The world’s best seller

WT300E Series
Digital Power Meter
The WT300E series is the enhanced version of Yokogawa’s 5th generation of compact power meters. The world’s best-selling power meter is the instrument of choice for a wide range of applications in production testing, quality assurance and Research & Development.

WT300E power meters are easy to use, cost effective and accurate for diverse applications such as the testing of electric devices, the development and evaluation of home appliances and induction cookers, battery and DC driven device testing, and conformance tests on uninterruptable power supplies.

The exceptional low power performance of the WT300E and power consumption software enables users to easily test their instruments to Energy Star, SPEC and standby power standards.

The WT300E delivers

**Expertise**
The WT300E represents over 30 years of reliability and innovation in the compact power meter segment. With the widest range of quality power measurement solutions, users can be confident that Yokogawa always provides the right solution for their needs.

**Performance**
WT300E power meters offer precision measurements at low cost, thus providing true customer satisfaction.

**Space**
The small footprint and compact size of the WT300E makes it ideal for ad-hoc bench use and for rack mounting.
30+ years of Compact Power Meter expertise and reliability.

- 1915 YOKOGAWA founded
- 1979 First Compact Digital Power Meter 2509
- 1992 2534/2535
- 1995 WT110/WT130
- 2002 WT210/WT230
- 2012 WT300 series
- 2015 Latest Compact Digital Power Meter WT300E series
Features and benefits

Improvement of basic power accuracy
The WT300E series provides a basic power accuracy of ±0.15% (50/60 Hz) on all measurement ranges. It is the most accurate power meter in the compact category. The influence at low power factors is twice as good (0.1% of S) than the previous model.

Wide current ranges
The WT300E series cover broad ranges of current input from a few mA up to 40 A rms. It can measure waveforms which include both AC and DC. Users can use it from the low currents of standby power to the high currents of induction cooking.

The WT300E series lineup

<table>
<thead>
<tr>
<th>WT300E Series</th>
<th>WT310E: 1 Input element model</th>
<th>WT310EH: 1 Input element/High current model</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT330E Series</td>
<td>WT332E: 2 Input elements model</td>
<td>WT333E: 3 Input elements model</td>
</tr>
</tbody>
</table>

50 µA, 5 mA, 10 mA, 20 A, 26 A, 40 A

Current range and broad bandwidth

Fast display and data update rate
The fast display and 100 ms maximum data update rate of the WT300E series offers customers a short tact time in their testing procedures.
Consistent Basic Measurement Accuracy for all input ranges.

Auto data update rate function for fluctuating input
The WT300E series can chase fluctuating input frequencies like those in motors by changing the data update rate automatically. It can cover from the lowest 0.1 Hz input.
Users can select an "Auto" update rate in addition to the fixed settings in previous models. It can detect cycles of input signal automatically and measure it correctly.

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.

High performance and reliability
Simultaneous measurement of all parameters
The WT300E 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 measurement items of up to 200 parameters.

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.

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 WT300E 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.

The mode of Crest Factor “6A”
When "6A" is chosen as the Crest factor, the maximum rated input of the voltage and current becomes 260% of the range and up to 280% is displayable. When high resolution is required, users can prevent frequent current range changes by using this mode.
Options and capabilities

A wide range of communication interfaces such as USB, GP-IB or RS-232 (selectable) and Ethernet (optional)

Users therefore have the flexibility to choose according to their application needs e.g. from production lines to engineering test benches. Users can use WTVviewerFreePlus 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

Connectivity of Modbus/TCP*1 with YOKOGAWA’s recorders and Ethernet*1 with PLC

Measured digital data of the WT series can be acquired by YOKOGAWA’s recorder GP10*1,2 and GM*1,2 via Ethernet or Modbus/TCP directly. It is possible to make use of the GA10*2 data logging software.

And also, it can be connected with YOKOGAWA’s PLC, FA-M3V*2 by VXI-11 protocol for production fields.

*1 /C7 Ethernet option is required.

*2 GP10/GM/GA10/FA-M3V are manufactured by Yokogawa Electric Corporation.

*3 /E2 and /MC options are required.

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 (±5 Vdc outputs).

(WT310E/WT310EH 4 CH, WT332E/WT333E 12 CH)

Comparator Function

The WT300E series outputs ±5 V, 0 V, or ±5 V. To replace the output with a relay contact output, like the WT210/WT230 comparator function, a user can implement their own relay and driving circuit.

Current sensor input

Users can select either an /EX1 input option (2.5 to 10 V) or an /EX2 (50 mV to 2 V) for measuring large currents using current clamps or current sensors with voltage outputs.

Automatic zero adjustment

The WT300E series compensates for any drift in the zero level by automatically performing a zero adjustment when the input ranges are changed. This is achieved in less than 100 ms and does not require the wiring to be disconnected.
Applications

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.
- D/A output function and Modbus/TCP* 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 low cost. The DA output and communication interfaces enable data to be remotely and flexibly captured.  

* "Modbus/TCP" function is supplied with the Ethernet (/C7 option).

Development and evaluation tool for home appliances
- 5 mA range helps small current measurement (WT310E)
- 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 WT300E series to rapidly adapt to changing input conditions.

The range skip function reduces the range change transition period. The WT310E 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 power meters for the application, rather than one, thereby saving capital cost.

Testing to international standards, such as IEC62301, Energy Star and SPECpower
- The WT310E has a high measurement resolution of maximum 100 µW under the 5 mA range setting.
- Simultaneous measurement of normal power parameters, harmonic components and THD.
- Dynamic input capability of crest factor maximum 300 (Peak value/minimum effective RMS value)
- Free PCM software for IEC62301*1 testing

The WT310E together with the power consumption measurement (PCM) software enables users to perform standby power testing according to international standard.

*1 The IEC62301 E2.0 is a reference standard in the EN50564: 2011 Directive. This software corresponds to a test method of those two standards.

Evaluation of large current equipment such as induction heaters/cookers
- Direct high current measurement up to 40 Arms without using external current sensors (WT310EH).
- Auto ranging function for Integration mode

The WT310EH allows the direct input of up to 40 Arms without the need to use current clamps or current sensors. This not only provides more precise measurement but also saves on investment costs. It provides wide current ranges of 1 A to 40 A and voltage from 15 V to 600 V.

Users can use it for the evaluation of special waveform driven devices such as IH cookers and heaters.
Automotive—Battery or DC driven device evaluation

- Accurate DC measurement: 0.3% total (WT310EH: 0.5% total)
- Direct high current measurement up to 40 A without any external current sensor (WT310EH).
- Charge/Discharge (±Wh, ±Ah) energy measurement for batteries

The WT310EH can measure currents up to 40 A 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 periods
- Modbus/TCP Protocol for data recording
- DC, 0.1 Hz to 100 kHz broad bandwidth capability (WT310EH: Up to 20 kHz)

The WT300E series provides reliable current integration (Ah) and energy (Wh) measurement for up to 10000 hours (approx. 1 year). The Modbus/TCP communication with /C7 option is used to save and monitor the measurement results up to a maximum of 200 channels. The YOKOGAWA GA10 data gathering software can be used to save data along with other parameters such as temperatures, torque and rotation speed by this Modbus/TCP Protocol.

*GA10/GP20 are manufactured by Yokogawa Electric Corporation.

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

- DC, 0.1 Hz to 100 kHz broad bandwidth capability (WT310EH: Up to 20 kHz)
- Average active power measurement under integration mode

The WT300E series has a broad frequency capability of DC and from 0.1 Hz to 100 kHz. 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 Intermittent waveform operated devices. Therefore the users can perform accurate distorted waveform measurements without using special mode settings.

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 WT300E series enables users to conduct conformity tests according to UPS performance testing standards. The WT300E 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 WT300E series along with the WTViewerFreePlus software helps to simultaneously measure all the necessary parameters required to test a UPS thereby reducing the evaluation time.
Software

Free PC application software
WTViewerFreePlus (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 WT300E series front panel to setup the powermeter, users can use the software to quickly set up their favorite conditions.

It also shows all the setting parameters and the status at a glance. In particular, the range-skip function (range configuration) can be set and the maximum order used for the THD calculation can be specified.

Measurement Window
The software can display items which cannot be shown on the display of the WT300E 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 WT300E series.

Power Consumption Measurement Software (Free)
The Power Consumption Measurement Software together with a WT310E (or another WT series instrument) provides a trustworthy power measurement solution 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 WT310E, 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.

The WT310E need to be equipped with the harmonic option (/G5) and a low distortion power supply must be used.

*The IEC62301 E2.0 is a reference standard in the EN50564: 2011 Directive. This software corresponds to a test method of those two standards.
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)

> “LabVIEW is a registered trademark of National Instruments Corporation in the U.S.A.

**Programming tool samples**
To help users create dedicated programs for their system, some sample programs which support Visual Basic/Visual C++/Visual Basic .NET and Visual C# are prepared*. The sample programs support communication via USB, GP-IB/RS-232 or Ethernet interfaces and can be downloaded from the web site.

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

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### Comparison between WT210/230 series, WT300 series and WT300E series

<table>
<thead>
<tr>
<th>Feature</th>
<th>WT300 series</th>
<th>WT300E series</th>
<th>WT310/WT330</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic power measurement accuracy (50/60 Hz)</strong></td>
<td>0.1% of reading + 0.05% of range</td>
<td>0.1% of reading + 0.1% of range</td>
<td>0.1% of reading + 0.1% of range</td>
</tr>
<tr>
<td><strong>Influence of power factor</strong></td>
<td>When power factor ($j = 0$) apparent power ±0.1% of S for 45 Hz ≤ f ≤ 66 Hz</td>
<td>When power factor ($j = 0$) apparent power ±0.2% of S for 45 Hz ≤ f ≤ 66 Hz</td>
<td>When power factor ($j = 0$) apparent power ±0.2% of S for 45 Hz ≤ f ≤ 66 Hz</td>
</tr>
<tr>
<td><strong>Frequency bandwidth</strong></td>
<td>DC, 0.1 Hz to 100 kHz (WT310EH DC, 0.1 Hz to 20 kHz)</td>
<td>DC, 0.5 Hz to 100 kHz (WT310EH DC, 0.5 Hz to 20 kHz)</td>
<td>DC, 0.5 Hz to 100 kHz</td>
</tr>
<tr>
<td><strong>Direct input Current range</strong></td>
<td>WT310E: 12 ranges/5 mA to 20 A, WT310EH: 6 ranges/1 to 40 A</td>
<td>WT310E: 12 ranges/5 mA to 20 A, WT332E/WT333E: 6 ranges/0.5 to 20 A</td>
<td>WT310: 12 ranges/5 mA to 20 A, WT310HC: 6 ranges/1 to 40 A</td>
</tr>
<tr>
<td><strong>External current input</strong></td>
<td>EX1: 2.5/5/10 [V] (OP.)</td>
<td>EX1: 2.5/5/10 [V] (OP.)</td>
<td>EX2: 2.5/5/10 [V] (OP.)</td>
</tr>
<tr>
<td><strong>Expansion of effective input range for voltage &amp; current (CF = 6A)</strong></td>
<td>2% to 260%*1</td>
<td>2% to 260%*1</td>
<td>No</td>
</tr>
<tr>
<td><strong>Expansion of maximum displaying value for voltage &amp; current (CF = 6A)</strong></td>
<td>Yes*1</td>
<td>Yes*1</td>
<td>No</td>
</tr>
<tr>
<td><strong>Simultaneous measurement of RMS, Voltage MEAN &amp; DC</strong></td>
<td>Yes*2</td>
<td>Yes*2</td>
<td>No</td>
</tr>
<tr>
<td><strong>Frequency measurement</strong></td>
<td>2 channels (voltage and current)</td>
<td>2 channels (voltage and current)</td>
<td>selected voltage or current (one)</td>
</tr>
<tr>
<td><strong>Number of display item</strong></td>
<td>4 items</td>
<td>4 items</td>
<td>3 items</td>
</tr>
<tr>
<td><strong>Sampling rate</strong></td>
<td>Approximately 100 kS/s</td>
<td>Approximately 100 kS/s</td>
<td>Approximately 50 kS/s</td>
</tr>
<tr>
<td><strong>Data Update rate</strong></td>
<td>100 m/250 m/500 m/125/150/20 sec, Auto</td>
<td>100 m/250 m/500 m/125/150/20 sec</td>
<td>100 m/250 m/500 m/125/150/20 sec</td>
</tr>
<tr>
<td><strong>Harmonic measurement</strong></td>
<td>Yes (OP, /A5)</td>
<td>Yes (OP, /A5)</td>
<td>Yes (OP, /HRM)</td>
</tr>
<tr>
<td><strong>THD calculation maximum order setting</strong></td>
<td>Yes (OP, 1 to 50th)</td>
<td>Yes (OP, 1 to 50th)</td>
<td>No</td>
</tr>
<tr>
<td><strong>Auto ranging of integration</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Communication interface</strong></td>
<td>USB</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>RS-232</strong></td>
<td>Yes (OP)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Ethernet</strong></td>
<td>Yes (OP)</td>
<td>Yes (OP)</td>
<td>No</td>
</tr>
<tr>
<td><strong>Modbus/TCP (Ethernet)</strong></td>
<td>Yes (OP, /C7)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>IEEE standard for GP-IB</strong></td>
<td>IEEE488.2</td>
<td>IEEE488.2</td>
<td>IEEE488.1 and IEEE488.2</td>
</tr>
<tr>
<td><strong>Comparator function</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Viewer software (setting &amp; data capturing)</strong></td>
<td>Free (included)</td>
<td>Free (included)</td>
<td>Free (download)</td>
</tr>
</tbody>
</table>

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1: WT310EH input range is 2% to 260% (20 A range only up to 220%)
2: WT310EH input range is 2% to 260% (20 A range only up to 220%)
3: 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 WT300E series and WT300 series works identically to a WT200 series except for the Store (and recall operation) and the Compare functions.

*Modbus/TCP communication requires /C7 Ethernet option.
Basic characteristics

Example of Frequency — power Accuracy Characteristics

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

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

*Performance of WT332E/WT333E is same as that of WT310E

Front and rear

Key switches

1. Function setting
2. Element setting
3. U/I range setting
4. Integration setting

Standard features

5. Voltage input terminals
6. Current Input terminals
7. USB communication interface
8. GP-IB/RS-232

Optional features

9. External current sensor input
10. Ethernet
11. D/A output connector
### Specifications

**Input**

<table>
<thead>
<tr>
<th>Input terminal type</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug-in terminal</td>
<td>Direct input</td>
<td>Large binding post</td>
</tr>
<tr>
<td>Safety terminal</td>
<td>External current sensor input option</td>
<td>Isolated BNC</td>
</tr>
</tbody>
</table>

**Input format**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Floating input through protective voltage divider</th>
</tr>
</thead>
<tbody>
<tr>
<td>floating through short</td>
<td></td>
</tr>
</tbody>
</table>

**Measurement range**

<table>
<thead>
<tr>
<th>Input impedance</th>
<th>Voltage</th>
<th>current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input resistance: Approx. 2 MΩ,</td>
<td>Voltage</td>
<td>input capacitance: Approx. 13 pF in parallel with the resistance</td>
</tr>
<tr>
<td>Crest factor 6 or 6A: 7.5 V/15 V/30 V/75 V/150 V/300 V</td>
<td>Crest factor 6 or 6A: 25 mV/50 mV/100 mV/250 mV/500 mV/1 V</td>
<td></td>
</tr>
<tr>
<td>Crest factor 3: 1.25 V/2.5 V/5 V or EX2: 25 mV/50 mV/100 mV/250 mV/500 mV/1 V</td>
<td>Crest factor 3: 0.5 A/1 A/2 A/5 A/10 A/20 A</td>
<td></td>
</tr>
</tbody>
</table>

**Continuous maximum allowable input**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Peak value of 1.5 kV or RMS value of 1 kV, whichever is less.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>Direct input</td>
</tr>
<tr>
<td>WT510E</td>
<td>Crest factor 3: 5 mA/10 mA/20 mA/50 mA/100 mA/200 mA/500 mA/1 A/2 A/5 A/10 A/20 A</td>
</tr>
<tr>
<td>Peak value of 100 A or RMS value of 35 A, whichever is less.</td>
<td></td>
</tr>
<tr>
<td>WT322E/WT332E/WT333E</td>
<td>Crest factor 3: 0.5 A/1 A/2 A/5 A/10 A/20 A/40 A</td>
</tr>
<tr>
<td>Peak value of 100 A or RMS value of 44 A, whichever is less.</td>
<td></td>
</tr>
</tbody>
</table>

**Continuous maximum common mode voltage**

600 Vrms CAT II

**Influence of common mode voltage**

- When 600 Vrms is applied between the input terminals and case with the voltage input terminals shorted, current input terminals open and external current input terminals shorted. Double the following values when the crest factor is set to 6 or 6A.

- **At 50/60 Hz:**
  - ±0.05% of range
  - ±0.1% of range
  - ±0.2% of range
  - ±0.3% of range
- **Peak value less than or equal to 10 times of the rated range.**

**Accuracy**

- **Voltage and Current Accuracy**
  - Resolution: 16 bits
  - Maximum conversion rate: 10 µs

**A/D converter**

- Simultaneous conversion of voltage and current inputs.
### Specifications

- **Influence of temperature changes after zero-level compensation or range change**
  - Add 0.02% of range* to the DC voltage accuracy.
  - Add the following to the DC current accuracies:
    - WT310E (5 mA/10 mA/20 mA/50 mA/100 mA/200 mA ranges): ± 5 µ°C
    - WT310E/WT332E/WT333E/WT333EH direct current input: ± 50 µ°C
  - Accuracy of the Upk and Upk waveform display data.

- **Voltage input**
  - Input: 1.5 x \(15\text{°C}/\text{range}\) of range

- **Direct current range**
  - WT310E: 0 mA/10 mA/50 mA/100 mA/200 mA/500 mA range:
  - WT310E/WT332E/WT333E direct current input: ± 50 µ°C

- **Influence of self-generated heat caused by voltage input**
  - Add 0.000001 x U2% of reading to the AC voltage accuracies.

- **Influence of self-generated heat caused by current input**
  - Add 0.00001 x I2% of range to the DC current accuracies.

- **Influence of temperature changes after zero-level compensation or range change**
  - Add 0.02% of range* to the DC voltage accuracy.
  - Add the following to the DC current accuracies:
    - WT310E (5 mA/10 mA/20 mA/50 mA/100 mA/200 mA ranges): ± 5 µ°C
    - WT310E/WT332E/WT333E/WT333EH direct current input: ± 50 µ°C

- **Temperature coefficient**
  - When the line filter is turned ON:
    - WT310E: ± 40 A ± 5 A/10 A/20 A range
    - WT310E/WT332E/WT333E/WT333EH direct current input: ± 50 µ°C

- **Data Update Interval**
  - (f is the input signal frequency in kHz).

- **Output range**
  - ±(0.1% of reading + 0.3% of range) ±(0.1% of reading + 0.05% of range)

- **Accuracy change caused by data update interval**
  - All accuracy figures for 0.1 Hz to 10 Hz are reference values.

- **Synchronization**
  - The synchronization signal must meet the frequency measurement input signal level.

### WT300E Series

#### Active Power Accuracy

<table>
<thead>
<tr>
<th>DC Voltage Accuracy</th>
<th>AC Voltage Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>±0.1%/reading ± 0.2% of range</td>
<td>±0.3%/reading ± 0.5% of range</td>
</tr>
</tbody>
</table>

#### WT310E/WT332E/WT333E

<table>
<thead>
<tr>
<th>DC Voltage Accuracy</th>
<th>AC Voltage Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>±0.1%/reading ± 0.2% of range</td>
<td>±0.3%/reading ± 0.5% of range</td>
</tr>
</tbody>
</table>

#### WT310EH

<table>
<thead>
<tr>
<th>DC Voltage Accuracy</th>
<th>AC Voltage Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>±0.1%/reading ± 0.2% of range</td>
<td>±0.3%/reading ± 0.5% of range</td>
</tr>
</tbody>
</table>

### When the line filter is turned ON

- 45 to 50 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 or 6A

- Accuracy obtained by doubling the measurement range error for the accuracy when the crest factor is set to 3.
Voltage, Current, and Active Power Measurements

Measurement method: Digital sampling method

Crest factor

3 ≤ 6 (μA)

Wiring system

WT310E, WT310EH (One element model)
Single-phase, two-wire (1P2W)

WT332E (Two element model)
Select from: single-phase, three-wire (1P3W); or three-phase, three-wire (3P3W)

WT333E (Three element model)
Select from: 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 Up

The range is upped when any of the following conditions are met.

• Crest factor: ≤ 3. 3.3% or more of the currently set measurement range.

When the input signal exceeds 300% of the currently set measurement range.
Upk, Ipk value of the input signal exceeds 600% of the currently set measurement range.

• Crest factor: ≤ 6A. 200% or more of the currently set measurement range.
Upk, Ipk value of the input signal exceeds 600% of the currently set measurement range.

The range is upped the next time the measured value is updated.

Range down

The range is downed when all of the following conditions are met.

• Crest factor: ≤ 3. Urms or Im is less than or equal to 125% of the next lower measurement range.

The range is downed when the measured value is less than 50% (100% when the crest factor is set to 6 or 6A) of the currently set measurement range.
Upk, Ipk value of the input signal exceeds 125% of the next lower measurement range.

The range is downed the next time the measured value is updated.

Display mode Switching

Select RMS (the true RMS value of voltage and current), VMEAN (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.

In the case of Auto Update Rate, select the voltage or current from the equipped element.

Line filter

Select OFF or ON (out-of-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 WT310E/WT310EH/WT332E/WT333E.

Frequency Measurement

Measured item

Voltage and current frequencies applied to one selected input element can be measured.

WT332E (two element model)
Select voltage (U1)/current (I1) of input element1 or voltage (U3)/current (I3) of input element2.

WT333E (three element model)
Select voltage (U1)/current (I1) of input element1, voltage (U3)/current (I2) of input element2 or voltage (U5)/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

10 μs: 20 kHz ≤ f ≤ 100 kHz
100 μs: 10 Hz ≤ f ≤ 1000 kHz
1 s: 100 Hz ≤ f ≤ 100 kHz
5 s: 0.5 Hz ≤ f ≤ 10 kHz
10 s: 0.2 Hz ≤ f ≤ 1 kHz
Auto: 0.1 Hz ≤ f ≤ 1 kHz

(*) Limit of the measurement lower limit frequency by the Timeout setting

Timeout lower limit frequency

1 s: 2.0 Hz
5 s: 0.5 Hz
10 s: 0.2 Hz
20 s: 0.1 Hz

Only for the direct current input of WT310EH, the maximum measurement range is 200 kHz.

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 (out-of-frequency of 500 Hz).

Accuracy

Requirements

• Frequency filter is ON when measuring voltage or current of 200 Hz or less.

Accuracy: ± 0.5% of reading

Computation

Computing equation of apparent power (S), reactive power (Q), power factor (ϕ), and phase angle (θ) of input element number

<table>
<thead>
<tr>
<th>Single-Phase</th>
<th>Three-Phase</th>
<th>Three-Phase</th>
<th>Three-Voltage</th>
<th>Three-Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1P2W</td>
<td>1P+2P3</td>
<td>1P+2P2+P3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1P3W</td>
<td>1P+3P</td>
<td>1P+2P2+P3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3P3W</td>
<td>3P</td>
<td>3P</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Uφ = VVT × IVT

PVT = URMS × IRMS

QVT = URMS × IRMS × ϕ

• Crest factor 3: Urms or Irms is less than or equal to 30% of the measurement range.

• Crest factor 6: Urms or Irms exceeds 100% of the currently set measurement range.

• Crest factor 6A: Urms or Irms exceeds 260% of the currently set measurement range.

On the WT332E/WT333E, when any of those input elements meets the above condition, the range is upped when any of those conditions is met.

Lead and lag detection (Phase angle θ is D (lead) and G (lag))

The lead and lag of the voltage and current inputs can be detected correctly for the following.

• Sine waves

• Frequency: 50 Hz, 60 Hz, or 1 kHz

• Crest factor: ≤ 6A

• Crest factor: ≤ 6

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.

Scoring

Select 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.

Scoring 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 WT332E/WT333E.

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, A2/B, and A/B2)

Average active power during integration

Computes the average active power within the integrated period.

Integration

Mode

Select manual integration mode, standard integration mode, or repetitive integration mode.

Auto Update Rate cannot use the Integration mode.

Timeout

Automatically stop timer by setting a timer. Selectable range: 0 hours 00 minutes 00 seconds to 9999 hours 99 minutes 99 seconds (S) automatically to manual integration mode for 0 hours 00 minutes 30 seconds.

Counter overflow

WP: -999999 MVT−999999 MVT, q: 999999 MVT−999999 MVT

Holds the elapsed integration time and integration value and stops integration when the elapsed time of integration reaches the maximum integration time of 10300 hours or when the integrator detects the maximum of the counter displayable integration value (99999999 or 99999999).

Accuracy

a(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 is available for Integration

For details on range switching, see section of "Voltage, Current, and Active Power Measurements."
Specifications

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 VOLTAGEMEAN:
  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.
(applicable to products with the GS4 or GS112 option)

Harmonic Measurement (DG Option)

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 2.12 kHz.

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 or 6A.
  The frequency filter must be turned on when the fundamental frequency is less than or equal to 200 Hz.

FFT data length
1024

Window function
Rectangular

Sample rate, window width, and upper limit of analysis

<table>
<thead>
<tr>
<th>Fundamental Frequency</th>
<th>Sample rate</th>
<th>Window Width</th>
<th>Upper Limit of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Hz to 15 Hz</td>
<td>f \times 1024</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>15 Hz to 300 Hz</td>
<td>f \times 1024</td>
<td>13</td>
<td>16</td>
</tr>
<tr>
<td>300 Hz to 600 Hz</td>
<td>f \times 128</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>600 Hz to 1200 Hz</td>
<td>f \times 64</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

The upper limit of analysis orders can be decreased.

Accumulator accuracy
(The accuracy shown below is the sum of reading and range errors.)

When Line Filter is OFF

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Voltage</th>
<th>Current</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Hz \leq f &lt; 45 Hz</td>
<td>±0.15% of range + 0.35% of range</td>
<td>±0.15% of range + 0.35% of range</td>
<td>±0.35% of range + 0.50% of range</td>
</tr>
<tr>
<td>45 Hz \leq f &lt; 440 Hz</td>
<td>±0.15% of range + 0.35% of range</td>
<td>±0.15% of range + 0.35% of range</td>
<td>±0.25% of range + 0.50% of range</td>
</tr>
<tr>
<td>440 Hz \leq f &lt; 1 kHz</td>
<td>±0.20% of range + 0.35% of range</td>
<td>±0.20% of range + 0.35% of range</td>
<td>±0.40% of range + 0.50% of range</td>
</tr>
<tr>
<td>1 kHz \leq f &lt; 2.5 kHz</td>
<td>±0.30% of range + 0.45% of range</td>
<td>±0.60% of range + 0.60% of range</td>
<td>±0.50% of range + 0.60% of range</td>
</tr>
<tr>
<td>2.5 kHz \leq f &lt; 5 kHz</td>
<td>±0.30% of range + 0.45% of range</td>
<td>±0.65% of range + 0.65% of range</td>
<td>±0.77% of range + 0.66% of range</td>
</tr>
</tbody>
</table>

The items listed below apply to all of the tables.

  * When the crest factor is set to 3.
  * When f (the power factor) is 1.
  * Power figures that exceed 1.2 kHz are reference values.
  * For the direct current range, add 10 µA to the current accuracy and (10 µV/direct current range) x 100% of range to the power accuracy.
  * For the external current sensor range, add 100 µV to the current accuracy and (100 µV/external current sensor range rating) x 100% of range to the power accuracy.
  * For 1st harmonics component input, add (f/m+15%)/50% of the 1st harmonics readings to the m-th harmonics and n-m harmonics of the voltage and current, and add (f/m+25%)/50% of the 1st harmonics readings to the n-th harmonics and n-m harmonics of the power.
  * Add (f/n)/50% of reading to the n-th component of the voltage and current, and add (v/n/50%) of reading to the m-th component of the power.
  * The accuracy when the crest factor is 6 or 6A 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.

WT300E Series

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 level of the frequency component, if the frequency component is small with respect to the range rating, the influence is also negligible.

Table

<table>
<thead>
<tr>
<th>Display type</th>
<th>When the number of displayed digits is 5</th>
<th>When the number of displayed digits is 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>When the number of displayed digits is 5</td>
<td>When the number of displayed digits is 4</td>
</tr>
<tr>
<td>U, I, P, S*, Q*</td>
<td>90999</td>
<td>90999</td>
</tr>
<tr>
<td>f*</td>
<td>1,000 to 1,000</td>
<td>1,000 to 1,000</td>
</tr>
<tr>
<td>100.00 to 999.99%</td>
<td>G180.0 to G190.0</td>
<td>G180.0 to G190.0</td>
</tr>
<tr>
<td>Uf, If</td>
<td>90999</td>
<td>90999</td>
</tr>
<tr>
<td>fU*, fI*</td>
<td>0.000 to 9999.99</td>
<td>0.000 to 9999.99</td>
</tr>
<tr>
<td>TIME</td>
<td>100.00 to 999.99%</td>
<td>100.00 to 999.99%</td>
</tr>
<tr>
<td>Crest factor</td>
<td>90999</td>
<td>90999</td>
</tr>
<tr>
<td>Current peak</td>
<td>90999</td>
<td>90999</td>
</tr>
<tr>
<td>Power peak</td>
<td>90999</td>
<td>90999</td>
</tr>
</tbody>
</table>

The computation accuracy (the value calculated from the measured value) is one-half the display resolution.

During harmonic measurement

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Voltage</th>
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<th>Power</th>
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<td>±0.65% of range + 0.65% of range</td>
<td>±0.77% of range + 0.66% of range</td>
</tr>
</tbody>
</table>

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, 5 s, 10 s, 20 s or Auto.
In the case of Auto Update Rate cannot use the Integration function and store the measurement data.

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.

Crest factor 3 or 6
When the measured value exceeds 140% of the rated range

Crest factor 6A
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, Uspk, Ipak and Ppk.
**General Specifications**

- **Warm-up time**: Approx. 30 minutes
- **Operating environment**: Temperature: 5°C to 40°C, Humidity: 20%RH to 80%RH (No condensation)
- **Elevation**: 2000 m 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**: 90 VAC to 264 VAC
**Rated supply frequency**: 50/60 Hz
**Permitted supply voltage frequency range**: 48 Hz to 63 Hz

**Maximum power Consumption**: WT310E, WT310EH: 50 VA, WT332E/WT333E: 70 VA
**External dimensions (excluding protrusions)**: WT332E/WT333E: Approx. 213 (W) × 88 (H) × 379 (D) mm
**Weight**: WT310E, WT310EH: Approx. 3 kg, WT332E/WT333E: Approx. 5 kg

**Battery backup**: Setup parameters are backed up with a lithium battery.

**Safety standard**: EN61010-1, EN61010-2-030
**Permissible category**: Measurement Category II

**Pollution degree**: 2

**Immunity**

- **Compliant standard**: EN61326-1 Class B, EN50110 Class A
- **Installation category (overvoltage)**: CAT IV (Not applicable to Windows Vista or Windows 7)
- **Electrical immunity**
  - EN55011 Class A
  - EN61000-6-2
  - EN61326-1 Class B

**Cable conditions**: Same as the cable conditions for emission above.

**Exterior View**

1. Applies to products with CE marks. For information on other products, contact your nearest YOKOGAWA dealer.
2. The overvoltage category (installation category) is a value used to define the transient overvoltage condition and includes the rated impulse withstand voltage, CAT II applies to electrical equipment that is powered through a fixed installation, such as a wall outlet wired to a distribution board.
3. This instrument is measurement category II product. Do not use it for Measurement Categories III, and IV. Measurement category II applies to measurement of other circuits that are not directly connected to a main power supply.
4. 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.
5. Use cables of length 3 m or less.
6. Use cables of length 30 m or less.