3 input ranges
702916	Current probe	DC to 120 MHz, 30 Arms, 3 input ranges

NOTICE

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

Yokogawa's approach to preserving the global environment

- Yokogawa's electrical products are developed and produced in facilities that have received ISO14001 approval.
- In order to protect the global environment, Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guidelines and Product Design Assessment Criteria.

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.

YOKOGAWA

https://tmi.yokogawa.com/ YMI-N-MI-M-E03

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