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

**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.

**Improvement of basic power accuracy**
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 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

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\(^{1,3}\) 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.

**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.

**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.

**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.

Multiple units & users support function
New version of WTViewerFreePlus gives the ability to connect up to four WT300E series units (with the same model code). The enables the collection of the measurement data from multiple units. The WT300E series provides flexibility to users by offering various communication interfaces such as USB, Ethernet, GP-IB and RS-232. With the “Device Search” feature, it allows the WT300E series to connect to the PC automatically. The software assist the set up of favorite conditions and the measurement of 200 power parameters simultaneously.

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.
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.

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

<table>
<thead>
<tr>
<th>Evaluation item</th>
<th>WT300 series</th>
<th>WT310/WT330 series</th>
<th>WT210/WT230</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic power measurement accuracy</td>
<td>0.1% of reading + 0.05% of range (50/60 Hz)</td>
<td>0.1% of reading + 0.1% of range (50/60 Hz)</td>
<td>0.1% of reading + 0.1% of range</td>
</tr>
<tr>
<td>Influence of power factor</td>
<td>When power factor (j) = 0 (S: apparent power) ±0.1% of S for 45 Hz ≤ f ≤ 66 Hz</td>
<td>When power factor (j) = 0 (S: apparent power) ±0.2% of S for 45 Hz ≤ f ≤ 66 Hz</td>
<td>When power factor (j) = 0 (S: apparent power) ±0.2% of S for 45 Hz ≤ f ≤ 66 Hz</td>
</tr>
<tr>
<td>Frequency bandwidth</td>
<td>DC, 0.1 Hz to 100 kHz (WT310EH DC, 0.1 Hz to 100 kHz)</td>
<td>DC, 0.5 Hz to 100 kHz</td>
<td>DC, 0.5 Hz to 100 kHz</td>
</tr>
<tr>
<td>Direct input Current range</td>
<td>WT310E: 12 ranges/6 mA to 20 A, WT310EH: 6 ranges/1 to 40 A</td>
<td>WT310: 12 ranges/6 mA to 20 A, WT310HC: 6 ranges/1 to 40 A</td>
<td>WT310: 12 ranges/6 mA to 20 A, WT310HC: 6 ranges/1 to 40 A</td>
</tr>
<tr>
<td>External current input</td>
<td>EX1: 2.5/5/10 [V]</td>
<td>EX2: 50 m/100 m/200 m/500 m/1/2 [V] (OP.)</td>
<td>EX1: 2.5/5/10 [V]</td>
</tr>
<tr>
<td>Expansion of effective input range for voltage &amp; current (CF = 6A)</td>
<td>2% to 260%*1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Simultaneous measurement of RMS, Voltage, MEAN &amp; DC</td>
<td>Yes*1</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Frequency measurement</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>Number of display item</td>
<td>4 items</td>
<td>4 items</td>
<td>3 items</td>
</tr>
<tr>
<td>Sampling rate</td>
<td>Approximately 100 kS/s</td>
<td>Approximately 100 kS/s</td>
<td>Approximately 50 kS/s</td>
</tr>
<tr>
<td>Data update rate</td>
<td>100 m/250 m/500 m/1000 m/1024/1026/1027 sec, Auto</td>
<td>100 m/250 m/500 m/1000 m/1024/1027 sec</td>
<td>100 m/250 m/500 m/1024/1027 sec</td>
</tr>
<tr>
<td>Harmonic measurement</td>
<td>Yes (OP, /G5)</td>
<td>Yes (OP, /G5)</td>
<td>Yes (OP, /HRM)</td>
</tr>
<tr>
<td>THD calculation maximum order setting</td>
<td>Yes (OP, 1 to 50th)</td>
<td>Yes (OP, 1 to 50th)</td>
<td>No</td>
</tr>
<tr>
<td>Auto ranging of integration</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Communication interface</td>
<td>USB</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Ethernet</td>
<td>Yes (OP)</td>
<td>Yes (OP)</td>
<td>No</td>
</tr>
<tr>
<td>Modbus/TCP (Ethernet)</td>
<td>Yes (OP, /C7)</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>IEEE standard for GP-IB</td>
<td>IEEE488.2</td>
<td>IEEE488.2</td>
<td>IEEE488.1 and IEEE488.2</td>
</tr>
<tr>
<td>Comparator function</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Viewer software (setting &amp; data capturing)</td>
<td>Free (included)</td>
<td>Free (included)</td>
<td>Free (download)</td>
</tr>
</tbody>
</table>

*1: WT310EH input range is 2% to 260% (20 A range only up to 220%)
*2: WT310EH input range is 2% to 280% (20 A range only up to 280%)
*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 WT300E 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 \(\cos \theta = 0\))

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

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

Input terminal type
Voltage Plug-in terminal (safety terminal)
Current Direct input: Large binding post
External current sensor input option: isolated BNC

Input format
Voltage Floating input through resistive voltage divider
Current Floating input through shunt

Measurement range
Current
Voltage Crest factor 3: 0.5 mA/1 A/2 A/5 A/10 A/20 A
Current Crest factor 3: 0.5 A/2 A/5 A/10 A/10 A/20 A
Peak value of 150 A or RMS value of 44 A, whichever is less.

Continuous maximum allowable input
Voltage Peak value of 1.5 kV or RMS value of 1 kV, whichever is less.
Current
Direct input
Crest factor 3: 5 mA/10 mA/20 mA/50 mA/100 mA/200 mA
Crest factor 6 or 6A: 0.25 A/0.5 A/1 A/2.5 A/5 A/10 A
Peak value of 100 A or RMS value of 35 A, whichever is less.

Input impedance
Voltage Input resistance: Approx. 1 MΩ
Input capacitance: Approx. 13 pF in parallel with the resistance

Input inductance
Input resistance: Approx. 500 mΩ

Information
Instantaneous maximum allowable input
Voltage Peak value of 2.8 kV or RMS value of 2.0 kV, whichever is less.

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

Influence of common mode voltage

Frequency filter
Line filter
Scaling function: OFF, Number of displayed digits: 5 digits

Accuracy
Temperature: 23 ±5°C, Humidity: 30 to 75%RH.
Input waveform: Sine wave, Crest factor 3, Common mode voltage: 0 V
Scales: OFF, Number of displayed digits: 5 digits
Frequency filter: Turn ON to measure voltage or current input of 200 Hz or less
Resolution: 16 bits. Maximum conversion rate: Approx. 10 µs.

Voltage and Current Accuracy

Due to zero-level compensation is done or measurement range is changed.

Accuracy (at 12 months)

(Accuracy shown below is the sum of reading and range errors.)
In the read error equation is the input signal frequency in kHz.

A/D converter
Simultaneous conversion of voltage and current inputs.
Resolution: 16 bits. Maximum conversion rate: Approx. 10 µs.

Voltage and Current Accuracy

Accuracy
Temperature: 23 ±5°C, Humidity: 30 to 75%RH.
Input waveform: Sine wave, Crest factor 3, Common mode voltage: 0 V
Scales: OFF, Number of displayed digits: 5 digits
Frequency filter: Turn ON to measure voltage or current input of 200 Hz or less
Resolution: 16 bits. Maximum conversion rate: Approx. 10 µs.

Voltage and Current Accuracy
Specifications

- 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 to the DC current accuracy:
  WT310E (5 mA/10 mA/20 mA/50 mA/100 mA/200 mA ranges): 5 µ°C
  WT310E (0.5 A/1 A/2 A/5 A/10 A/20 A ranges) and WT332E/WT333E direct current input: 500 µ°C

- Accuracy of the Upk, lpk and waveform data display.
  Add the following to the above accuracy (reference value).
  The effective input range is within ±100% of range (within ±100% for Crest factor 6 or 6A)
  Voltage input: 1.5 × (Vt + 0.05% of DcRange)
  Direct current input range: WT310E (6 mA/10 mA/20 mA/50 mA/100 mA/200 mA/200 mA ranges); 3 × 0.05% of DcRange
  WT310E (0.5 A/1 A/2 A/5 A/10 A/20 A ranges) or WT332E/WT333E direct current input: current in mA
  ±(0.3% of reading + 0.2% of range)
  ±(0.3% of reading + 0.2% of range)
  ±(0.3% of reading + 0.2% of range)
  ±(0.3% of reading + 0.2% of range)

- Accuracy of self-generated heat caused by voltage input
  Add 0.0000001 × U to the AC voltage accuracies.
  Add 0.0000001 × U to the AC voltage accuracies.
  Add 0.0000001 × U to the AC voltage accuracies.
  Add 0.0000001 × U to the AC voltage accuracies.

- Influence of self-generated heat caused by current input
  WT310E:
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.

- Accuracy changes caused by data update interval
  When the data update interval is 100 ms, and Auto, add 0.05% of reading to the 0.1 Hz to 1 kHz accuracy.
  Guaranteed accuracy ranges for frequency, voltage and current (direct input)

- Temperature stability
  When the current exceeds 10 Hz to 45 Hz, and 400 Hz to 30 kHz when the current exceeds 20 A are reference values.
  WT310E: The maximum current input is 6 A when the frequency is over 30 kHz to 100 kHz.

- Input range
  1.3% with respect to the rated range of voltage or current. (It displays up to 140%)
  Add the reading error + 0.5 to above accuracies for the range of 110% to 130% of the rated range.

- Crest factor 6A: 2 to 260% with respect to the rated range of voltage or current.

- Synchrospin error

Measurement frequency range

- Temperature coefficient
  Add ±0.03°C of reading range within 5° to 18°C or 28° to 40°C.

- 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.

- Influence of power factor
  When power factor (P) = 0 (apparent power)
  ±0.1% of S for 45° Hz ≤ 66 Hz
  ±(0.1 + 0.15% of S) for up to 100 kHz as reference data.
  ±1% of reading in signal input in kHz.

- Influence of phase difference
  ±[ψ - cos (2 × 0.0002)] × sin (influence from the power factor when ψ = 0°/100°/1 deg) + 1 deg
  ±(0.05% of reading + 0.5% of range)
  ±(0.09 × (1 – 0.1)% of reading)

- WT300E Series Specifications

<table>
<thead>
<tr>
<th>Active Power Accuracy</th>
</tr>
</thead>
</table>
| Accuracy Requirements
  Same as the conditions for voltage and current.
  Power factor: 1 |

Accuracy (±12 months)

<table>
<thead>
<tr>
<th>DC</th>
<th>(Current Direct input)</th>
</tr>
</thead>
<tbody>
<tr>
<td>±(0.3% of reading + 0.2% of range)</td>
<td>±(0.3% of reading + 0.2% of range)</td>
</tr>
</tbody>
</table>

- Influence of temperature changes after zero-level compensation or range change
  Add 0.0000001 × U to the DC voltage accuracy.
  Add 0.0000001 × U to the DC voltage accuracy.
  Add 0.0000001 × U to the DC voltage accuracy.

- Influence of self-generated heat caused by voltage input
  Add 0.0000001 × U to the AC voltage accuracies.
  Add 0.0000001 × U to the AC voltage accuracies.
  Add 0.0000001 × U to the AC voltage accuracies.

- Influence of self-generated heat caused by current input
  WT310E:
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.

- Accuracy changes caused by data update interval
  When the data update interval is 100 ms, and Auto, add 0.05% of reading to the 0.1 Hz to 1 kHz accuracy.

- Guaranteed accuracy ranges for frequency, voltage and current (direct input)

- Influence of self-generated heat caused by current input
  WT310E:
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.
  Add 0.00013 × I to the DC current accuracies.

- Influence of power factor
  When power factor (P) = 0 (apparent power)
  ±0.1% of S for 45° Hz ≤ 66 Hz
  ±(0.1 + 0.15% of S) for up to 100 kHz as reference data.
  ±1% of reading in signal input in kHz.

- Influence of phase difference
  ±[ψ - cos (2 × 0.0002)] × sin (influence from the power factor when ψ = 0°/100°/1 deg) + 1 deg
  ±(0.05% of reading + 0.5% of range)
  ±(0.09 × (1 – 0.1)% of reading)

- When the line filter is turned ON
  45 to 56 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.

- Accuracy of apparent power S
  Voltage accuracy = current accuracy

- Accuracy of reactive power Q
  Accuracy of apparent power + ×[(cos + 0.0002) × sin (influence from the power factor when ψ = 0°/100°/1 deg)] + 1 deg
  ±(0.05% of reading + 0.5% of range)
  ±(0.09 × (1 – 0.1)% of reading)

- Accuracy of phase difference Δψ
  ±[ψ - cos (2 × 0.0002)] × sin (influence from the power factor when ψ = 0°/100°/1 deg) + 1 deg
  ±(0.05% of reading + 0.5% of range)
  ±(0.09 × (1 – 0.1)% of reading)
**Measurement Range**

\[
\frac{(U_1 + U_3)}{2}, \quad \text{and} \quad \frac{(I_1 + I_3)}{2}
\]

\[
10 \text{Hz} \leq f \leq 100 \text{kHz}
\]

\[
0.2 \text{Hz} \leq f \leq 100 \text{kHz}
\]

\[
i \quad \text{lower limit frequency}
\]

\[
2.0 \text{Hz}
\]

\[
\frac{(S_1 + S_2 + S_3)}{3}
\]

\[
P_1 + P_2 + P_3
\]

\[
13
\]

**Auto range**

- **Range up**
  - Crest factor 3: Ums or Ims is less than or equal to 30% of the measurement range.
  - Crest factor 6: Ums or Ims is less than or equal to 125% of the next lower measurement range.
  - Crest factor 6: Ums or Ims is less than or equal to 125% of the next lower measurement range.

- **Range down**
  - Crest factor 3: Ums or Ims is less than or equal to 30% of the measurement range.
  - Crest factor 6: Ums or Ims is less than or equal to 125% of the next lower measurement range.

**Display mode switching**

- Select RMS (the true RMS value of voltage and current).
- VOLTS 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).

**Zero-level compensation**

Removes the internal offset of the WT310E/WT310EH/WT332E/WT333E.

**Frequency Measurement**

<table>
<thead>
<tr>
<th>Measured Item</th>
<th>Measurement equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage and current frequencies applied to one selected input element can be measured.</td>
<td>WT332E (two element model)</td>
</tr>
<tr>
<td>Voltage (U1)’ current (I1) of input element1 or voltage (U3)’ current (I3) of input element3.</td>
<td>WT333E (three element model)</td>
</tr>
</tbody>
</table>

**Method**

Reciprocal method

**Frequency measuring range**

<table>
<thead>
<tr>
<th>Data Update Interval</th>
<th>Measurement Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 s</td>
<td>20 Hz x t x 100 kHz</td>
</tr>
<tr>
<td>0.25 s</td>
<td>10 Hz x t x 100 kHz</td>
</tr>
<tr>
<td>0.1 s</td>
<td>5 Hz x t x 100 kHz</td>
</tr>
<tr>
<td>2 s</td>
<td>2 Hz x t x 100 kHz</td>
</tr>
<tr>
<td>5 s</td>
<td>0.5 Hz x t x 100 kHz</td>
</tr>
<tr>
<td>10 s</td>
<td>0.2 Hz x t x 100 kHz</td>
</tr>
<tr>
<td>Auto (1)</td>
<td>0.1 Hz x t x 100 kHz</td>
</tr>
</tbody>
</table>

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

**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

#### Frequency Ranges for Integration
- **Active power**: DC to 45 kHz
- **Current**: DC, lower limit frequency determined by the data update interval to 45 kHz
- **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 to 45 kHz

#### Accuracy
- The accuracy shown below is the sum of reading and range errors.
- The guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for ordinary measurement.

#### 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 1.2 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 tuned on when the fundamental frequency is less than or equal to 200 Hz.

#### FPT data length
- 1024

#### Window function
- Rectangular

#### Maximum display range
- 9999 9999 9999 9999 9999
- ±(0.80% of reading)
- ±(0.20% of reading)
- ±(0.15% of reading)
- ±(3.05% of reading)
- ±(0.15% of reading)
- ±(0.60% of range)

#### WT300E Series
- **When 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.

#### Display
- **Display type**: 7-segment LED
- **Simultaneous display**: 4 items

### WT332E/WT333E Specifications

#### Frequency Ranges

<table>
<thead>
<tr>
<th>Frequency Ranges</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 × 1024</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td>15 Hz to 30 Hz</td>
<td>f × 512</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>30 Hz to 60 Hz</td>
<td>f × 256</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>f × 128</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Display Accuracy

<table>
<thead>
<tr>
<th>Harmonic Measurement</th>
<th>n th harmonics reading</th>
<th>(n/500)% of range</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Hz to 15 Hz</td>
<td>±15% of reading</td>
<td>±0.35% of range</td>
</tr>
<tr>
<td>15 Hz to 30 Hz</td>
<td>±15% of reading</td>
<td>±0.35% of range</td>
</tr>
<tr>
<td>30 Hz to 60 Hz</td>
<td>±20% of reading</td>
<td>±0.45% of range</td>
</tr>
<tr>
<td>60 Hz to 120 Hz</td>
<td>±20% of reading</td>
<td>±0.45% of range</td>
</tr>
</tbody>
</table>

#### Crest Factor
- **WT310EH**: 40 A range
- **WT332E/WT333E**: 600 A range
- **WT300E**: 200 A range

#### Unit symbols
- m, k, V, A, W, VA, var, °, Hz, h, TIME, %

#### 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.**

#### Display
- **Displayed item**
  - U, I, P, S, Q, M, V, A, W, VA, var, °, Hz, h, %

#### Display Accuracy
- **Displayed item**
  - U, I, P, S, Q, M, V, A, W, VA, var, °, Hz, h, %

#### 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.**

#### Auto range monitor
- The indicator illuminates when the input signal meets the conditions for auto range switching.

#### Overrange display
- **Overrange**: '-' is displayed for the following conditions.
  - When the measured value exceeds 140% of the rated range
  - When the measured value exceeds 110% of the rated range

#### Hold
- Holds the displayed value.

#### MAX hold
**Internal memory**
- 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. In the case of Auto Update Rate cannot store the measurement data.

**Setup information**
- Saves/load patterns of setup information.

**External Current Sensor Input ([EX1 and [EX2 options]**
- Allows input of output voltage type current sensor signal. For detailed input specifications, see "Input." Measurement range of the [EX1 option
  - Crest factor 3, 2.5 V S, 1.9 V
  - Crest factor 6 or 6 A: 1.25 V, 2.5 V, 5 V
- Measurement range of the [EX2 option
  - Crest factor 3: 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V
  - Crest factor 6 or 6 A: 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V

**D/A Output ([DA4,[DA12 Options]**
- 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
  - U, I, P, Q, S, U, I, P, Q, S, U, P, Q, U, P, Q, U, P, Q, U
- Accuracy
  - ±0.05%/°C of FS
- D/A conversion resolution
  - 16 bits
- Minimum load
  - 100 kΩ
- Update Interval
  - Same as the data update interval. In the case of Auto Update Rate, update interval is equal to signal interval. More than 100ms.
- Temperature coefficient
  - ±0.05%/°C of FS

**Remote Control Input/Output Signal ([VA4, [DA12 Options]**
- 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)**
- Usable devices
  - National Instruments Corporation
  - PCI-GPIB or PCI-GPIB+, PCIe-GPIB or PCIe-GPIB+
  - PCMCIA-GPIB (+PCMCIA-GPIB+)
- Connectors
  - D-Sub 9-pin (plug)
  - D-Sub 9-pin (socket)
- Electrical and mechanical specifications
  - Complies with EIEEE 488.2M Ver. 2.0
- Serial (RS-232) Interface (Standard on [C2)
- Connector type
  - D-Sub 9-pin (plug)
- Electrical specifications
  - Complies with EIEEE 488.2M (IEEE 488.2M) standard for 9-pin
- Baud rate
  - Select from 1200, 2400, 4800, 9600, 19200, 38400 or 57600 bps.

**USB PC Interface**
- Number of ports
  - 1
- Connector type
  - Type B connector (receptacle)
- Electrical and Mechanical specifications
  - Complies with USB Rev. 2.0
- Supported transfer modes
  - Hi-Speed (480 Mbps) and Full Speed (12 Mbps)
- Supported protocols
  - USBIF-3.0, SBCS-4.5

**PC system requirements**
- A PC with a USB port, running the English or Japanese version of Windows (32 bit/64 bit), Windows 7 (32 bit/64 bit), Windows Vista (32 bit/64 bit) Dedicated driver will be supplied from Yokogawa home page

**Ethernet Interface ([C/T Options)**
- Ports
  - 1
- Connector type
  - RJ-45 connector
- Electrical and Mechanical specifications
  - Complies with EIEEE 802.3
- Transmission system
  - Ethernet (10BASE-TX, 10BASE-T)
- Transmission rate
  - 100 Mbps max.
- Communication protocol
  - TCP/IP
- Supported services
  - DHCP, remote control (W9-11, Modbus/TCP)

**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
- Storage environment
  - Temperature: -25°C to 60°C
  - Humidity: 20%RH to 80%RH (No condensation)
**Model and Suffix code**

<table>
<thead>
<tr>
<th>Model</th>
<th>Suffix Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT310E</td>
<td></td>
<td>1 Input element model</td>
</tr>
<tr>
<td>WT310EH</td>
<td></td>
<td>1 Input element /High current model</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Communication Interface</th>
<th>-C1 select one</th>
<th>GP-IB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-C2</td>
<td>RS-232</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Power Cord</th>
<th>-D</th>
<th>UL, CSA standard, PSE compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>-I</td>
<td></td>
<td>AS standard</td>
</tr>
<tr>
<td>-Q</td>
<td></td>
<td>BS standard</td>
</tr>
<tr>
<td>-R</td>
<td></td>
<td>GB standard</td>
</tr>
<tr>
<td>-T</td>
<td></td>
<td>NT standard</td>
</tr>
</tbody>
</table>

**Optional function**

<table>
<thead>
<tr>
<th>-EX1</th>
<th>External sensor input 2.5 V/5 V/10 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>-EX2</td>
<td>External sensor input</td>
</tr>
<tr>
<td></td>
<td>50 mV/100 mV/200 mV/500 mV/1 V/2 V</td>
</tr>
<tr>
<td>-GS</td>
<td>Harmonics Measurement</td>
</tr>
<tr>
<td>-DA4</td>
<td>DA-/ output (4 CH)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Powered Cord</th>
<th>-D</th>
<th>UL, CSA standard, PSE compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>-I</td>
<td></td>
<td>AS standard</td>
</tr>
<tr>
<td>-Q</td>
<td></td>
<td>BS standard</td>
</tr>
<tr>
<td>-R</td>
<td></td>
<td>GB standard</td>
</tr>
</tbody>
</table>

**Optional function**

<table>
<thead>
<tr>
<th>-EX1</th>
<th>External sensor input 2.5 V/5 V/10 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>-EX2</td>
<td>External sensor input</td>
</tr>
<tr>
<td></td>
<td>50 mV/100 mV/200 mV/500 mV/1 V/2 V</td>
</tr>
<tr>
<td>-GS</td>
<td>Harmonics Measurement</td>
</tr>
<tr>
<td>-DA4</td>
<td>DA-/ output (4 CH)</td>
</tr>
</tbody>
</table>

**AC/DC Current Sensor**

**Name**

- **CT60/CT200/CT1000/CT2000A**

**Clamp on Probe**

**Description**

- **Current Output**

**Accessories**

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>758917</td>
<td>Measurement lead</td>
<td>0.75 m safety terminal cable with 2 leads (red and black) in a set</td>
</tr>
<tr>
<td>758922</td>
<td>Small alligator clip adapter</td>
<td>Safety terminal-alligator clip adapter, containing 2 pieces (red and black) in a set</td>
</tr>
<tr>
<td>758929</td>
<td>Large alligator clip adapter</td>
<td>Safety terminal-alligator clip adapter, containing 2 pieces (red and black) in a set</td>
</tr>
<tr>
<td>758921</td>
<td>Fork terminal adapter</td>
<td>Safety terminal-fork terminal adapter, containing 2 pieces (red and black) in a set</td>
</tr>
<tr>
<td>705926</td>
<td>Connection Cable</td>
<td>26-pin cable for options DA4 and DA15</td>
</tr>
</tbody>
</table>

**Yokogawa’s Approach to Preserving the Global Environment**

- Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guidelines and Product Design Assessment Criteria.