Digital Power Meter

YOKOGAWA

WT300 SERIES

DIGITAL POWER METER

THE 5TH GENERATION OF THE WORLD'S BEST SELLING POWER METER

High Performance and Reliability

- Basic Accuracy of 0.1% of Reading
- Low Current Measurement down to 50 micro-Amps
- DC, 0.5 Hz to 100 kHz Frequency Range
- Standard USB, and GPIB or RS232 Interfaces

For more information, go to
tmi.yokogawa.com
Test & Measurement Instruments

3-Year Warranty

CE

Bulletin WT300-01EN

Yokogawa's new compact WT300 series for reliable power measurement

The WT300 series is the 5th generation of Yokogawa's compact power meter portfolio. The world's best selling power meter is the power meter of choice in multiple industries from production lines to R&D applications.

WT310(1ch)

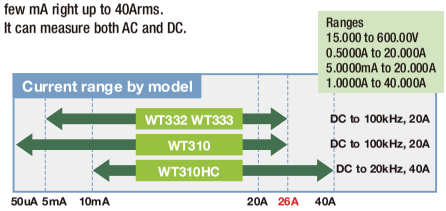
WT310HC(1ch, MAX40A)

WT332(2ch)/WT333(3ch)

Wide current input range with high performance and reliability

Wide current input ranges

The WT300 series offers customers a wide range of current inputs from a few mA right up to 40Arms.
It can measure both AC and DC.



Simultaneous measurement of all parameters

A WT300 series can measure all DC and AC parameters. It can also measure harmonics and perform integration simultaneously without changing the measurement mode. The WTViewerFreePlus software is used to monitor and save all these parameters.

Example of WTViewerFreePlus display

Fast display and data update rate

The fast display and 100ms maximum data update rate of the WT300 series offers customers a short tact time in their testing procedures.
Consistent Basic Measurement Accuracy for all input ranges.

0.1% of reading + 0.1% of range (50Hz/60Hz)

Convenient measurement functions

- **MAX hold function**
  The maximum values of RMS/PEAK voltage & current active power, reactive power and apparent power can be held.
- **Line filter and frequency filter capability**
  These filter functions will cut off unnecessary noise & harmonic components for fundamental waveform measurements.

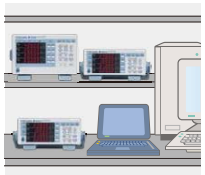
PC, Data Logger and External Sensors connectivity

The WT300 series offers a wide range of communication interfaces such as USB, GP-IB or RS-232 (Selectable) and Ethernet (Optional).

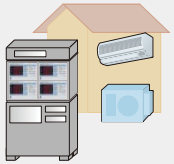
Customers therefore have the flexibility to choose according to their application needs e.g. from production lines to engineering test benches. Customers can use WTViewerFreePlus software to set up all kinds of measurements. Additionally, the numeric values, waveform display* and trend graphs of the measurement data can be displayed and saved.

* Waveform display requires the /G5 Harmonic option

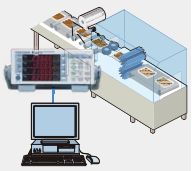
Test bench



Air conditioner evaluation



Production line test system

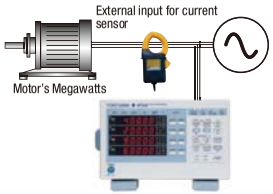


D/A output for measurement recording

The D/A option is used to output Voltage, Current, Power and other measured data for recording to data loggers (+/-5Vdc outputs).
(WT310/WT310HC 4CH, WT332/WT333 12CH)

Current sensor input

Customers have the option to select either 2.5V to 10V range (/EX1 option) or 50mV to 2V range (/EX2 option) inputs for measuring large currents using current clamps or current sensors with voltage outputs.

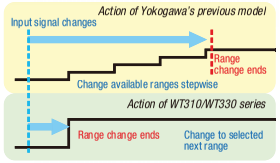


First in Class* and First in Industry*

First in class : Auto ranging function available in selected ranges

The auto-range function is used to select/change the range automatically in specific ranges.
This results in shorter range changing times and thus quicker and more efficient testing.

Image of Range skip (configuration) function operation



First in industry : Integration measurement auto ranging function

Conventionally, when power meters operate in an integration mode to measure power consumption and standby power, the measuring ranges need to be fixed. However, if the level of the input exceeds the maximum of the selected range, the results will be incorrect and the test will need to be repeated with higher ranges applied.
The WT300 series has a high speed automatic ranging capability in integration mode which removes this need to repeat the test and integration is continuous and accurate.
This function is not only available for +/- Wh but also for Ah and DC current.

* According to YOKOGAWA survey by Dec, 2012

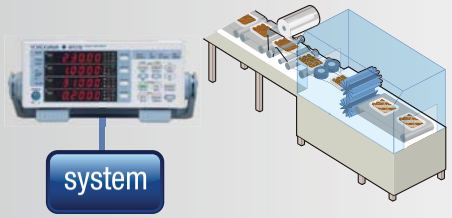
WT300 power meters are easy to use, cost effective and accurate for a wide range of applications in Production, Testing, Evaluation and R&D.

For Home appliances and Office equipment

Production line or QA testing of electric Devices

- Compact half rack mount size helps customers build smaller test systems with a better Return on Investment (ROI).
- D/A output function for data recording
- Multiple communication interfaces. USB, RS-232 or GP-IB and Ethernet capability.

The simultaneous measurement of power consumption parameters such as U, I, P, frequency, Power Factor and Harmonics for production line or QA testing results in reduced tact times. Thus testing is faster and cheaper. The DA output and communication interfaces enable data to be remotely and flexibly captured.

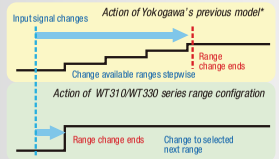


Development and evaluation tool for home appliances

- 5mA range helps small current measurement (WT310)
- Auto ranging function under Integration mode
- Range skip (range configuration) function provides the ability to select the usable ranges in advance. Auto ranging enables the WT300 series to rapidly adapt to changing input conditions.

The range skip function reduces the range change transition period. The WT310 can measure both large and small currents accurately in a single test. This can reduce the total evaluation period or removes the need to use two rather than one power meters for the application, thereby saving capital cost.

Image of range configuration function for WT300 series

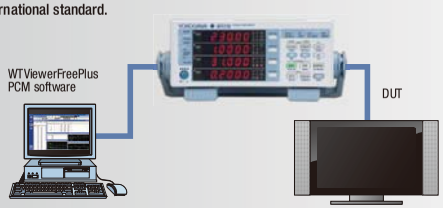


* Comparison with Yokogawa's previous model WT210/WT230

Testing to international standards, such as IEC62301, Energy Star and SPECpower

- The WT310 has a high measurement resolution of Max. 100μW under the 5mA range setting.
- Simultaneous measurement of normal power parameters, harmonic components and THD.
- Dynamic input capability of crest factor Max 300 (Peak value / minimum effective RMS value)
- Free PCM software for IEC62301 testing

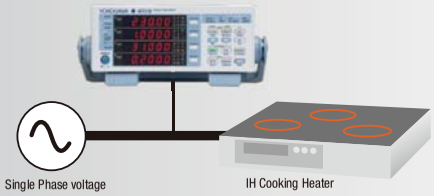
The WT310 together with the power consumption measurement (PCM) software enables users to perform standby power testing according to international standard.



Evaluation of large current equipment such as Induction Heaters/Cookers

- Direct high current measurement up to 40Arms without using external current sensors (WT310HC).
- Auto ranging function for Integration mode

The WT310HC allows 40Arms to be directly inputted without the requirement to use current clamps or current sensors. This not only provides more precise measurement but also saves on investment costs. The wide current ranges are from 1A to 40A and voltage ranges are from 15 V to 600 V.
Customers can use it for the evaluation of special waveform driven devices such as IH cookers and heaters.



Please visit the URL below which shows many applications and examples. It will be regularly updated with the latest applications.

For Industrial equipment and Transportation

Automotive - Battery or DC driven device evaluation

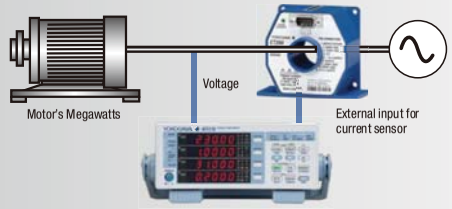
- Accurate DC measurement: 0.3% total (WT310HC: 0.5% total)
- Direct high current measurement up to 40A without any external current sensor (WT310HC).
- Charge/Discharge (+/-Wh, +/-Ah) energy measurement for batteries

The WT310HC can measure currents up to 40A directly.
This provides a cost effective and accurate method for testing DC driven devices in vehicles without having to use extra sensors.

Duration testing and efficiency measurement for industrial motors and rotating machinery

- Integration measurement for long period
- D/A output function for data recording
- DC, 0.5Hz to 100kHz broad bandwidth capability

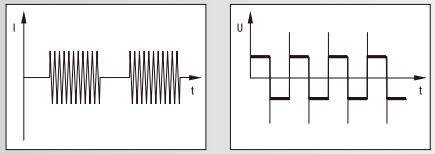
The WT300 series provides reliable current integration (Ah) and Energy (Wh) measurement for up to 10,000 hours (approx. 1 year). The D/A option is used to save and monitor the measurement results (WT310/WT310HC: 4ch, WT332/WT333: 12ch). An external recorder or data logger like, a ScopeCorder, can be used to save this D/A function data along with other parameters such as temperatures, torque and rotation speed.



Evaluation testing of special waveform driven devices and distorted waveforms (including DC component)

- DC, 0.5Hz to 100kHz broad bandwidth capability
- Average active power measurement under integration mode

The WT300 series has a broad frequency capability of DC and from 0.5Hz to 100kHz. It can measure the RMS value of distorted waveforms like square waveforms or special waveform driven devices. The average active power measurement function gives accurate power consumption data for fluctuating power devices such as burst waveform operated devices. Therefore the customer can perform accurate distorted waveform measurements without using special mode settings.

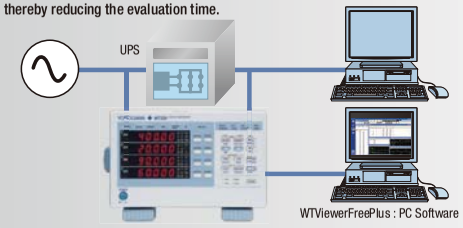


Burst Waveform　　Square Waveform

Conformance and evaluation testing of uninterruptable power supplies (UPS)

- Maximum order setting for THD calculations
- Efficiency measurements using a single power meter
- Average active power measurement under integration Mode

The WT300 series enables users to conduct conformity tests according to UPS performance testing standards. The WT300 series is used to measure and calculate input & output levels, the efficiency, frequency and THD. The average active power data also provides accurate values of power consumption. The WT300 series along with the WTViewerFreePlus software helps to simultaneously measure all the necessary parameters required to test a UPS thereby reducing the evaluation time.



http://tmi.yokogawa.com/technical-library/application-notes/

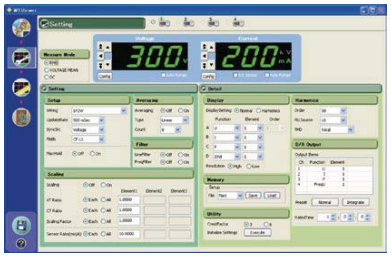
Easy set up and display of Numeric data, Trend graphs and Waveforms using PC application software

WTViewerFreePlus For WT300 Series (included)

The WTViewerFreePlus software can capture measured numeric values, harmonic values and waveform data. The data can be transferred to a PC via a USB, GP-IB/RS-232 or Ethernet communication interface, and it can be displayed* and saved on the PC.

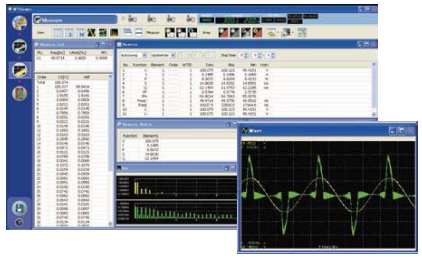
* Waveform display requires /G5 Harmonic option.

Setting Window



As well as using the WT300 series front panel to setup the powermeter, you can use the software to quickly set up your favorite conditions. It also shows all the setting parameters and the status at a glance. In particular, you can set up the range-skip function (range -configuration setting) and specify the maximum order used for the THD calculation.

Measurement Window



The software can display items which cannot be shown on the display of the WT300 series, such as multiple numeric measurement parameters, the harmonics data of each order, bar graphs, trend graphs and voltage & current waveforms. The free software thus adds additional performance to the WT300 series.

* Please check the Instruction manual in the CD for more information.

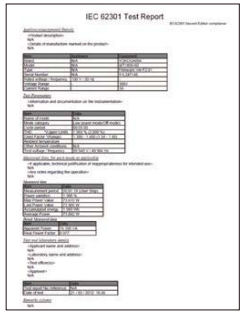
Standby power measurement conforming to IEC62301 Ed2.0

Power Consumption Measurement Software (Free)

The Power Consumption Measurement Software together with a WT310 (or another WT series instrument) provides a trustworthy power measurement solutions for testing the standby and off mode power of household products and office equipment.

The solution enables testing to be performed according to the IEC62301 Ed1.0 and Ed2.0 standards which specify the use of special algorithms for determining the power stability in the device under test. The software thus gathers all the required measurement data from the WT310, which includes not only voltage/ current/ power/ frequency but also the total harmonic distortion (THD) and the crest factor (CF) of the AC power supply. We therefore also recommend that the WT310 is installed with the harmonic option (/G5) and that a low distortion power supply is used for the test.

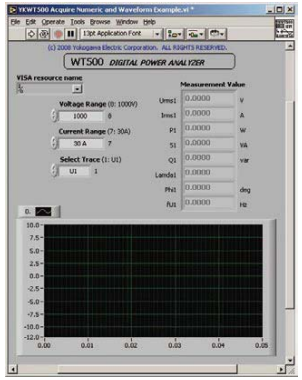
Configuring and Establishing a New Connection between the WT310 and a PC



Test Report

Support tools for creating dedicated programs!

LabVIEW Drivers



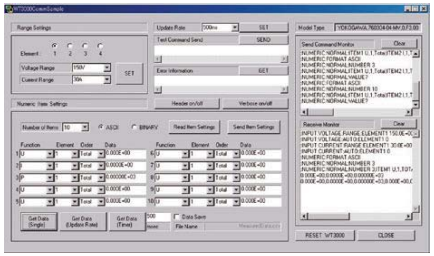
Data acquisition is possible using LabVIEW. LabVIEW drivers can be downloaded from our Web site. (Free of charge)

Coming soon

* LabVIEW is a registered trademark of NATIONAL INSTRUMENTS Corporation in the U.S.A.

Programming tool samples

To help you create dedicated programs for your system, we provide sample programs which support Visual Basic/Visual C++/Visual Basic .NET and Visual C# *. The sample programs support communication via USB, GP-IB/RS-232 or Ethernet interfaces and can be downloaded from our Web site.



* Visual Basic, Visual C++, Visual Basic .NET and Visual C# are registered trademarks of MICROSOFT Corporation in the U.S.A.

Comparison between WT210/230 series and WT310/330 series

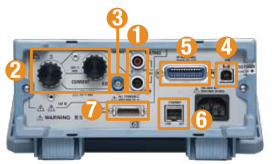
		WT310/WT332/WT333	WT310HC	WT210/WT230
DC power measurement accracy		0.1% of reading+0.2% of range	0.3% of reading+0.2% of range	0.3% of reading+0.2% of range
Current range (Crest factor=3)	Direct input	5m/10m/20m/50m/100m/200m/ 0.5/1/2/5 /10/20[A] (WT310) 0.5/1/2/5/10/20[A] (WT332/WT333)	1/2/5/10/20/40[A]	5m/10m/20m/50m/100m/200m/ 0.5/1/2/5 /10/20[A] (WT210) 0.5/1/2/5/10/20[A] (WT230)
	External current input	EX1: 2.5//5/10[V] EX2: 50m/100m/200m/500m/1/2[V] (OP.)	EX1: 2.5//5/10[V] EX2: 50m/100m/200m/500m/1/2[V] (OP.)	EX1: 2.5/5/10[V] EX2: 50m/100m/200m[V] (OP.)
Effective input range for voltage & current (CF=3)		1% to 130%	1% to 100% (40A range only)	1% to 130%
Maximum displaying value for voltage & current (CF=3)		1% to 140%	1% to 110% (40A range only)	1% to140%
	0<PF<1	Power reading x (power reading error + (power range / apparent power reading) + tanØ x (influence when PF = 0)) %	Power reading x (power reading error + (power range / apparent power reading) + tanØ x (influence when PF = 0)) %	Add the power reading x (tanØ x (influence when PF = 0))%.
Simultaneous measurement of RMS, VoltageMEAN & DC		Yes *1	Yes *1	No
Frequecy measurement		2 channels (voltage and current)	2 channels (voltage and current)	selected voltage or current (one)
Number of display item		4 items	4 items	3 items
Sampling rate		Approximately 100 kS/s	Approximately 100 kS/s	Approximately 50 kS/s
Harmoinc measurement		Yes (OP. / G5)	Yes (OP. / G5)	Yes (OP. / HRM)
THD calculation maximum order setting		Yes (OP. 1-50th)	Yes (OP. 1-50th)	No
Auto ranging of integaration		Yes	Yes	No
Communication interface	USB	Yes	Yes	No
	GP-IB	Yes GP-IB or RS-232	Yes GP-IB or RS-232	Yes (OP) GP-IB or RS-232C
	RS-232	Yes GP-IB or RS-232	Yes GP-IB or RS-232	Yes (OP) GP-IB or RS-232C
	Ethernet	Yes (OP)	Yes (OP)	No
IEEE stanndard for GP-IB		IEEE488.2	IEEE488.2	IEEE488.1 and IEEE488.2
Comparetor function		No	No	Yes
Viewer software (setting & data capturing)		Free (included)	Free (included)	Free (download)

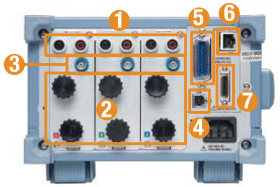
*1: Simultaneous, mode independent measurement using the WTViewerFreePlus PC software.
*A command compatible mode for the previous WT200 series is prepared. (IEEE488.2 only)
In that mode, the WT300 series works identically to a WT200 series except for the Store (and recall operation) and the Compare functions.

Superior points
Changed points

Rear View

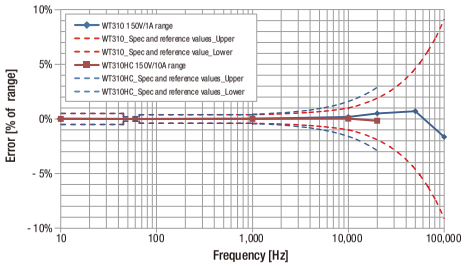
1. Voltage input terminals
2. Current Input terminals
3. External current sensor input
4. USB communication interface
5. GP-IB/RS-232 (Standard)
6. Ethernet (Optional)
7. D/A output connector



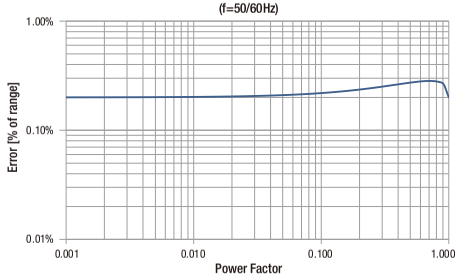


Example of basic characteristics

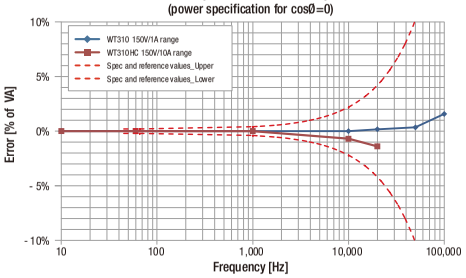
Example of Frequency -power Accuracy Characteristics



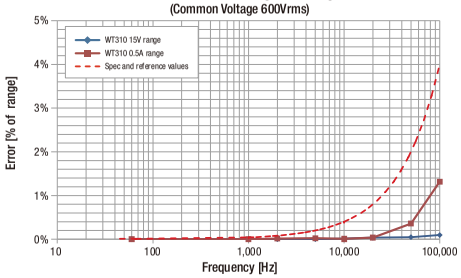
Total power Error with rated range input for an arbitrary power factor (f=50/60Hz)



Example of frequency versus power accuracy characteristic (power specification for cosØ=0)

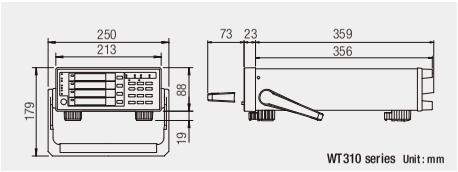


Effect of common mode voltage on reading value (Common Voltage 600Vrms)

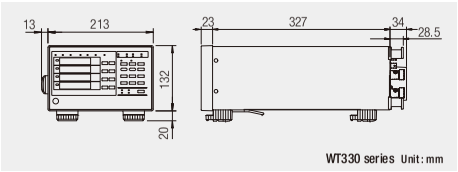


* Performance of WT332/WT333 is same as that of WT310

Exterior View



WT310 series Unit: mm



WT330 series Unit: mm

Specification

Input	
Item	Specifications
Input terminal type	Voltage Plug-in terminal (safety terminal)) Current • Direct input: Large binding post • External current sensor input option: isolated BNC connector
Input format	Voltage Floating input through resistive voltage divider Current Floating input through shunt
Measurement range	Voltage Crest factor 3: 15V/30V/60V/150V/300V/600V Crest factor 6: 7.5V/15V/30V/75V/150V/300V Current • Direct input: Crest factor 3: • WT310: 5mA/10mA/20mA/50mA/100mA/200mA/0.5A/1A/2A/5A/10A/20A • WT310HC: 1A/2A/5A/10A/20A/40A • WT332 and WT333: 0.5A/1A/2A/5A/10A/20A Crest factor 6: • WT310: 2.5mA/5mA/10mA/25mA/50mA/100mA/0.25A/0.5A/1A/2.5A/5A/10A • WT310HC: 0.5A/1A/2.5A/5A/10A/20A • WT332 and WT333: 0.25A/0.5A/1A/2.5A/5A/10A • External current sensor input (/EX1,/EX2): Crest factor 3: • EX1: 2.5V/5V/10V or EX2: 50mV/100mV/200mV/500mV/1V/2V Crest factor 6: • EX1: 1.25V/2.5V/5V or EX2: 25mV/50mV/100mV/250mV/500mV/1V
Input impedance	Voltage Input resistance: Approx. 2 MΩ, input capacitance: Approx. 13 pF in parallel with the resistance Current • Direct input • WT310 Crest factor 3: 5mA/10mA/20mA/50mA/100mA/200mA Crest factor 6: 2.5mA/5mA/10mA/25mA/50mA/100mA at the above range setting, Input resistance: Approx. 500mΩ, Input inductance: Approx. 0.1uH in series with the resistance Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A at the above range setting, Input resistance: Approx. 6 mΩ + 10 mΩ (max)*Factory setting Input inductance: Approx. 0.1uH in series with the resistance • WT310HC Crest factor 3: 1A/2A/5A/10A/20A/40A Crest factor 6: 0.5A/1A/2.5A/5A/10A/20A Input resistance: Approx. 5mΩ,input inductance: Approx. 0.1uH in series with the resistance • WT332/WT333 Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A Input resistance: Approx. 6mΩ, input inductance: Approx. 0.1uH in series with the resistance • External current sensor input (/EX1): Crest factor 3: 2.5V/5V/10V Crest factor 6: 1.25V/2.5V/5V Input resistance: Approx. 100kΩ • External current sensor input (/EX2): Crest factor 3: 50mV/100mV/200mV/500mV/1V/2V Crest factor 6: 25mV/50mV/100mV/250mV/500mV/ 1V Input resistance: Approx. 20kΩ
Instantaneous maximum allowable input (1 period, for 20 ms)	Voltage Peak value of 2.8 kV or RMS value of 2.0 kV, whichever is less. Current • Direct input • WT310 Crest factor 3: 5mA/10mA/20mA/50mA/100mA/200mA Crest factor 6: 2.5mA/5mA/10mA/25mA/50mA/100mA at the above range setting, Peak value of 150A or RMS value of 100 A, whichever is less. Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A at the above range setting, Peak value of 450A or RMS value of 300 A, whichever is less. • WT310HC Crest factor 3: 1A/2A/5A/10A/20A/40A Crest factor 6: 0.5A/1A/2.5A/5A/10A/20A Peak value of 450A or RMS value of 300 A, whichever is less. • External current sensor input Peak value less than or equal to 10 times of the rated range. • WT332/WT333 Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A Peak value of 450A or RMS value of 300 A, whichever is less.
Instantaneous maximum allowable input (for 1 s)	Voltage Peak value of 2kV or RMS value of 1.5kV, whichever is less Current • Direct input • WT310 Crest factor 3: 5mA/10mA/20mA/50mA/100mA/200mA Crest factor 6: 2.5mA/5mA/10mA/25mA/50mA/100mA at the above range setting, Peak value of 30A or RMS value of 20A, whichever is less. Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A at the above range setting, Peak value of 150A or RMS value of 40A, whichever is less. • WT310HC Crest factor 3: 1A/2A/5A/10A/20A/40A Crest factor 6: 0.5A/1A/2.5A/5A/10A/20A Peak value of 150A or RMS value of 44A, whichever is less. • WT332/WT333 Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A Peak value of 150A or RMS value of 40A, whichever is less. • External current sensor input Peak value less than or equal to 10 times of the rated range.
Continuous maximum allowable input	Voltage Peak value of 1.5kV or RMS value of 1kV, whichever is less. Current • Direct input • WT310 Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A at the above range setting, Peak value of 100A or RMS value of 30A, whichever is less. Crest factor 3: 5mA/10mA/20mA/50mA/100mA/200mA Crest factor 6: 2.5mA/5mA/10mA/25mA/50mA/100mA at the above range setting, Peak value of 30A or RMS value of 20A, whichever is less. • WT310HC Crest factor 3: 1A/2A/5A/10A/20A/40A Crest factor 6: 0.5A/1A/2.5A/5A/10A/20A Peak value of 100A or RMS value of 44A, whichever is less. • WT332/WT333 Crest factor 3: 0.5A/1A/2A/5A/10A/20A Crest factor 6: 0.25A/0.5A/1A/2.5A/5A/10A Peak value of 100A or RMS value of 30A, whichever is less. • External current sensor input Peak value less than or equal to 5 times of the rated range.
Continuous maximum	Common- mode voltage (during 50/60 Hz input) 600Vrms CAT II
Influence of common mode voltage	When 600 Vrms is applied between the input terminal and with the voltage input terminals shorted, current input terminals open and external current sensor input terminals shorted. Double the following values when the crest factor is set to 6. • At 50/60 Hz −80 dB or more (±0.01% of range or less) • Up to 100 kHz (reference value) 0.01% of range or more. f is frequency of input signal in kHz. • 15 V, 30 V, 60 V, 150 V, 300 V, 600 V ranges, 0.5 A, 1 A, 2 A, 5 A, 10 A, 20 A ranges of WT310/WT332/WT333, 1 A, 2 A, 5 A, 10 A, 20 A, 40A ranges of WT310HC and, external current sensor input (/EX2 Option) Within ± {(Maxmum rated range) / (Rated range) × 0.001 × f% of range} The maximum rated range is 600 V for the voltage input terminal and 20 A for the current input of WT310/WT332/WT333 and 40 A for the current input terminal of WT310HC and 2 V for option /EX2. • 5mA, 10mA, 20mA, 50mA, 100mA and 200mA range of WT310 Within ± {(Maxmum rated range) / (Rated range) × 0.0002 × f% of range} The Maximum rated range is 20A. • External current sensor input (/EX1 Option) ranges Within ± {(Maxmum rated range) / (Rated range) × 0.01 × f% of range} The maximum rated range is 10 V
Line filter	Select OFF or ON (cutoff frequency of 500 Hz).
Frequency filter	Select OFF or ON (cutoff frequency of 500 Hz).
A/D converter	Simultaneous conversion of voltage and current inputs. Resolution: 16 bits. Maximum conversion rate: Approx. 10us.

Voltage and Current Accuracy	
Item	Specifications
Accuracy	Requirements Temperature: 23±5°C, Humidity: 30 to 75%RH., Input waveform: Sine wave, Crest factor: 3, Common-mode voltage: 0 V Scaling function: OFF, Number of displayed digits: 5 digits Frequency filter: Turn ON to measure voltage or current of 200 Hz or less After warm-up time has passed After zero-level compensation or measurement range is changed. Accuracy (at 12 months) (The accuracy shown below is the sum of reading and range errors.) * f in the read error equation is the input signal frequency in kHz.

	WT310,WT330 (Voltage/Current)	WT310HC (Voltage, Current EXT sensor input)	WT310HC (Current Direct input)
DC	±(0.1% of reading +0.2% of range)	±(0.1% of reading +0.2% of range)	±(0.2% of reading +0.2% of range)
0.5Hz ≤ f < 45Hz	±(0.1% of reading +0.2% of range)	±(0.1% of reading +0.2% of range)	±(0.1% of reading +0.2% of range)
45Hz ≤ f ≤ 66Hz	±(0.1% of reading +0.1 % of range)	±(0.1% of reading +0.1 % of range)	±(0.1% of reading +0.1 % of range)
66Hz < f ≤ 1kHz	±(0.1% of reading +0.2 % of range)	±(0.1% of reading +0.2 % of range)	±(0.1% of reading +0.2 % of range)
1kHz < f ≤ 10kHz	±{(0.07×f)% of reading +0.3 % of range}	±{(0.07×f)% of reading +0.3 % of range}	±{(0.13*f)% of reading +0.3 % of range)
10kHz < f ≤ 20kHz			±{(0.13*f)% of reading +0.5 % of range)
10kHz < f ≤ 100kHz	±(0.5 % of reading +0.5 % of range) ±[{0.04×(f−10)}% of reading	±(0.5 % of reading +0.5 % of range) ±[{0.04×(f−10)}% of reading	

- Influence of temperature changes after zero-level compensation or range change
  Add 0.02% of range/°C to the DC voltage accuracy. Add the following value to the DC current accuracies.
  WT310 (5mA/10mA/20mA/50mA/100mA/200mA ranges): 5uA/°C
  WT310 (0.5A/1A/2A/5A/10A/20A ranges) and WT330 direct current input: 500uA/°C
  WT310HC direct current input: 1mA/°C
  External current sensor input (/EX1): 1mV/°C
  External current sensor input (/EX2): 50uV/°C
- Accuracy of the waveform display data, Upk and Ipk
  Add the following value to the above accuracy (reference value). The effective input range is within ±300% of range (within ±600% for crest factor 6)
  Voltage input: 1.5 × √(15/range) % of range
  Direct current input range:
  WT310 (5mA/10mA/20mA/50mA/100mA/200mA range): 3 × √(0.005/range) % of range
  WT310 (0.5A/1A/2A/5A/10A/20A range) and WT330 direct current input: 3 × √(0.5/range) % of range
  WT310HC direct current input: 3 × √(1/range) % of range
  External current sensor input range:
  /EX1 Option: 3 × √(2.5/range) % of range
  /EX2 Option: 3 × √(0.05/range) % of range
- Influence of self-generated heat caused by voltage input
  Add 0.0000001 ×U% of reading to the AC voltage accuracies.
  Add 0.0000001 ×U% of reading + 0.0000001 ×U% of range to the DC current accuracies. U is the voltage reading (V).
  Influence of self-generated heat caused by voltage input lasts until falling the temperature of the input resistor even if voltage input decreases.
- Influence of self-generated heat caused by current input
  WT310:
  Add 0.00013 × I²% of reading to the AC current accuracies.
  Add 0.00013 × I²% of reading + 0.004 × I² mA (0.5A/1A/2A/5A/10A/20A range) or 0.00013 × I²% of reading + 0.00004 × I² mA (5mA/10mA/20mA/50mA/100mA/200mA range), to the DC current accuracies. I is the current reading (A).
  WT310HC:
  Add 0.00006 × I²% of reading to the AC current accuracies.
  Add 0.00006 × I²% of reading + 0.001 × I² mA to the DC current accuracies. I is the current reading (A).
  WT332/WT333:
  Add 0.00013 × I²% of reading to the AC current accuracies.
  Add 0.00013 × I²% of reading + 0.002 × I² mA to the DC current accuracies. I is the current reading (A).
  Influence of self-generated heat caused by current input lasts until falling the temperature of the shunt resistor even if current input decreases.
- Accuracy changes caused by data update interval
  When the data update interval is 100 ms, add 0.05% of reading to the 0.5Hz to 1kHz accuracy.
- Guaranteed accuracy ranges for frequency, voltage, and current
  All accuracy figures for 0.5 to 10 Hz are reference values
  The current accuracy figures for DC, 10 Hz to 45 Hz, and 400 Hz to 100 kHz when the current exceeds 20 A are reference values.

Input range	1 to 130% with respect to the rated range of voltage or current. (If displays up to140%) * WT310HC: 40ARange Only 1 to 100%(display is 110%) (Add the reading error × 0.5 to above accuracies for the range of 110% to 130% of the rated range.)	
Measurement frequency range	data update interval	Measurement Frequency Range
	0.1s	DC, 25Hz ≤ f ≤ 100kHz
	0.25s	DC, 10Hz ≤ f ≤ 100kHz
	0.5s	DC, 5Hz ≤ f ≤ 100kHz
	1s	DC, 2.5Hz ≤ f ≤ 100kHz
	2s	DC, 1.5Hz ≤ f ≤ 100kHz
	5s	DC, 0.5Hz ≤ f ≤ 100kHz
	Only for direct current input of WT310HC, the maximum measurement range is 20kHz.	
When the line filter is turned ON	45 to 66 Hz: Add 0.2% of reading. Less than 45 Hz: Add 0.5% of reading.	
Temperature coefficient	Add: ±0.03% of reading/°C within the range 5 to 18°C or 28 to 40°C.	
Accuracy when the crest factor is set to 6	Accuracy obtained by doubling the measurement range error for the accuracy when the crest factor is set to 3.	

Active Power Accuracy	
Item	Specifications
Accuracy	Requirements Same as the conditions for voltage and current. • Power factor: 1 Accuracy (at 12 months) (The accuracy shown below is the sum of reading and range errors.) * f in the read error equation is the input signal frequency in kHz.

	WT310, WT332, WT333, WT310HC (Current EXT sensor input)	WT310HC (Current Direct input)
DC	±(0.1% of reading+0.2% of range)	±(0.3% of reading+0.2% of range)
0.5Hz ≤ f < 45Hz	±(0.3% of reading+0.2% of range)	±(0.3% of reading+0.2% of range)
45Hz ≤ f ≤ 66Hz	±(0.1% of reading+0.1 % of range)	±(0.1% of reading+0.1 % of range)
66Hz < f ≤ 1kHz	±(0.2% of reading+0.2 % of range)	±(0.2% of reading+0.2 % of range)
1kHz < f ≤ 10kHz	±(0.1% of reading+0.3 % of range) ±[{0.067 ×(f−1)}% of reading]	±((0.13*f)% of reading+0.3 % of range)
10kHz < f ≤ 20kHz		±((0.13*f)% of reading+0.5 % of range)
10kHz < f ≤ 100kHz	±(0.5 % of reading+0.5 % of range) ±[{0.09×(f−10)}% of reading]	

Specification

- Influence of temperature changes after zero-level compensation or range change
  Add the product of the voltage influence and the current influence listed below to the DC power accuracies.
  DC voltage accuracy: 0.02% of range/°C
  DC current accuracies
  WT310 (5mA/10mA/20mA/50mA/100mA/200mA ranges): 5uA/°C
  WT310 (0.5A/1A/2A/5A/10A/20A ranges) and WT330 direct current input: 500uA/°C
  WT310HC direct current input: 1mA/°C
  External current sensor input (/EX1): 1mV/°C
  External current sensor input (/EX2): 50uV/°C
- Influence of self-generated heat caused by voltage input
  Add 0.0000001 ×U% of reading to the AC power accuracies.
  Add 0.0000001 ×U% of reading + 0.0000001 ×U% of range to the DC power accuracies. U is the voltage reading (V).
  Influence of self-generated heat caused by voltage input lasts until falling the temperature of the input resistor even if voltage input decreases.
- Influence of self-generated heat caused by current input
  WT310:
  Add 0.00013 × I% of reading to the AC power accuracies.
  Add 0.00013 × I% of reading + 0.004 × I² mA (0.5A/1A/2A/5A/10A/20A range) or 0.00013× I% of reading + 0.00004 × I² mA (5mA/10mA/20mA/50mA/100mA/200mA range), to the DC power accuracies. I is the current reading (A).
  WT310HC:
  Add 0.00006 × I% of reading to the AC power accuracies.
  Add 0.00006 × I% of reading + 0.001 × I² mA to the DC power accuracies. I is the current reading (A).
  WT330:
  Add 0.00013 × I% of reading to the AC power accuracies.
  Add 0.00013 × I% of reading + 0.002 × I² mA to the DC power accuracies. I is the current reading (A).
  Influence of self-generated heat caused by current input lasts until falling the temperature of the shunt resistor even if current input decreases.
- Accuracy changes caused by data update interval
  When the data update interval is 100 ms, add 0.05% of reading to 0.5Hz to 1kHz accuracy.
- Guaranteed accuracy ranges for frequency, voltage, and current
  All accuracy figures for 0.5 to 10 Hz are reference values
  The 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.

Influence of power factor	When power factor (λ) = 0(S: apparent power) • ±0.2% of S for 45 Hz ≤ f ≤ 66 Hz. • ±(0.2 + 0.2 × f)% of S} for up to 100 kHz as reference data. f is frequency of input signal in kHz. When 0 < λ < 1 (Ø: phase angle of the voltage and current) (power reading) × [(power reading error %) + (power range error %) × (power range/indicated apparent power value) + {tanØ× (influence when λ = 0)%}]
When the line filter is turned ON	45 to 66 Hz: Add 0.3% of reading. Less than 45 Hz: Add 1% of reading.
Temperature coefficient	Same as the temperature coefficient for voltage and current.
Accuracy when the crest factor is set to 6	Accuracy obtained by doubling the measurement range error for the accuracy when the crest factor is set to 3.
Accuracy of apparent power S	Voltage accuracy + current accuracy
Accuracy of reactive power Q	Accuracy of apparent power +(√ 1.0004 –λ²) (√ 1 –λ²) × 100 % of range
Accuracy of power Factor λ	±[(λ –λ / 1.0002) + |cosØ – cos{Ø + sin⁻¹ (influence from the power factor when λ = 0%/100)}| ± 1 digit when voltage and current are at the measurement range rated input
Accuracy of phase difference Ø	±[Ø – cos⁻¹ (λ / 1.0002)| + sin⁻¹{(influence from the power factor when λ = 0%)/100}] deg ± 1 digit when voltage and current are at the measurement range rated input

Voltage, Current, and Active Power Measurements

Item	Specifications
Measurement method	Digital sampling method
Crest factor	3 or 6
Wiring system	WT310, WT310HC (One element model) Single-phase, two-wire (1P2W) WT332 (Two element model) Select from single-phase, two-wire (1P2W); single-phase, three-wire (1P3W); or three-phase,three-wire (3P3W) WT333 (Three element model) Select from single-phase, two-wire (1P2W); single-phase, three-wire (1P3W); three-phase,three-wire (3P3W); three-phase, four-wire (3P4W); or three-voltage, three-current (3V3A).
Range select	Select manual or auto ranging.
Auto range	Range increase • The range is upped when any of the following conditions is met. • Urms or Irms exceeds 130% of the currently set measurement range. • Crest factor 3: Upk, Ipk value of the input signal exceeds 300% of the currently set measurement range. • Crest factor 6: Upk, Ipk value of the input signal exceeds 600% of the currently set measurement range, On the WT330, when any of those input elements meets the above condition, the range is increased the next time the measured value is updated. Range decrease • The range is decreased when all of the following conditions are met. • Urms or Irms is less than or equal to 30% of the measurement range. • Urms or Irms is less than or equal to 125% of the next lower measurement range. • Crest factor 3: Upk, Ipk value of the input signal exceeds 300% of the currently set measurement range. • Crest factor 6: Upk, Ipk value of the input signal exceeds 600% of the currently set measurement range. On the WT330, when all of the input elements meet the above condition, the range is downed down the next time the measured value is updated.
Display mode Switching	Select RMS (the true RMS value of voltage and current), VOLTAGE MEAN (the rectified mean value calibrated to the RMS value of the voltage and the true RMS value of the current), DC (simple average of voltage and current).
Measurement synchronization source	Select voltage, current, or the entire period of the data update interval for the signal used to achieve synchronization during measurement.
Line filter	Select OFF or ON (cutoff frequency at 500 Hz).
Peak measurement	Measures the peak (max,min) value of voltage, current or power from the instantaneous voltage, instantaneous current or instantaneous power that is sampled.
Zero-level compensation	Removes the internal offset of the WT310/WT310HC/WT332/WT333.

Frequency Measurement

Item	Specifications	
Measured item	Voltage and current frequencies applied to one selected input element can be measured. WT332 (two element model) Select voltage (U1)/ current (I1) of input element1 or voltage (U3)/ current (I3) of input element3. WT333 (three element model) Select voltage (U1)/ current (I1) of input element1, voltage (U2)/ current (I2) of input element2 or voltage (U3)/ current (I3) of input element3.	
Method	Reciprocal method	
Frequency measuring range	Varies depending on the data update interval (see description given later) as follows.	
	Data Update Interval	Measurement Range
	0.1s	25Hz ≤ f ≤ 100kHz
	0.25s	10Hz ≤ f ≤ 100kHz
	0.5s	5Hz ≤ f ≤ 100kHz
	1s	2.5Hz ≤ f ≤ 100kHz
	2s	1.5Hz ≤ f ≤ 50kHz
	5s	0.5Hz ≤ f ≤ 20kHz
	Only for the direct current input of WT310HC, the maximum measurement range is 20kHz.	
Measurement range	Auto switching among six types: 1 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz, and 100 kHz.	
Frequency filter	Select OFF or ON (cutoff frequency of 500 Hz).	
Accuracy	Requirements When the input signal level is 30% or more of the measurement range If the crest factor is set to 3. (60% or more if the crest factor is set to 6) • Frequency filter is ON when measuring voltage or current of 200 Hz or less. Accuracy: ± (0.06% of reading)	

Computation

Item	Specifications
Computing equation of apparent power (S), reactive power (Q), power factor (λ), and phase angle (Ø)	

i: input element number

		Single-Phase, Three-Wire (1P3W)	Three-Phase, Three-Wire (3P3W)	Three-Voltage, Three-Current Method (3V3A)	Three-Phase, Four-Wire (3P4W)
UΣ[V]		(U1+U3)/2		(U1+U2+U3)/3	
IΣ[A]		(I1+I3)/2		(I1+I2+I3)/3	
PΣ[W]		P1+P3			P1+P2+P3
SΣ[VA]	Si=Ui×Ii	S1+S3	$\frac{\sqrt{3}}{2}$ (S1+S3)	$\frac{\sqrt{3}}{3}$ (S1+S2+S3)	S1+S2+S3
QΣ[var]	$Qi=\sqrt{Si^2-Pi^2}$	Q1+Q3			Q1+Q2+Q3
λΣ	λi=Pi/Si	$\frac{P\Sigma}{S\Sigma}$			
Ø[°]	Øi=cos⁻¹ $\left(\frac{Pi}{Si}\right)$	cos⁻¹ $\left(\frac{P\Sigma}{S\Sigma}\right)$			

On the WT310/WT310HC/WT332/WT333, S, Q, λ, and Ø are derived through the computation of the measured values of voltage, current, and active power. Therefore, for distorted signal input, the value obtained on the WT310/WT310HC/WT332/WT333 may differ from that obtained on other instruments that use a different method.

- If the voltage or current is less than 0.5% (less than or equal to 1% if the crest factor is set to 6) of the rated range, zero is displayed for S or Q, and error is displayed for λ and Ø.
- For Q[var], when the current leads the voltage, the Q value is displayed as a negative value; when the current lags the voltage, the Q value is displayed as a positive value. The value of QΣ may be negative, because it is calculated from the Q of each element with the signs included.

D(LEAD)/G(LAG) Lead and lag detection (Phase angle Ø' s D (lead) and G (lag))	The lead and lag of the voltage and current inputs can be detected correctly for the following: • Sine waves • When the measured value is 50% or more (100% or more when the crest factor is 6) of the measurement range • Frequency: 20 Hz to 2kHz(WT310HC: to 1kHz) • Phase difference: ±(5° to 175°)
Scaling	Set the current sensor transformation ratio, VT ratio, CT ratio, and power factor when applying the external current sensor, VT, or CT output to the instrument. • Significant digits: Selected automatically according to significant digits in the voltage and current ranges. • Selectable range: 0.001 to 9999
Averaging	Select the method from the following two types. • Exponential averaging method • Moving average method Select the attenuation constant for exponential averaging; select the sample number from 8, 16, 32 and 64 for moving average.
Efficiency	Computation of efficiency is possible on the WT332/WT333.
Crest factor	Computes the crest factor (peak value/RMS value) of voltage and current.
Four arithmetic operation	Six types of four arithmetic operations possible (A+B, A–B, A*B, A/B, A^B, and A'B')
Average active power during integration	Computes the average active power within the integrated period.

Integration

Item	Specifications
Mode	Select manual integration mode, standard integration mode, or repetitive integration mode.
Timer	Automatically stop integration by setting a timer. Selectable range: 0 hours 00 minutes 00 seconds to 10000 hours 00 minutes 00 seconds (Set automatically to manual integration mode for 0 hours 00 minutes 00 seconds)
Count overflow	WP: 9999999MWh/-99999MWh, q: 9999999MAh/-99999MAh Holds the elapsed integration time and integration value and stops integration when the elapsed time of integration reaches the maximum integration time of 10000 hours or when the integrated value reaches the maximum or minimum displayable integration value (999999M or –99999M).
Accuracy	±(Power accuracy (or current accuracy) + 0.1% of reading) (fixed range) * In the case of auto range: The measurement is not carried out during a range change. The first measurement data after the range change is added for the Period which measurement was not carried out.
Range setting	Auto range or fixed range for integration is available For details on range switching, see section of Voltage, Current, and Active Power Measurements.
Valid Frequency Ranges for Integration	Active power DC to 45 kHz Current When the measurement mode is RMS: DC, lower limit frequency determined by the data update interval to 45 kHz When the measurement mode is VOLTAGE MEAN: DC, lower limit frequency determined by the data update interval to 45 kHz When the measurement mode is DC: DC to 45 kHz
Timer accuracy	±0.02%
Remote control	Start, stop and reset operations are available using an external remote signal. (applies to products with the /DA4 or /DA12 option)

Specification

Harmonic Measurement (/G5 Option)

Item	Specifications
Measured item	All Installed elements.
Method	PLL synchronization method
Frequency range	Fundamental frequency of the PLL source is in the range of 10 Hz to 1.2k Hz.
PLL source	Select voltage or current of each input element. • Input level 50% or more of the rated measurement range when the crest factor is 3. 100% or more of the rated measurement range when the crest factor is 6. • The frequency filter must be turned on when the fundamental frequency is less than or equal to 200Hz.
FFT data length	1024
Window function	Rectangular

Sample rate, window width, and upper limit of analysis

Fundamental Frequency	Sample rate	Window Width	Upper Limit of* Analysis orders
10Hz ~ 75Hz	f*1024	1	50
75Hz ~ 150Hz	f*512	2	32
150Hz ~ 300Hz	f*256	4	16
300Hz ~ 600Hz	f*128	8	8
600Hz ~ 1200Hz	f*64	16	4

*The upper limit of analysis orders can be decreased.

Accuracy
(The accuracy shown below is the sum of reading and range errors.)
When Line Filter is OFF

<WT310/WT332/WT333>

Frequency	Voltage	Current	Power
10Hz ≤ f < 45Hz	0.15% of reading +0.35% of range	0.15% of reading +0.35% of range	0.15% of reading +0.50% of range
45Hz ≤ f ≤ 440Hz	0.15% of reading +0.35% of range	0.15% of reading +0.35% of range	0.25% of reading +0.50% of range
440Hz < f ≤ 1kHz	0.20% of reading +0.35% of range	0.20% of reading +0.35% of range	0.40% of reading +0.50% of range
1kHz < f ≤ 2.5kHz	0.80%+ of reading +0.45% of range	0.80%+ of reading +0.45% of range	1.56% of reading +0.60% of range
2.5kHz < f ≤ 5kHz	3.05% of reading +0.45% of range	3.05% of reading +0.45% of range	5.77% of reading +0.60% of range

<WT310HC>

Frequency	Voltage	Current	Power
10Hz ≤ f < 45Hz	0.15% of reading +0.35% of range	0.15% of reading +0.35% of range	0.35% of reading +0.50% of range
45Hz ≤ f ≤ 440Hz	0.15% of reading +0.35% of range	0.15% of reading +0.35% of range	0.25% of reading +0.50% of range
440Hz < f ≤ 1kHz	0.20% of reading +0.35% of range	0.20% of reading +0.35% of range	0.40% of reading +0.50% of range
1kHz < f ≤ 2.5kHz	0.80%+ of reading +0.45% of range	0.95%+ of reading +0.45% of range	1.68% of reading +0.60% of range
2.5kHz < f ≤ 5kHz	3.05% of reading +0.45% of range	3.35% of reading +0.45% of range	6.05% of reading +0.60% of range

The items listed below apply to all of the tables.

- When the crest factor is set to 3.
- When λ (the power factor) is 1.
- Power figures that exceed 1.2kHz are reference values.
- For the direct current range, add 10uA to the current accuracy and (10uA/direct current range)×100% of range to the power accuracy.
- For the external current sensor range, add 100 µV to the current accuracy and (100uV/external current sensor range rating)× 100% of range to the power accuracy.
- For nth harmonics component input, add {(n/(m + 1))/50}% of (the nth harmonics reading) to the n + mth harmonics and n – mth harmonics of the voltage and current, and add {(n/(m + 1))/25}% of (the nth harmonics reading) to the n + mth harmonics and n – mth harmonics of the power.
- Add (n/500)% of reading to the nth component of the voltage and current, and add (n/250)% of reading to the nth component of the power.
- The accuracy when the crest factor is 6 is the same as the accuracy when the crest factor is 3 after doubling the measurement range.
- The guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for ordinary measurement.
  If the amplitude of the high frequency component is large, influence of approximately 1% may appear in certain harmonics.
  Because the influence depends on the size of the frequency component, if the frequency component is small with respect to the range rating, the influence is also negligible.

Display

Item	Specifications
Display type	7-segment LED
Simultaneous display	4 items
Maximum display (display range)	During normal measurement

Displayed item	When the number of displayed digits is 5	When the number of displayed digits is 4
U, I, P, S*, Q*	99999	9999
λ*	1.0000 to –1.0000	1.000 to –1.000
Ø*	G180.0 to d180.0	G180.0 to d180.0
fU*, fI*	99999	9999
WP, WP±, q, q±		
• When the unit is MWh or MAh	999999	99999
	(–99999 for negative watt hour and ampere hour.)	
• When the unit is other than MWh or MAh	99999	99999
TIME		
Elapsed integration time	Display A indication	Display resolution
0 to 99 hours 59 minutes 59 seconds	0.00.00 to 99.59.59	1s
100 hours to 9999 hours 59 minutes 59 seconds	100.00 to 9999.59	1minute
10000 hours	10000	1 hour
Efficiency (WT330 only)	100.00 ~ 999.99 (%)	100.0 ~ 999.9 (%)
Crest factor	99999	9999
Four arithmetic operation	99999	9999
Average active power	99999	9999
Voltage peak	99999	9999
Current peak	99999	9999
Power Peak	99999	9999

Maximum display (display range)	During harmonic measurement

Displayed item	When the number of displayed digits is 5	When the number of displayed digits is 4
U, I, P	99999	9999
λ	1.0000 to –1.0000	1.000 to –1.000
Uhdf, Ihdf, Phdf	0.000 to 99.999 to	0.00 to 99.99 to
	100.00 to 999.99%	100.0 to 999.9%
Uthd, Ithd	0.000 to 99.999 to	0.00 to 99.99 to
	100.00 to 999.99%	100.0 to 999.9%
ØU, ØI		
• Phase angle of the 1st fundamental current with respect to the 1st fundamental voltage.	G180.0 to d180.0	G180.0 to d180.0
• Phase angle of the 2nd harmonics and higher harmonic of voltage with respect to the 1st fundamental voltage	–180.0 to 180.0	–180.0 to 180.0
• Phase angle of the 2nd harmonics and higher harmonics of current with respect to the 1st fundamental current	–180.0 to 180.0	–180.0 to 180.0

Unit symbols	m, k, M, V, A, W, VA, var, °, Hz, h±, TIME, %
Number of displayed digits	Select 5 or 4 digits
Data update interval	Select 0.1 s, 0.25 s, 0.5 s, 1 s, 2 s, or 5 s.
Response time	At maximum, 2 times the data update rate (The time it takes to reach the accuracy of the final value when the displayed value changed from 0 to 100% or 100 to 0% of the rated range)
Auto range monitor	The indicator illuminates when the input signal meets the conditions for auto range switching.
Overrange display	Overrange "- - oL- -" is displayed for the following conditions. When the measured value exceeds 140% of the rated range *WT310HC: 40A range When the measured value exceeds 110% of the rated range
Hold	Holds the displayed value.
Single update	Updates the displayed value once each time the SINGLE key is pressed during Hold.
MAX hold	Holds the maximum displayed value of U, I, P, S, Q, U±pk, I±pk and P±pk.

Internal memory

Item	Specifications
Measured data	Recall the stored measurement data by a communication command. Store interval Data update interval or in the range of 1 s to 99 hrs 59 min 59 s. There is no backup function of stored measurement data
Setup information	Saves/Loads four patterns of setup information.

External Current Sensor Input (/EX1 and /EX2 options)

Item	Specifications
Allows input of voltage output type current sensor signal. For detailed input specifications, see "Input."	Measurement range of the /EX1 option: Crest factor 3: 2.5V, 5V, 10V Crest factor 6: 1.25V, 2.5V, 5V Measurement range of the /EX2 option: Crest factor 3: 50mV, 100mV, 200mV, 500mV, 1V, 2V Crest factor 6: 25mV, 50mV, 100mV, 250mV, 500mV, 1V

D/A Output (/DA4, /DA12 Options)

Item	Specifications
Output voltage	±5 V FS (approx. ±7.5 V maximum) against each rated value.
Number of output channels	4 outputs for products with the /DA4; 12 outputs for products with the /DA12 option
Output items	Set for each channel. U, I, P, S, Q, λ, Ø, fU, fI, Upk, Ipk, WP, WP±, q, q± and MATH
Accuracy	±(accuracy of each measurement item + 0.2% of FS)(FS=5V)
D/A conversion resolution	16 bits
Minimum load	100 kΩ
Update Interval	Same as the data update interval.
Temperature coefficient	±0.05%/°C of FS

Remote Control Input/Output Signal (/DA4, /DA12 Options)

Item	Specifications
Remote control input signal	EXT HOLD, EXT TRIG, EXT START, EXT STOP, EXT RESET
Remote control output signal	INTEG BUSY
I/O level	TTL
I/O logic format	Negative logic, falling edge

GP-IB Interface (Standard on -C1)

Item	Specifications
Usable devices	National Instruments Corporation • PCI-GPIB or PCI-GPIB+, PCIe-GPIB or PCIe-GPIB+ • PCMCIA-GPIB or PCMCIA-GPIB+ (not support on Windows Vista or Windows 7) • GPIB-USB-HS Use driver NI-488.2M Ver. 2.8.1 or later.
Electrical and mechanical	Complies with IEEE St'd 488-1978 (JIS C 1901-1987)

Serial (RS-232) Interface (Standard on -C2)

Item	Specifications
Connector type	D-Sub 9-pin (plug)
Electrical specifications	Complies with EIA-574 (EIA-232 (RS-232) standard for 9-pin)
Baud rate	Select from 1200, 2400, 4800, 9600, 19200, 38400 or 57600bps.

USB PC Interface

Item	Specifications
Number of ports	1
Connector	Type B connector (receptacle)
Electrical and Mechanical specifications	Complies with USB Rev. 2.0
Supported transfer modes	HS (High Speed; 480 Mbps) and FS (Full Speed; 12 Mbps)
Supported protocols	USBTMC-USB488 (USB Test and Measurement Class Ver. 1.0)
PC system requirements	A PC with a USB port, running the English or Japanese version of Windows 7 (32 bit/64 bit), Windows Vista (32 bit), or Windows XP (32 bit, SP2 or later) Dedicated driver will supplied from Yokogawa home page

Ethernet Interface (/C7 Options)

Item	Specifications
Ports	1
Connector type	RJ-45 connector
Electrical and Mechanical specifications	Complies with IEEE 802.3
Transmission system	Ethernet (100BASE-TX, 10BASE-T)
Transmission rate	100 Mbps max.
Communication protocol	TCP/IP
Supported services	DHCP, remote control (VXI-11)

Specification

General Specifications	
Item	Specifications
Warm-up time	Approx. 30 minutes
Operating environment	Temperature: 5°C to 40°C Humidity: 20%RH to 80%RH (No condensation) Elevation: 2000m or less
Installation location	Indoors
Storage environment	Temperature: –25°C to 60°C Humidity: 20%RH to 80%RH (No condensation)
Rated supply voltage	100 VAC to 240 VAC
Permitted supply range voltage	90 VAC to 264 VAC
Rated supply frequency	50/60 Hz
Permitted supply voltage frequency range	48 Hz to 63 Hz
Maximum power Consumption	WT310, WT310HC: 50VA, WT332/WT333: 70VA
External dimensions (excluding protrusions.)	WT310, WT310HC: Approx. 213 (W) × 88 (H) × 379 (D) mm WT332/WT333: Approx. 213 (W) × 132 (H) × 379 (D) mm
Weight	WT310, WT310HC: Approx. 3 kg WT332/WT333: Approx. 5 kg
Battery backup	Setup parameters are backed up with a lithium battery.

Rack Mount

Model/parts number	Product	Description	Order Q'ty
751533-E2	Rack mounting kit	For WT310 series EIA standalone installation	1
751533-J2	Rack mounting kit	For WT310 series JIS standalone installation	1
751534-E2	Rack mounting kit	For WT310 series EIA connected installation	1
751534-J2	Rack mounting kit	For WT310 series JIS connected installation	1
751533-E3	Rack mounting kit	For WT330 series EIA standalone installation	1
751533-J3	Rack mounting kit	For WT330 series JIS standalone installation	1
751534-E3	Rack mounting kit	For WT330 series EIA connected installation	1
751534-J3	Rack mounting kit	For WT330 series JIS connected installation	1

Ask Yokogawa for information on rack mounts in which WT310 and WT330 str combined.

Accessory (sold separately)

Model/parts number	Product	Description	Order Q'ty
758917	Test lead set	A set of 0.8 m long, red and black test leads	1
758922 ⚠	Small alligator-clip	Rated at 300 V and used in a pair	1
758929 ⚠	Large alligator-clip	Rated at 1000 V and used in a pair	1
758923	Safety terminal adapter	(spring-hold type) Two adapters to a set	1
758931	Safety terminal adapter	(screw-fastened type) Two adapters to a set 1.5 mm hex Wrench is attached	1
758924 ⚠	Conversion adapter	BNC-banana-jack (female) adapter	1
366924 ⚠*	BNC-BNC cable	1 m	1
366925 ⚠*	BNC-BNC cable	2 m	1
758921 ⚠	Fork terminal adapter	Banana-fork adapter, Two adapters to a set	1
B9284LK ⚠	External sensor cable	Current sensor input connector, Length 0.5 m	1
705926	Connection Cable	1 m, For DA4, DA12 option	1

⚠ Due to the nature of this product, it is possible to touch its metal parts. Therefore, there is a risk of electric shock, so the product must be used with caution.
* Use these products with low-voltage circuits (42 V or less).

AC/DC Current sensor /Clamp on Probe

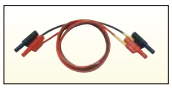
Model	Product Name	Description
CT1000	AC/DC Current sensor	DC~300 kHz, ±(0.05% of reading +30uA), 1000 Apk
CT200	AC/DC Current sensor	DC~500 kHz, ±(0.05% of reading +30uA), 200 Apk
CT60	AC/DC Current sensor	DC~800 kHz, ±(0.05% of reading +30uA), 60 Apk
751552	Clamp-on probe	30 Hz~5 kHz, 1400 Apeak(1000 Arms)
96030	Clamp-on probe	20 Hz~20 kHz, ±0.5% reading, 200 Arms
751574	AC/DC Current sensor	DC~100 kHz, 600 Apeak(400 Arms)

* CT series do not conform CE Marking.
* For detailed information, see Power Meter Accessory Catalog Bulletin CT1000-00E

Model and Suffix Codes

Model	SuppixCode		Description
WT310			1 Input element model
Power Cord	-D		UL, CSA standard, PSE
	-F		VDE standard
	-R		AS standard
	-Q		BS standard
	-H		GB standard
	-N		NBR standard (for Brazil)
Communication Interface *USB is standard	-C1	select one	GP- IB
	-C2		RS- 232
Optional function	/C7		Ethernet interface
	/EX1	select one	External sensor input 2.5V/5V/10V
	/EX2		External sensor input 50mV/100mV/200mV/500mV/1V/2V
	/G5		Harmonics Measurement
	/DA4		D/A- output(4CH)
Model	Suppix-Code		Describe
WT310HC			1 Input element /High current model
Power Cord	-D		UL, CSA standard, PSE
	-F		VDE standard
	-R		AS standard
	-Q		BS standard
	-H		GB standard
	-N		NBR standard (for Brazil)
Communication Interface *USB is standard	-C1	select one	GP- IB
	-C2		RS- 232
Optional function	/C7		Ethernet interface
	/EX1	select one	External sensor input 2.5V/5V/10V
	/EX2		External sensor input 50mV/100mV/200mV/500mV/1V/2V
	/G5		Harmonics Measurement
	/DA4		D/A- output(4CH)
Model	Suppix-Code		Describe
WT332			2 Input elements model
WT333			3 Input elements model
Power Cord	-D		UL, CSA standard, PSE
	-F		VDE standard
	-R		AS standard
	-Q		BS standard
	-H		GB standard
	-N		NBR standard (for Brazil)
Communication Interface *USB is standard	-C1	select one	GP- IB
	-C2		RS- 232
Optional function	/C7		Ethernet interface
	/EX1	select one	External sensor input 2.5V/5V/10V
	/EX2		External sensor input 50mV/100mV/200mV/500mV/1V/2V
	/G5		Harmonics Measurement
	/DA12		D/A- output(12CH)

Standard accessories
Power cord(1set), Rubber foot(1set), Current input protective cover(each 1 set), Start up guide(1set), Connector (provided only with /DA4 or /DA12, each 1set), Safety terminal adapter 758931(provided two adapters in a set times input element number), CD (1piece,included the startup guide, user guide, instruction manual and the communication manual by PDF data, and Viewer Software)



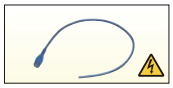
758917 Test lead set
Two leads in a set. Use 758917 in combination with 758922 or 758929. Total length: 75 cm
Rating: 1000 V, 32 A

758922 Small alligator adapters
For connection to measurement leads (758917). Two in a set.
Rating: 300 V

758929 Large alligator adapters
For connection to measurement leads (758917). Two in a set.
Rating: 1000 V

758923 *1
Safety terminal adapter set (spring-hold type) Two adapters in a set.

758931 *1
Safety terminal adapter set
Screw-fastened adapters. Two adapters in a set. 1.5 mm Allen wrench included for tightening.



B9284LK *2
External Sensor Cable
For connection the external input of the WT500 to current sensor.
Length: 50 cm

709526
26-pin cable for options DA4 and DA12

Due to the nature of this product, it is possible to touch its metal parts. Therefore, there is a risk of electric shock, so the product must be used with caution.
*1 Maximum diameters of cables that can be connected to the adapters 758923 core diameter: 2.5 mm or less; sheath diameter: 4.8 mm or less 758931 core diameter: 1.8 mm or less; sheath diameter: 3.9 mm or less
*2 The coax cable is simply cut on the current sensor side. Preparation by the user is required.

YOKOGAWA
Yokogawa Meters & Instruments Corporation

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

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