**WT3000**

Precision Power Analyzer

High-end Power Meter with top precision*

Basic Power Accuracy: 0.02% of reading

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**New Options Available**

- Store Function (Comes standard)
- USB Port for Peripherals (Optional)
- USB Port for connection to PC (Optional)
- Ethernet Communication Function (Optional)

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**Basic Power Accuracy**

0.02% of reading

**Frequency Power Range**

DC, 0.1 Hz to 1 MHz

**Use as many as**

4 input elements

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* Compared to previous Yokogawa model

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www.yokogawa.com/tm/
**Yokogawa’s power measurement technology provides best-in-class¹ precision and stability**

**Precision Power Analyzer WT3000**

With basic power accuracy of ± 0.02% of reading, DC and 0.1 Hz–1 MHz measurement bandwidths, and up to four input elements, the WT3000 provides higher-accuracy measurement for inverter I/O efficiency.

**Better Efficiency in Power Measurements**

In developing the WT3000, Yokogawa focused on improving efficiency in two basic areas. One goal was to obtain highly precise and simultaneous measurements of the power conversion efficiency of a piece of equipment. The other objective was to improve equipment evaluation efficiency by making simultaneous power evaluations and tests easier and faster.

**New Innovations to Enhance the Reliable Measurement Technology Developed for the WT2000**

The WT2000 is based on a measurement system which combines the measurement technology used in the WT2000 as well as other WT Series models. With the WT3000, we made further improvements to the basic performance specifications for even better functionality and reliability. We are confident users will appreciate these improvements to power and efficiency measurements thanks to the new power control technologies we have introduced.

**A Variety of External Interface Choices**

The WT3000 is the first model in the WT Series which is standard-equipped with a PC card slot (ATA flash card slot). The variety of interface choices allows customers to use the best interfaces for a wide variety of equipment, media, and network environments.

**Select the model most suited to your measurement needs.**

**Standard Version**

- High Accuracy and Wide Frequency Range
  - Basic Power Accuracy: ±0.02% of reading + 0.04% of range
  - Frequency Range: DC, 0.1 Hz to 1 MHz
- Low Power Factor Error
  - Power factor influence when cosø=0: 0.03% of S
  - S is reading value of apparent power
  - ø is phase angle between voltage and current
- Current Range
  - Direct Input: 0.5/1/2.5/5/10/20/30 [A]
  - Models with input elements supporting current output type current sensors are planned for release.
- External Input:
  - 50m/100m/200m/500m/1/2/5/10 [V] *
- Voltage Range:
  - 15/30/60/100/150/300/600/1000 [V] *
  - Voltage range and current range are for crest factor 3
- Continuous Maximum Common Mode Voltage: (50/60 Hz) 1000 [Vrms]
- Data Update rate: 50 ms to 20 sec
- Effective input range: 1% to 130%
- Simultaneous measurement with 2 Units
- Standard PC Card Slot
- Storage Function (Approximately 30MB internal memory)

**Motor Version**

In addition to the functions of the standard version, the new models offer powerful motor/inverter evaluation functions.

- Motor Efficiency and Total Efficiency Measurement
  - Analog or pulse signal from rotating sensor and torque meter can be input, and allows calculation of torque, revolution speed, mechanical power, synchronous speed, slip, motor efficiency, and total efficiency in a single unit.

**More Precise. More Bandwidth. More Features.**²

- The WT3000 is a truly innovative measurement solution, combining top-level measurement accuracy with special functions.
- The large, 8.4-inch liquid crystal display and the range indicator LEDs ensure good readability and make the system easy to use.

The WT3000 is the answer to your measurement problems.

Have you had problems or questions such as these?

- When working with efficiency-improvement evaluation data for a high-efficiency motor, improvements cannot be seen unless measurements are taken with very high precision.
- Measurement efficiency is poor during power measurements and power supply quality measurements.

For answers to these questions, see page 6.

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¹ As of June 2005, the preset accuracy in a three-phase power meter (as investigated by Yokogawa)
² As compared to Yokogawa’s WT2000
**FUNCTIONS**

**WT3000 Controls: Simple to Use, Easy to View**

The WT3000 was designed with user-friendly functions and controls in response to user requests for a simpler range setting operation and more user-friendly parameter setting display process.

A wide range of standard functions

**A variety of display formats**

The WT3000 lets you display input signal waveforms in addition to numerical value data. This means you don’t need to connect a special waveform analyzer just to check signal waveforms. The internal harmonic measurement function lets you display vectors and bar graphs for enhanced visualization.

- **Waveform display**
- **Bar graph display**
- **Vector display**
- **Trend display**

High-speed measurement to capture rapid data fluctuations

Fast updating allows you to precisely capture rapidly changing transient states in the measurement subject.* The WT3000 switches between different calculation systems depending on the data updating interval. See page 15 for details.

Compensations for the loss

This function compensates for the loss caused by the wiring of each element. The WT3000 has the following three types of correction functions to measure the power and efficiency.

- **Wiring Compensation**
- **Efficiency Compensation**
- **Two-Wattmeter Method**

Storing measurement data

**Store Function**

- **Flicker measurement (/FL)**
- **Storing measurement data**
- **Cycle by Cycle function (/CC)**

**Compensated active power measurement**

1. USB driver required for USB communications. A USB driver will be available from our Web site.
2. The optional built-in printer is installed on the front side of the WT3000, so it is easy to use even if the WT3000 is mounted on a rack. The printer can be used to print data and waveform memos.

**A way to add user-defined measurement parameters**

As many as twenty user-defined formulas can be set in the WT3000. These equations can be used to calculate various parameters, such as mean active power (see “A variety of integration functions” below).

**Apparent power integration and reactive power integration**

A variety of integration functions

- **Active power, current, apparent power, reactive power**
- **Waveform data capturing function**
- **Integration functions**

**Efficiency calculation function**

This function can be used to set up to four efficiency calculation formulas.

**A variety of display formats**

The WT3000 has nine numeric item pages for displaying measurement values. Once you set the measurement parameters you want displayed on a particular item page, you can easily switch between entire groups of displayed parameters.

**Using item pages to set display preferences**

Every switch is based on a new page.

**Power value**

**Average active power**

**Integrated active power (WP)**

**Integrated displaced active power (mWP)**

**Future Release Plans**

- **Advanced calculation functions (/G6)**
  - These functions can perform IEC harmonic measurements, MATH calculations, FFT calculations, and waveform data capturing function.
  - **IEC harmonic measurement function**
    - This function allows harmonic measurements in compliance with IEC61000-3-2. In addition, it can measure up to 50 orders of harmonics on signals from the fundamental frequency to 2 kHz. The function is useful for measuring the harmonics of equipment in which the fundamental frequency changes to harmonics.
  - **MATH calculation function**
    - This function can be used to calculate combinations measurement parameters on each channel, and then display the waveforms calculated using the formula.
  - **Waveform data capturing function**
    - This function can be used to externally output all sampled voltage and current data.

**Cycle by cycle function (CC)**

This function collects data such as voltage, current, power for each cycle in an AC cycle, then saves the data as a list.

**Flicker measurement (FL)**

This function enables measurement of voltage fluctuations/flicker in compliance with EN50160:2000 (Ed1:2000).

- **Note:** The descriptions and specifications may change.
**APPLYATIONS**

**Measurement Applications to Utilize WT3000’s Capabilities**

- **Measurement of Inverter Efficiency**
  - Measuring Efficiency with High Precision:
    - Simultaneous Measurement of Input and Output
      - The WT3000 offers up to four input elements capable of simultaneous measurement of single-phase input/three-phase output, or three-phase input/three-phase output.
  - **Accurate Measurement of Fundamental and Harmonic Waveforms**
    - Motor drive technology has become more complex in recent years; pure sinewave-modulated PWM is less common, and cases in which the voltage mean differs greatly from the fundamental voltage waveform arise frequently. With the optional harmonic measurement function of the WT3000, accurate measurements of commonly measured values such as active power and the fundamental or harmonic components can be taken simultaneously without changing measuring modes.
  - **Phase Voltage Measurement without a Neutral Line**
    - With the delta computation function (DT option), an object under test without a neutral line can be measured in a three-phase three-wire (3VT3W) configuration, allowing calculation of each phase voltage.
  - **Achieving Higher Precision:**
    - Measuring Instrument Loss Correction Function
      - These functions can compensate for instrument related losses resulting from the power meter’s internal impedance as well as losses related to wiring during measurement with low power meters.

- **Evaluation of Lighting Devices**
  - **Simultaneous Measurement of Voltage, Current, and THD (Total Harmonic Distortion)**
    - Testing of lighting devices often involves measurement of voltage, current, and THD, a parameter that indicates the degree of harmonic distortion in voltage or current waveforms. THD is becoming more prevalent due to the increasing complexity of control systems.
  - **The WT3000 can simultaneously measure voltage and current with THD, eliminating these inconveniences and allowing for more accurate and rapid measurements of an instrument’s characteristics and fluctuations.**

- **High Accuracy Measurements of Transformers**
  - **High Accuracy Even at Low Power Factors**
    - The WT3000 represents great improvement over previous models in terms of power factor error (it is approximately three times more accurate). With improved measurement accuracy in the lower power factors—such as with transformers—copper and iron losses can be calculated.
  - **Simultaneous Measurement of RMS and MEAN of Voltage waveform**
    - Voltage RMS (the true RMS value) and voltage MEAN (rectified mean value calibrated for zero voltage) are used in power conversion technologies such as those used in EVs and power conditioning.
  - **Phasor Voltage Confirmation**
    - The delta computation function (DT option) allows both star-delta and delta-star conversion.

**Reference equipment for power calibration**

- **Basic power accuracy of ±0.02% of reading**
  - The WT3000 can be used as a reference instrument for periodic in-house calibration of general-purpose power measurement instruments, such as the WT210 and WT230.

**Harmonic measurements**

- **Harmonic measurements on four input elements**
  - The WT3000 can be used to observe changes in the harmonic distortion factor in each phase. Note that this capability requires the GS option.
- **Measurement of phase angles between phases**
  - The WT3000 can determine the phase angle formed between the voltage fundamental waveform of input element 2 or 3, and the voltage fundamental waveform of input element 1. Note that this capability requires the GS option.

**SOFTWARE**

**Utility Software**

- **WTViewer**
  - Communications: GP-IB, Serial (RS-232, C2), USB(2)/121), or Ethernet (C7)
  - WTViewer is an application software tool that reads numeric, waveform, and harmonic data measured with the WT3000 Precision Power Analyzer.
  - **Numeric Data**
    - WTViewer can simultaneously display voltage, current, power and various other measured parameters for each to four elements individually, and for IA and LB calculators.
  - **Measuring Harmonics**
    - WTViewer can numerically or graphically display the results of measured harmonics up to the 100th order for such parameters as voltage, current, power and phase angle.
    - Requires GS or G6 option.
  - **Vectorial Views**
    - In three-phase wiring system you can view a sectorial display of the fundamental voltage, current and phase angle. A virtual presentation of the interphase relationship in a three-phase power system shows the load condition intuitively.
    - Requires GS or G6 option.
  - **Viewing Trends**
    - You can capture and view various types of data, measured with the WT3000 on your PC in a graphical trend format.
    - This feature lets you monitor power supply voltage fluctuations, changes in current consumption and other time-based variations.
  - **Accuracy Measurement of Fundamental PWM Voltage Waveforms**
    - Harmonics can be judged as acceptable or unacceptable in accordance with standards classification (A, B, C, and D). In addition to simply hiding data, the application provides various trends like bar graph, line graph, and vectorial graph. Bar graphs can be used to compare measurement values and standard limit values for each harmonic component.

**LabVIEW Driver (free)**

You can download this software program from our web site

**Future Software Releases**

**Software for Standards-Compliant Measurements**

- **Communications**: GP-IB, Serial (RS-232, C2), USB(2)/121), or Ethernet (C7)
- **Hamonic measurement function (requires G6 option)**
- **Measuring Harmonics**
  - Harmonics can be judged as acceptable or unacceptable in accordance with standards classification (A, B, C, and D). In addition to simply hiding data, the application provides various trends like bar graph, line graph, and vectorial graph. Bar graphs can be used to compare measurement values and standard limit values for each harmonic component.

- **Delta computation function (DT option)**
  - Allows both star-delta and delta-star conversion.

- **Simultaneous Measurement of Voltage, Current, and THD**
  - Simultaneous measurement of single-phase input/three-phase output, or three-phase input/three-phase output.

- **Achieving Higher Precision:**
  - Measuring Instrument Loss Correction Function
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**High Accuracy Measurements of Transformers**

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- **Measurement of phase angles between phases**
  - The WT3000 can determine the phase angle formed between the voltage fundamental waveform of input element 2 or 3, and the voltage fundamental waveform of input element 1. Note that this capability requires the GS option.
**Standard features**
1. Voltage input terminals
2. Current external sensor input terminals
3. Current direct input terminals
4. GP-IB port
5. BNC connector for two-system synchronized measurement

**Optional features**
1. Serial (RS-232) port (option/C2)
2. USB port (PC) (option/C12)
3. Ethernet port (10BASE-TX/10BASE-T) (option/C7)
4. VGA port (option/V1)
5. D/A output (option/DA)
6. Torque and speed input terminals (motor version)

**Characteristics**

**Example of basic characteristics showing the WT3000’s high precision and excellent stability**

**Chart 1:**
- **Title:** Power error with respect to the range for an arbitrary power factor (0.6070)
- **Table:**
  - Frequency (Hz): 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000
  - Power factor: 0.5, 0.8, 0.95, 1
  - Total power error (% of range): 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000

**Chart 2:**
- **Title:** Effect of common mode voltage on reading value
- **Table:**
  - Frequency (Hz): 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000
  - Gain (V/V): 1, 2, 5, 8
  - Error (% of reading): 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000

**Chart 3:**
- **Title:** Power factor
- **Table:**
  - Power factor: 0.5, 0.8, 0.95, 1
  - Total power error (% of range): 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000, 100000

**Connecting Diagram**

**Connecting the Measurement Cables and Adapters**

**Connecting Diagram for Clamp-on Probe**

**Accessories**

**Related products**

**Current Sensor Unit**
- 751521, 751523
- WT3000 DC to 100kHz

**Current Transducer**
- 751574
- WT3000 DC to 100 kHz/600A

**Current Clamp on Probe**
- 751552
- AC1000Amps (1400Apk)

**Adapters and Cables**

**Current Sensor Unit**
- 758922
- Small alligator adapters
- 758923
- Large alligator adapters
- 758924
- Small fork terminal adapter (option/V1)

**Current Transducer**
- 758931
- Safety terminal adapter set
- 758925
- Large alligator adapters

**Current Clamp on Probe**
- 758926
- Small alligator adapters
- 758927
- Large alligator adapters

**Related products**

**Precision Power Analyzer WT3000**
The crest factor is the ratio of the waveform peak value and the RMS value.

\[ \text{Crest factor} = \frac{\text{waveform peak}}{\text{RMS value}} \]

When measuring the crest factor of our power measuring instruments, please refer to the following equation.

\[ \text{Crest factor (CF)} = \frac{\text{measuring range} \times \text{CF setting} (3 \text{ or } 6)}{\text{measured value (RMS)}} \]

* The crest factor on a power meter is specified by how many times peak input value is allowed relative to rated input value. Even if some measured signals exist whose crest factors are larger than the specifications of the instrument (the crest factor standard at the rated input), you can measure signals having crest factors larger than the specifications by setting a measurement range that is large relative to the measured signal. For example, even if you set CF = 3, CF5 or higher measurements are possible as long as the measured value (RMS) is 60% or less than the measuring range. Also, for a setting of CF = 3, measurements of CF = 300 are possible with the minimum effective input (1% of measuring range).

**Comparison of Specifications and Functions in WT3000, Other WT Series Models, and PZ4000**

**WT3000 Specifications**

<table>
<thead>
<tr>
<th>Feature</th>
<th>WT3000</th>
<th>Other WT Series Models</th>
<th>PZ4000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power measurement capacity</td>
<td>200 kVA</td>
<td>300 kVA</td>
<td>100 kVA</td>
</tr>
<tr>
<td>Voltage measurement range</td>
<td>0.1 V to 1000 V</td>
<td>0.1 V to 1000 V</td>
<td>0.1 V to 1000 V</td>
</tr>
<tr>
<td>Current measurement range</td>
<td>50 mA to 250 A</td>
<td>50 mA to 250 A</td>
<td>50 mA to 250 A</td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>±0.05% of reading</td>
<td>±0.1% of reading</td>
<td>±0.2% of reading</td>
</tr>
<tr>
<td>Waveform Display</td>
<td>8.4-inch color TFT LCD monitor</td>
<td>7-inch color TFT LCD monitor</td>
<td>7-inch color TFT LCD monitor</td>
</tr>
<tr>
<td>Data update rate</td>
<td>50 ms to 1 s</td>
<td>50 ms to 1 s</td>
<td>50 ms to 1 s</td>
</tr>
<tr>
<td>Storage (internal memory for storing data)</td>
<td>Approximately 30MB</td>
<td>Approximately 10MB</td>
<td>Approximately 10MB</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Single-ended (safety terminal)</td>
<td>Single-ended</td>
<td>Single-ended</td>
</tr>
<tr>
<td>Number of Channels</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.001 A</td>
<td>0.001 A</td>
<td>0.001 A</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Terminal block (safety terminal)</td>
<td>Terminal block</td>
<td>Terminal block</td>
</tr>
<tr>
<td>Current</td>
<td>50 mA to 250 A</td>
<td>50 mA to 250 A</td>
<td>50 mA to 250 A</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.001 A</td>
<td>0.001 A</td>
<td>0.001 A</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>8.4-inch color TFT LCD monitor</td>
<td>7-inch color TFT LCD monitor</td>
<td>7-inch color TFT LCD monitor</td>
</tr>
<tr>
<td>Resolution</td>
<td>640 (horiz.) x 480 (vert.) dots</td>
<td>480 (horiz.) x 234 (vert.) dots</td>
<td>234 (horiz.) x 170 (vert.) dots</td>
</tr>
</tbody>
</table>

**Calculation Functions**

- **Accuracy**
  - ±0.05% of reading ±0.05% of range
  - ±0.1% of reading ±0.1% of range
  - ±0.2% of reading ±0.2% of range

The crest factor is 6.

- **Waveform Display (WAVD display)**
  - RMS/MEAN/AC/DC simultaneous measurement
  - IFT spectral analysis
  - User-defined functions

- **Digital Display**
  - 3.4-inch color TFT LCD monitor
  - 440 (horiz.) x 240 (vert.) dots
  - Waveform display resolution

- **Environmental**
  - Operating temperature: 0°C to 40°C (32°F to 104°F)
  - Relative humidity: 10% to 90% (non-condensing)
  - Storage temperature: -20°C to 60°C (−4°F to 140°F)

- **Precision Power Analyzer WT3000**
  - WT3000
  - WT3000 series
  - PZ4000

**SUPPORTS Crest Factor 6**

<table>
<thead>
<tr>
<th>Crest factor (CF, peak factor) = waveform peak</th>
<th>RMS value</th>
</tr>
</thead>
</table>

* The units of f in the reading error equation are kHz.

- When the measured values of U and I fall to 30% or less of the rated range value within equations is 30 A or 10 V.
- When the measured values of U and I exceed 110% of the range value, add 0.02% of the pixels on the LCD may be defective.

- Before warm up. After zero level compensation or range value change while measuring.

- Add 0.05% of range for crest factor 6.

- **Line filter**
  - Select OFF, 500 Hz, 5.5 kHz, or 50 kHz.

- **Measurement range**
  - 000 V, 100 V, 500 V, 1000 V for crest factor 2
  - 300 V, 500 V, 1000 V, 1500 V, 2000 V, 3000 V for crest factor 6

- **Current**
  - 000 mA, 1 A, 2 A, 5 A, 10 A, 20 A, 40 A for crest factor 2
  - 60 A for crest factor 6

- **Data update rate**
  - Approximately 30 ms for data update rate.
  - Approximately 100 ms for external sensor input.

- **Accuracies**
  - ±0.05% of reading ±0.05% of range
  - ±0.1% of reading ±0.1% of range
  - ±0.2% of reading ±0.2% of range

- **RMS/MEAN/AC/DC simultaneous measurement**
  - IFT spectral analysis
  - User-defined functions

- **Digital Display**
  - 3.4-inch color TFT LCD monitor
  - 440 (horiz.) x 240 (vert.) dots
  - Waveform display resolution

- **Environmental**
  - Operating temperature: 0°C to 40°C (32°F to 104°F)
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  - Storage temperature: -20°C to 60°C (−4°F to 140°F)

- **Precision Power Analyzer WT3000**
  - WT3000
  - WT3000 series
  - PZ4000

**Display**

- Digital display: 3.4-inch color TFT LCD monitor
  - 440 (horiz.) x 240 (vert.) dots
  - Waveform display resolution

- Environmental
  - Operating temperature: 0°C to 40°C (32°F to 104°F)
  - Relative humidity: 10% to 90% (non-condensing)
  - Storage temperature: -20°C to 60°C (−4°F to 140°F)

**Supports Crest Factor 6**

The crest factor is the ratio of the waveform peak value and the RMS value.

\[ \text{Crest factor} = \frac{\text{waveform peak}}{\text{RMS value}} \]

When measuring the crest factor of our power measuring instruments, please refer to the following equation.

\[ \text{Crest factor (CF)} = \frac{\text{measuring range} \times \text{CF setting} (3 \text{ or } 6)}{\text{measured value (RMS)}} \]

* However, the peak value of the measured signal must be less than or equal to the continuous maximum allowed input.

* The crest factor on a power meter is specified by how many times peak input value is allowed relative to rated input value. Even if some measured signals exist whose crest factors are larger than the specifications of the instrument (the crest factor standard at the rated input), you can measure signals having crest factors larger than the specifications by setting a measurement range that is large relative to the measured signal. For example, even if you set CF = 3, CF5 or higher measurements are possible as long as the measured value (RMS) is 60% or less than the measuring range. Also, for a setting of CF = 3, measurements of CF = 300 are possible with the minimum effective input (1% of measuring range).
Precision Power Analyzer WT3000

**Functions**

**Measurement method**
- Digital multiplication method

**Accuracy**
- 0.1% of reading + 0.1% of range

**Measurement range**
- ± 0.05% of reading

**Measurement period**
- 150 ms to 100 s (continuous measurement)

**Measurement functions**
- Voltage measurement
- Current measurement
- Resistance measurement
- Capacitance measurement
- Frequency measurement

**Wiring**
- You can select one of the 4 wiring settings:
  - 1PH1W (single-phase, 2 wires), 3PH3W (3-phase, 3 wires), 3PH4W (3-phase, 4 wires)

**Compensation Functions**
- **Bi-direction Compensation**
- **Automatic Compensation**

**Scalable**
- 20 channels (each channel can be set separately)

**Input Filter**
- High-pass filter

**Averaging**
- The average calculations below are performed on the normal measurement results using the averaging frequency F and F.
- Select averaging and averaging mode.

**Data update rate**
- Approx. 10 ms

**Sample rate**
- 30 kHz

**Delta Calculation Function (△T Optional)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Measurement method</th>
<th>Measurement range</th>
<th>Measurement period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog input data</td>
<td>Digital multiplication method</td>
<td>± 0.05% of reading</td>
<td>150 ms to 100 s (continuous measurement)</td>
</tr>
<tr>
<td>Analog input data</td>
<td>Digital multiplication method</td>
<td>± 0.05% of reading</td>
<td>150 ms to 100 s (continuous measurement)</td>
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**Harmonic Measurement Function (△I Optional)**

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</thead>
<tbody>
<tr>
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<td>Digital multiplication method</td>
<td>± 0.05% of reading</td>
<td>150 ms to 100 s (continuous measurement)</td>
</tr>
</tbody>
</table>

**Vibration Analysis**

<table>
<thead>
<tr>
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<th>Measurement period</th>
</tr>
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<tbody>
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AC signals have waveforms that fluctuate repeatedly when viewed instantaneously. Therefore, measuring the power values of AC signals requires averaging for each period in a repeated interval, or averaging the data of several periods using a filtering process. The WT3000 automatically selects the appropriate calculation method (one of the above two methods) based on the data updating period. This approach ensures fast response and high stability as suitable for the particular measurement objective.

- When the data updating period is 50ms, 500ms, 1s, or 2s, measurement values are determined by applying an Average for the Synchronous Source Periodic Function calculation to the sample data within the data updating period. (Note that this excludes power integrated values with, as well as current integrated values in DC mode.) With ASP, a frequency measurement circuit is used to detect the input signal period as the synchronous source. Sample data corresponding to an interval which is an integer multiple of the input period are used to perform the calculation. Based on its fundamental principle, the ASP method allows measurement values to be obtained simply by averaging an interval corresponding to a single period, so it is useful in cases where the data updating period is short or when measuring the efficiency of low-frequency signals. This method will not provide correct measurement values unless the period of the set synchronous source signal is accurately set. Therefore, it is necessary to check whether the frequency of the synchronous source signal has been accurately measured and displayed. See the user’s manual for notes on the synchronous source signal and frequency filter settings.

- When the data updating period is 50ms, 500ms, 1s, or 2s, measurement values are determined by applying an Exponential Averaging for Measuring Period (SAMP) calculation to the sample data within the data updating period. With SAMP, the sample data are averaged by applying a digital filtering process. This method does not require accurate detection of the input period. SAMP provides excellent measurement value stability.

**Selecting formulas for calculating apparent power and reactive power**

There are several types of power—active power, reactive power, and apparent power. Generally, the following equations are satisfied:

- **Active power** $P = U I \cos \phi$
- **Reactive power** $Q = U I \sin \phi$
- **Apparent power** $S = UI$

These defining equations are only valid for sinewaves. In recent years, there has been an increase in measurements of distorted waveforms, and users are measuring sine wave signals less frequently. Distorted waveform measurements provide different measurement values for apparent power and reactive power depending on what is the definition of power. In addition, because no definition for power is a distorted wave, it is not necessarily clear which equation is correct. Therefore, three different formulas for calculating apparent power and reactive power are provided with the WT3000.

- **Type B** (method used in normal mode with older WT Series models)

  With this method, the apparent power for each phase is calculated from equation (3), and reactive power for each phase is calculated from equation (4). Next, the results are added to calculate the power.

  Active power for three-phase four-wire connection: $P = P_1 + P_2 + P_3$
  Reactive power for three-phase four-wire connection: $Q = Q_1 + Q_2 + Q_3$

- **Type C** (method used in harmonic measurement mode with WT1600 and WT4000)

  This is the only method in which the reactive power for each phase is directly calculated using equation (4). Three-phase reactive power is calculated from three-phase apparent power and three-phase active power using equation (4).

  Active power for three-phase four-wire connection: $P = P_1 + P_2 + P_3$
  Reactive power for three-phase four-wire connection: $Q = Q_1 + Q_2 + Q_3$

- **Type D** (method used in harmonic measurement mode with WT1600 and WT4000)

  This is the only method in which the reactive power for each phase is directly calculated using equation (4). Three-phase reactive power is calculated from three-phase apparent power and three-phase active power using equation (4).

  Active power for three-phase four-wire connection: $P = P_1 + P_2 + P_3$
  Reactive power for three-phase four-wire connection: $Q = Q_1 + Q_2 + Q_3$
**Model and Suffix Codes**

- **Power Analyzer WT3000**
  - **Standard accessories**
    - Power cord, Spare power fuse, Rubber feet, current input protective cover, User's manual, expanded user's manual, communication interface user's manual, printer roll paper (provided only with DA), safety terminal adapter 758931 (provided two adapters in a set times input element number)
    - *Sale of the optional harmonic measurement function.
    - *Use these products with low-voltage circuits (42V or less).
  - **Accessory (sold separately)**
    - Safety terminal adapter 758931 (spring-hold type) Two adapters to a set. 1
    - Safety terminal adapter 758922 (small alligator-clip) Rated at 300V and used in a pair 1
    - Safety terminal adapter 758923 (large alligator-clip) Rated at 1000V and used in a pair 1
    - Test read set A set of 0.8m long, red and black test leads 1
  - **Mounts**
    - Standard version
    - UL/CSA standard
    - VDE standard
    - SAA standard
    - BS standard
    - GB standard
    - AS standard
    - VDE standard
    - UL/CSA standard
    - VDE standard
    - SAA standard
    - BS standard
    - GB standard
    - AS standard

- **PZ4000 Power Analyzer**
  - **Current Sensor Unit**
    - **Mounts**
      - Standard version
      - UL/CSA standard
      - VDE standard
      - SAA standard
      - BS standard
      - GB standard
      - AS standard
      - VDE standard
      - UL/CSA standard
      - VDE standard
      - SAA standard
      - BS standard
      - GB standard
      - AS standard
  - **Clamp on Probe / Current transducer**
    - **Models**
      - **Model**
        - **Suffix code**
        - **Description**
      - **Model**
        - **Suffix code**
        - **Description**
      - **Model**
        - **Suffix code**
        - **Description**
  - **External**
    - **Unit (mm)**
      - **Key board and mouse table**

**Subject to change without notice.**

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[Image of WT Series & PZ models]

**WT Series & PZ**

- **WT1600**
  - This model has a wide range of display capabilities and has a large variety of applications.

- **WT210**
  - The WT210 is a simple-to-use model with a large variety of applications.

**PZ4000 Power Analyzer**

- **Model**
  - **Suffix and codes**
  - **Description**

**Accessory (sold separately)**

- **Model**
  - **Suffix code**
  - **Description**

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**Communication & Measurement Business Headquarters**

Phone: (81)-422-52-6768, Fax: (81)-422-52-6624

E-mail: tm@csv.yokogawa.co.jp

Printed in Japan, 02/09P

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[Image of WT230 models]

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**Standard accessories**

- Power cord, Spare power fuse, Rubber feet, current input protective cover, User's manual, expanded user's manual, communication interface user's manual, printer roll paper (provided only with DA), safety terminal adapter 758931 (provided two adapters in a set times input element number)
- Sale of the optional harmonic measurement function.
- Use these products with low-voltage circuits (42V or less).

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**Applicatin Software**

- **Model**
  - **Suffix**
  - **Description**

**Mounts**

- **Model**
  - **Suffix code**
  - **Description**

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**Exterior**

- **Unit (mm)**
  - **Key board and mouse table**

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[Image of WT230 models]

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[Image of WT Series & PZ models]

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