Power Analyzer WT500

YOKOGAWA

# WT500

## Power Analyzer


- Simultaneous measurement of voltage, current, power, and harmonics
- High-speed data updating (100 ms)
- Display of numerical values, waveforms and trends
- Measurement of bought and sold watt hours
- Easy setup and operation

Current Range **0.5 to 40 A**

Voltage Range **15 to 1000 V**

Basic Power Accuracy **0.1%**

Frequency range **DC 0.5 Hz to 100 kHz**

3-Year Warranty

CE

(WT500)

Bulletin 7602-00E

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Compact and easy to use. The Power Analyzer for the renewable energy generation

# Power Analyzer WT500

**The WT500 Power Analyzer features a color TFT and compact body that enables single-phase and three-phase power measurement, achieving ±0.1% basic accuracy, maximum input of 1000 Vrms, 40 Arms and a measurement bandwidth of 100 kHz.**

## Key layout offers intuitive control


### Cursor Keys
Cursor keys can be used to move the on-screen cursor in four different directions. The cursor keys and SET key can also be used for making selections in soft menus. The WT500's menu structure is even more user-friendly than other models.

### RANGE Keys
The RANGE keys can be used to set the voltage and current ranges. Quick intuitive range control is available by using direct keys.

### DISPLAY Keys
DISPLAY keys can be used to switch between numerical values, waveforms, and other displays.
The display format can easily be changed.

### SETUP Key
The SETUP key can be used to enter various settings required for power measurement such as the wiring method and filters.

### FILE, IMAGE, and STORE Keys
The keys related to data storage are located in the same area.
Data can be easily stored in USB memory.

## Features

### ○ Simultaneous measurement of DC and AC signals
Evaluation of DC/AC signal conversion technology is critical in the renewable energy market. With input from 2 or more elements, the WT500 can measure DC and AC signals simultaneously and calculate input-to-output efficiency.

### ○ Separate integration functions for charge/discharge and bought/sold power
The WT500 is equipped with integration functions that can not only evaluate charge and discharge current such as from secondary cells, but also bought and sold power in photovoltaic power generation systems.

### ○ Saving measured data directly to USB memory
Measured data can be saved in CSV format directly to USB memory.

### ○ Easy setup with cursor keys
Menu-type screen offers intuitive settings.

### ○ Simultaneous measurement of normal data and harmonic data with the harmonic measurement, /G5 option
Voltage RMS, current RMS, power values, and harmonic components up to the 50 order can be measured simultaneously.

### ○ WT series for power evaluation of energy-saving equipment
The WT series have been used as powermeters for Green IT, Energy Star, $CO_2$ reduction and other energy-saving equipment. The WT series—Including the WT500—supports your power evaluation needs.

### Features
□ Standard feature
⬡ Option
○ Software (sold separately)

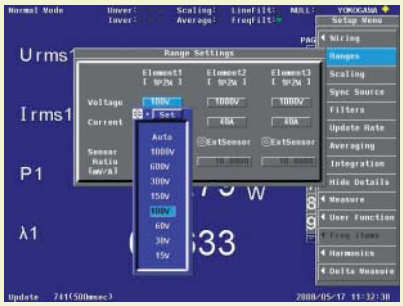
Voltage range: 15-1000V
Current range: 0.5-40A
External sensor range: 0.05-10V /EX
Frequency power range: 100kHz
Inputs: 1,2,3
Basic Power Accuracy: ±0.1%
Crest factor: 6(300)
Display: 5.7TFT
Data updating interval: 100ms-5s
Harmonics /G5
Delta computation /DT
Frequency measurement: 6ch /FQ
USB memory
Internal Memory: 20MB
VGA: 232.23V /V1
Comm: USB
Comm: GP-IB /C1
Comm: Ethernet /C7
Software: WTViewer 760122

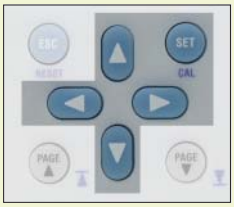
# FUNCTIONS

## Newly Designed Architecture

New!

Intuitive control by using cursor keys in four different directions.
To reduce setting errors, menus display settings in order of relative importance in order.





Example of voltage range setting

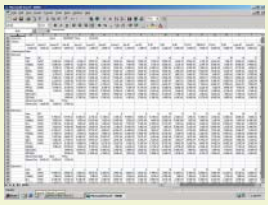
## Measured Value Direct Save Function

New!

Two USB ports for peripherals are installed for direct data saving (up to 1 G byte) in USB memory at shortest intervals. The saved data can be opened in applications such as Excel.



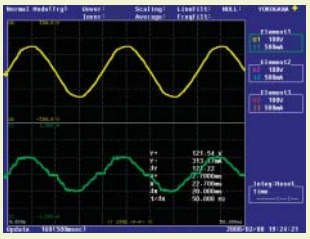
CSV format



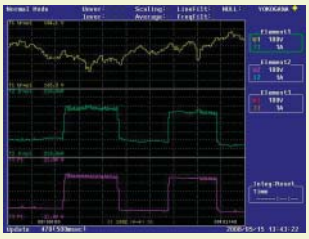
* Excel is a registered trademark of Microsoft Corporation in the U.S.A.

## A Variety of Display Formats

In addition to numerical data, the WT500 can display input signal waveforms and trends (time variation of numerical data). Also bar graph display and vector display are available with the harmonic measurement (/G5) option.



Waveform *1



Trend

Vector *2

Bar graph

*1 Waveforms of up to approximately 5 kHz can be displayed.
*2 Excludes single-phase models.
Split screen display for numerical values and waveforms is not available.

## Simple Setting and Display of Efficiency

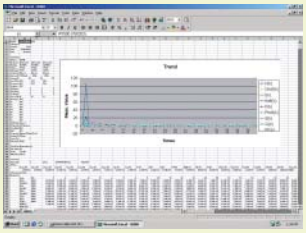
Two efficiency calculations can be set by selecting input elements or output elements from a list.

**Example:** $\eta 1 = P\Sigma / P1 \times 100\%$
$\eta 2 = P\Sigma / P2 \times 100\%$

## USB Memory Storage Function

Only necessary items within the measured data like voltage, current, and power can be saved in USB memory in binary or CSV format (up to 1 GB).

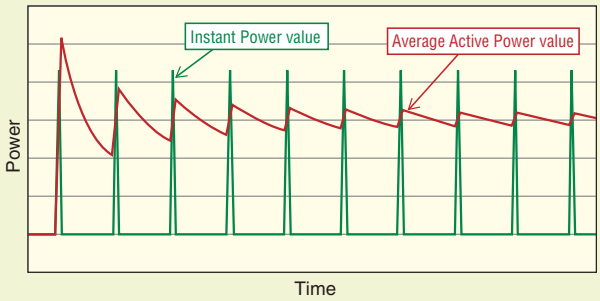
Files saved in CSV format can be opened in general-purpose applications such as Excel to allow displaying of data in graphs.



## Variety of Integration Functions

In addition to integration functions of active power (WP), current (q), reactive power (WQ), and apparent power (WS), a new feature provides measurement of bought and sold watt hours.
Also, average active power can be calculated over an integration interval.
This feature is useful for evaluating the power consumed by intermittent-control instruments in which the power value fluctuates. Average active power is calculated by using user-defined settings.

$$\text{Average active power} = \frac{\text{Integration power (WP)}}{\text{Elapsed time (H)}}$$

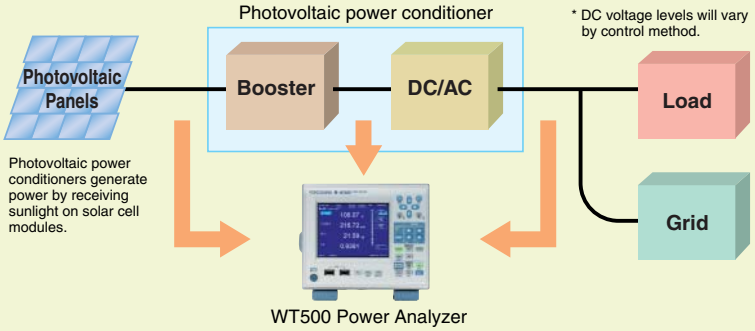


# APPLICATIONS

## Power Measurement for Renewable Energy

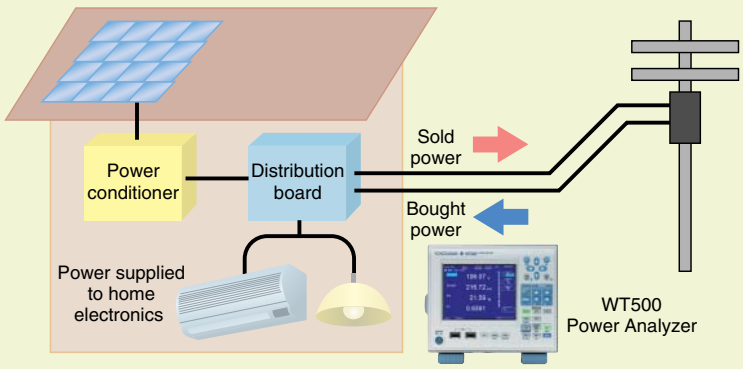
Photovoltaic power generation systems have been a focus of attention under the backdrop of the prevention of global warming.
Thermal power generation and other forms of power based on the limited resources of oil and coal release environmentally harmful $CO_2$, the main cause of global warming. On the other hand, because photovoltaic power generation does not release $CO_2$, it is considered to be an important renewable energy resource for the future.
The WT500 is capable of evaluating voltage, current, and power conversion efficiency by measuring DC signals and AC signals generated by photovoltaic power, a renewable energy source.

### Measurements of photovoltaic power consumption and power conversion efficiency



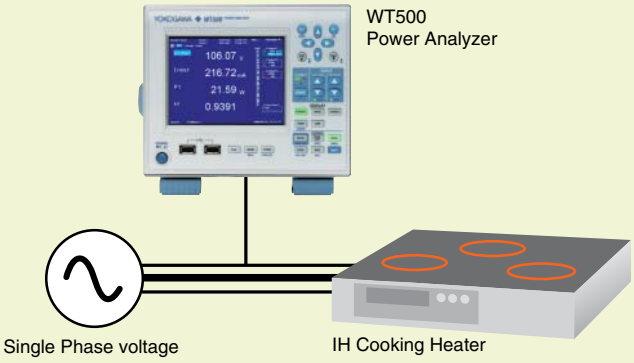

Industry is moving ahead with aggressive energy-savings and usage of renewable energy. Japan in particular has been actively developing equipment for photovoltaic power generation systems. The WT500 measures power consumption of “sold power,” which supplies photovoltaically generated power to interconnected systems, and “bought power” (purchases of electricity) and simultaneously displays data of bought/sold power, consumed/regenerated energy, and other data for energy-saving monitoring.

### Measurement of power conditioned and bought for home electronics



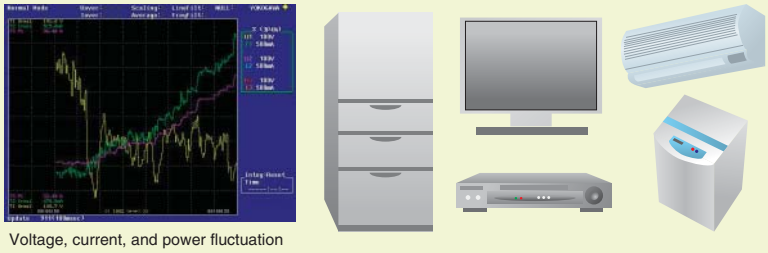

## Large Current Measurements for Electrical Appliances

In recent years, the “all-electric lifestyle” of household electronics such as kitchen appliances and hot water heaters has grown in popularity, and there is increased demand for Induction Heating Cookers and other Electrical Appliances that are promoted as being safer than gas-operated stoves.
A large amount of current is applied and converted to heat in order to increase the output of IH cooking heaters. The WT500 can measure voltage, current, power, and total harmonic distortion (THD) by inputting the large current (up to 40 A) flowing to the IH cooking heater, without the need for a current sensor. Measurements can be taken faster, allowing for high speed acquisition of power data on manufacturing lines.




## Evaluation and Testing of Home Electronics

Power consumption reduction measures have been adopted in consumer appliances such as air conditioners and washing machines due to implementation of Energy Star. Control methods are used in home electronics in which consumed current is precisely controlled to reduce power consumption.
The WT500 provides measurement of the fluctuating power consumption in these appliances.

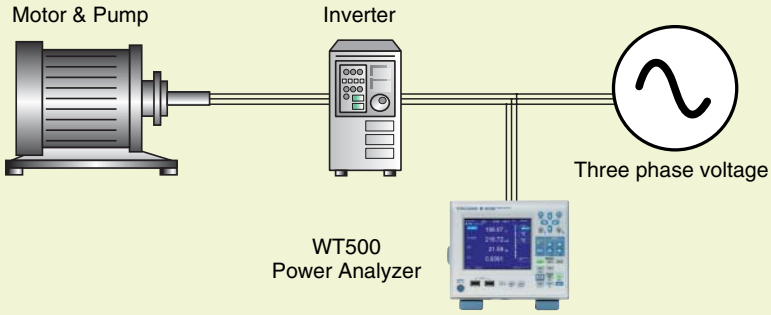


Voltage, current, and power fluctuation measurement screens

# APPLICATIONS

## Measuring Power Consumption of Various Motor Loads

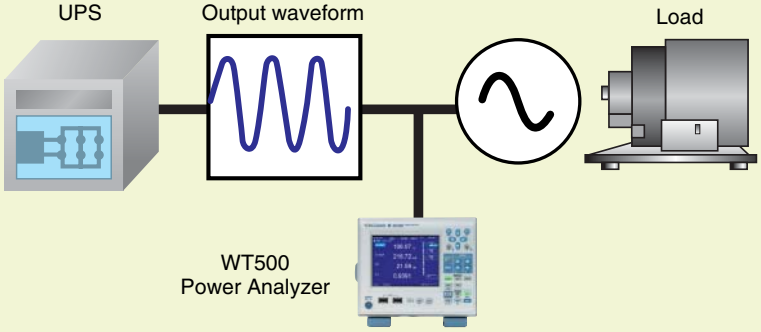
Various industrial motor & pump and air-conditioning fans are used in factories and other such locations. The revolution speed of these motor & pump has to be controlled in order to save energy, therefore many inverter-driven motor & pump are used.
The WT500 not only measures variation of voltage, current and power to evaluate performance of these motor & pump, but also enables you to examine energy efficiency by measuring integrated power.




## Power Quality Evaluation and Testing of UPS (Uninterruptable Power Supplies)

Uninterruptible Power Supplies (UPS) are systems that provide stable supplies of power at all times even during power failures such as power outages, instantaneous power failures, voltage fluctuations, and frequency changes.
As UPS performance tests, the WT500 can calculate input-to-output efficiency, power output, frequency, and distortion factor.

Note: The standard model can measure up to two frequencies.



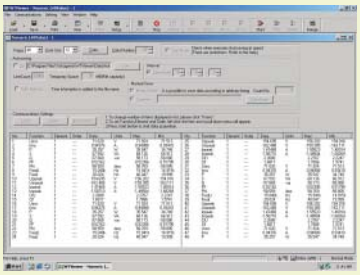

# SOFTWARE

## WTViewer 760122 (Coming Soon)

WTViewer is a software program that reads measured numerical, waveform, and harmonic data. Data can be transferred to a personal computer via GP-IB, Ethernet, or USB communications to display and store numeric or waveform data.
A communications option can be installed in the WT500 as needed.

**Communication Interface: USB, GP-IB(/C1), Ethernet(/C7)**

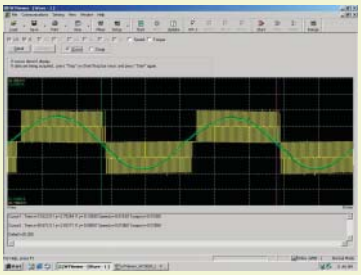
### ● Numerical Data Display



Measured data of input elements 1 to 3, and PΣ can be displayed on the PC screen via communication.

*Picture is a sample of WT3000

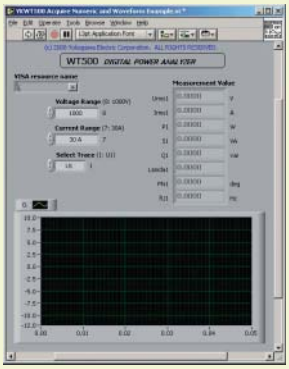
### ● Waveform Display



Voltage and current waveforms can be monitored on the PC screen.
You can confirm the voltage and current waveform shapes, waveform distortion, and other phenomena.

## LabVIEW Drivers

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



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

# OPTIONS

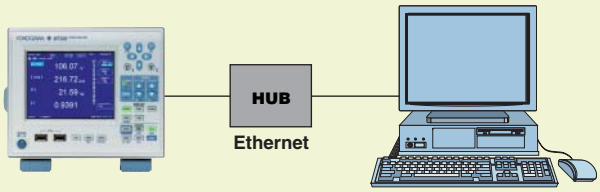
## GP-IB Communication (/C1)

GP-IB communication enables you to control the WT500 or transfer data from a PC.

## Ethernet Communication (/C7)

Data can be transferred via Ethernet* communication.
It enables file transfers using an FTP server.

*100BASE-TX




## External Current Sensor Input (/EX1, /EX2, /EX3)

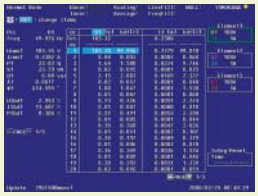
Current can be measured by using current clamps without disconnecting power supply wiring (voltage output type). By setting an external current sensor conversion ratio, it can support various types of current clamp-on probes.

## VGA Output (/V1)

By connecting to a monitor, you can create large displays of numerical values and waveforms. This function is convenient for simultaneously confirming data on multiple monitors, or to check data remotely.

## Harmonic Measurement (/G5)

This function enables simultaneous measurement of normal and harmonic data.
Harmonic components of up to the 50 th order can be measured.
With the WT500 you can simultaneously confirm voltage, current, and the distortion factor (THD) as well as measure the distortion factor without switching modes.



Harmonic Dual List


THD measurement

## Delta Computation

This function allows you to calculate individual phase voltages and phase currents from the line voltages and phase currents measured in a three-phase, three-wire system. The phase voltage can be calculated from the line voltage measured with the three-phase, three-wire (3V3A) method. This is useful when you want to determine the phase voltage in a DUT with no neutral line by using the three-phase, three-wire (3V3A) method.

Note: This function cannot be installed on products with only one element.

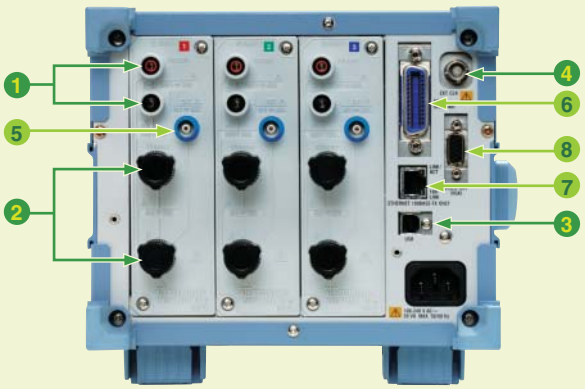
## Added Frequency Measurement (/FQ)

In addition to the standard two channels of frequency measurement, an option is available for frequency measurement on all channels. This option provides frequency measurement of voltage and current on all channels with input elements 1 through 3 installed.
This is necessary when you want to measure voltage and current frequency from the instrument's I/O as well as voltage and current frequencies of multiple items under test at the same time.

Note: This function cannot be installed on products with only one input element.

# REAR PANEL

## Rear Panel




**Standard feature**

1. Voltage input terminals
2. Current input terminals
3. USB communication interface
4. External trigger Signal, External clock input Connector

**Optional feature**

5. External Current Sensor Input Terminals (/EX option)
6. GP-IB communication Interface (/C1 option)
7. Ethernet Port (100BASE-TX)
8. VGA Output (/V1 option)

# ACCESSORIES

## Current Transducer　Current Clamp on Probe

### 751574　Current Output

**Current Transducer**
**DC to 100 kHz/600 Apk**

- Wide measurement frequency range: DC and up to 100 kHz (-3 dB)
- High-precision fundamental accuracy: ±(0.05% of reading + 40 μA)
- Wide dynamic range: 0-600 A (DC)/600 A peak (AC)
- ±15 V DC power supply, connector, and load resistor required.

For detailed information, see Power Meter Accessory Catalog Bulletin 7515-52E.


### 751552　Current Output

**Current Clamp on Probe**
**AC1000 Arms (1400 Apeak)**

- Measurement frequency range: 30 Hz to 5 kHz
- Basic accuracy: ±0.3% of reading
- Maximum allowed input: AC 1000 Arms, max 1400 Apk (AC)
- Current output type: 1 mA/A

A separately sold fork terminal adapter set (758921), measurement leads (758917), etc. are required for connection to WT500. For detailed information, see Power Meter Accessory Catalog Bulletin 7515-52E.

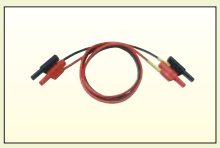

### 751550　Voltage Output

**AC 400 Arms (600 Apeak)**

- Wide dynamic range: 0.5 to 400 Arms (AC)
- Wide measurement frequency range: 20 Hz to 20 kHz (±5%)
- Basic accuracy: ±1.0% of reading ±0.2 mV
- Voltage output type: 10 mV/A

*This model is treated as a special-order product.

## Adapters and Cables



### 758917
**Measurement leads**

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

### 758922 ⚠
**Small alligator adapters**

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

### 758929 ⚠
**Large alligator adapters**

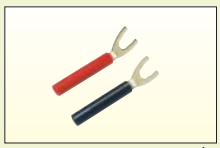
For connection to measurement leads (758917). Two in a set.
Rating: 1000 V

### 758923*1
**Safety terminal adapter set**

(spring-hold type) Two adapters in a set.

### 758931*1
**Safety terminal adapter set**

Screw-fastened adapters. Two adapters in a set. 1.5 mm Allen wrench included for tightening.



### 758921 ⚠
**Fork terminal adapter**

Two adapters (red and black) to a set. Used when attaching banana plug to binding post.

### 701959 ⚠
**Safety mini-clip set (hook Type)**

2 pieces (red and black) in one set.　Rating 1000 V

### 758924
**Conversion adapter**

For conversion between male BNC and female banana plug

### 366924/25*2 ⚠
**BNC cable**

(BNC-BNC 1 m/2 m)
For connection to simultaneously measurement with 2 units, or for input external trigger signal.

### B9284LK*3 ⚠
**External Sensor Cable**

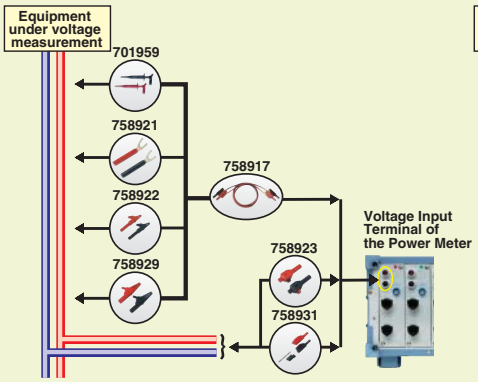
For connection the external input of the WT500 to current sensor.
Length: 50 cm

⚠ Due to the nature of this product, it is possible to touch its metal parts. Therefore, there is a risk of electric shock, so the product must be used with caution.

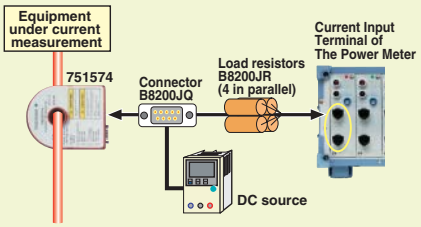
*1 Maximum diameters of cables that can be connected to the adapters
758923 core diameter: 2.5 mm or less;
sheath diameter: 4.8 mm or less
758931 core diameter: 1.8 mm or less;
sheath diameter: 3.9 mm or less
*2 Use with a low-voltage circuit (42 V or less)
*3 The coax cable is simply cut on the current sensor side. Preparation by the user is required.

## Connection Diagram

### Connection the Measurement Cables and Adapters



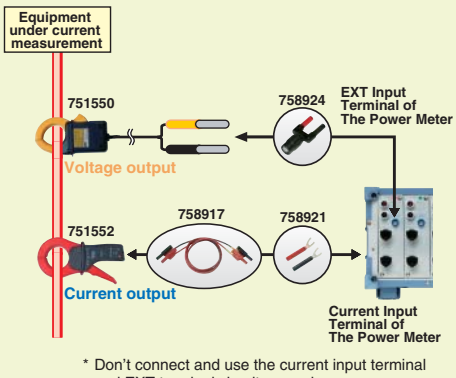

### Connection Diagram for Current Transducer




**Accessories (sold separately)**

| Product | Part no. | Specifications | Order quantity |
|---|---|---|---|
| Output connector | B8200JQ | D-SUB 9-pin, with 2 screws | 1 |
| Load resistors | B8200JR | 10 Ω, 0.25 W × 4<br>Connect 4 in parallel to set resistance to 2.5 Ω. | 1 |

### Connection Diagram for Clamp-on Probe




* Don't connect and use the current input terminal and EXT terminal simultaneously.

# Comparison of Specifications and Functions in WT500, Other WT Series Models

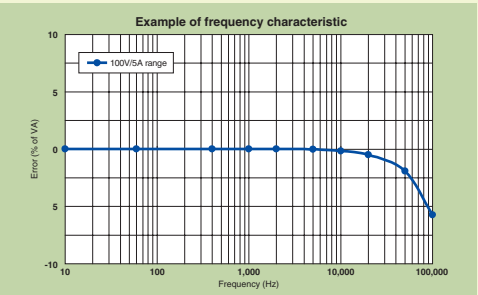
## Comparison among WT series

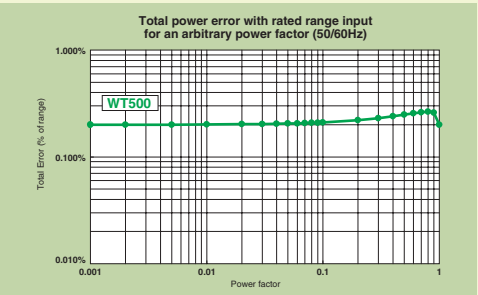
| | | | WT500 | WT210/WT230 | WT1600 | WT3000 |
|---|---|---|---|---|---|---|
| Range | Basic power accuracy (50/60 Hz) | | 0.1% of reading + 0.1% of range | 0.1% of reading + 0.1% of range | 0.1% of reading + 0.05% of range | 0.02% of reading + 0.04% of range |
| | Measurement power bandwidth | | DC, 0.5 Hz to 100 kHz | DC, 0.5 Hz to 100 kHz | DC, 0.5 Hz to 1 MHz | DC, 0.1 Hz to 1 MHz |
| | Input elements | | 1, 2, 3 | (WT210), 2&3 (WT230) | 1, 2, 3, 4, 5, 6 | 1, 2, 3, 4 |
| | Voltage range (Crest factor=3) | | 15/30/60/100/150/300/600/1000 [V] | 15/30/60/120/200/300/600 [V] | 1.5/3/6/10/15/30/60/100/150/300/600/1000 [V] | 15/30/60/100/150/300/600/1000 [V] |
| | Current range (Crest factor=3) | Direct input | 0.5/1/2/5/10/20/40 [A] | 5 m/10 m/20 m/50 m/0.1/0.2/0.5/1/2/5 /10/20 [A] (WT210) 0.5/1/2/5/10/20 [A] (WT230) | Select from 10 m/20 m/50 m/100 m/200 m /500 m/1/2/5 [A] or 1/2/5/10/20/50 [A] | 0.5/1/2/5/10/20/30 [A] |
| | | External sensor input | 50 m/100 m/200 m/500 m/1/2/5/10 [V] (opt.) | 50 m/100 m/250 m [V] or 2.5/5/10 [V] (opt.) | 50 m/100 m/250 m/500 m/1/2.5/5/10 [V] | 50 m/100 m/200 m/500 m/1/2/5/10 [V] |
| | Guaranteed accuracy range for voltage and current ranges | | 1% to 110% | 1% to 130% | 1% to 110% | 1% to 130% |
| Measurement parameters | Main measurement parameters | | **Voltage, current, active power, reactive power, apparent power, power factor, phase angle, peak voltage, peak current, crest factor** | | | |
| | Peak hold (instantaneous maximum value hold) | | ✓ | ✓ | ✓ | ✓ |
| | MAX hold | | ✓ | ✓ | ✓ | ✓ |
| | Voltage RMS/MEAN simultaneous measurement | | ✓ | | ✓ | ✓ |
| | RMS/MEAN/AC/DC simultaneous measurement | | ✓ | | ✓ | |
| | Average active power | | ✓ (user-defined function) | ✓ | ✓ (user-defined function) | ✓ (user-defined function) |
| | Active power amount (WP) | | ✓ | ✓ | ✓ | ✓ |
| | Apparent power amount (WS) | | ✓ | | | ✓ |
| | Reactive power amount (WQ) | | ✓ | | | ✓ |
| | Frequency | | 2 channels (up to 6 channels with option /FQ) | selected voltage or current (one) | Up to three from voltages or currents on installed input elements | 2 channels (up to 8 channels with option /FQ) |
| | Efficiency | | ✓ | ✓ | ✓ | ✓ |
| | Motor evaluation | | | | Torque and rotational velocity input (opt.) | Torque, rotating speed input (motor version) (opt.) |
| | FFT spectral analysis | | | | | (/G6) (opt.) |
| | User-defined functions | | ✓ (8 functions) | | ✓ (4) | ✓ (20 functions) |
| Display | Display | | 5.7-inch TFT color LCD | 7-segment display | 6.4-inch TFT color LCD | 8.4-inch TFT color LCD |
| | Display format | | Numerical values, waveforms, trends, bar graphs,vectors | Numerical values (3) | Numerical values, waveforms, trends, bar graphs, vectors | Numerical values, waveforms, trends, bar graphs, vectors |
| | Sampling frequency | | Approximately 100 kS/s | Approximately 50 kS/s | Approximately 200 kS/s | Approximately 200 kS/s |
| Measurement/ functions | Harmonic measurement | | ✓ (/G5) (opt.) | ✓ (opt.) | ✓ | (/G6) (opt.) |
| | IEC standards-compliant harmonic measurement | | | | | (/G6) (opt.) |
| | Flicker measurement | | | | | (/FL) (opt.) |
| | Cycle by cycle | | | | | (/CC) (opt.) |
| | Delta calculation function | | ✓ (/DT) (opt.) | | ✓ (diff are not supported) | (/DT) (opt.) |
| | DA output | | | 4 channels (WT210) (opt.), 12 channels (WT230) (opt.) | 30 channels (opt.) | 20 channels (/DA) (opt.) |
| | Synchronized operation | | ✓ | | ✓ | ✓ |
| | Storage (internal memory for storing data) | | Approximately 20 MB (Internal Memory) Max. 1 GB (direct memory to USB) | MAX.600 sample (WT210), MAX.300 sample (WT230) | Approximately 11 MB | approximately 30MB |
| Other features | Interfaces | | USB, GP-IB (/C1 opt.) Ethernet (/C7 opt.), VGA output (/V1)(opt.) | GP-IB; or RS-232; (opt.) (WT210) GP-IB; or RS-232 (WT230) | GP-IB or RS-232; SCSI (opt.); Ethernet (opt.); VGA output | GP-IB; RS-232 (/C2) (opt.); USB (/C12) VGA output (/V1) (opt.); Ethernet (/C7) (opt.) |
| | Data updating interval | | 100 m/200 m/500 m/1/2/5 [S] | 100 m/250 m/500 m/1/2/5 [S] | 50 m/100 m/200 m/500 m/1/2/5 [S] | 50 m/100 m/250 m/500 m/1/2/5/10/20 [S] |
| | Removable storage | | USB | | FDD | PC card interface; USB (/C5) (opt.) |
| | Printer | | | | Built-in printer (front side) (opt.) | Built-in printer (front side) (/B5) (opt.) |

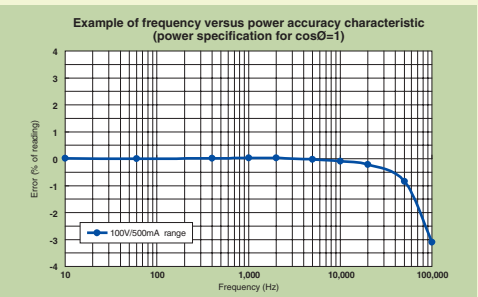
There are limitations on some specifications and functions. See the individual product catalogs for details.

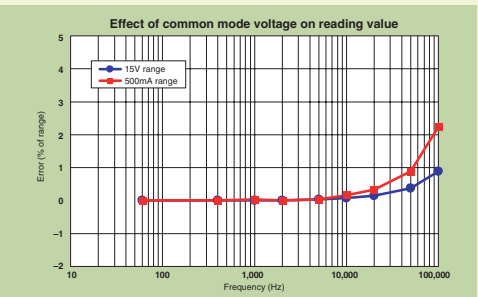
# CHARACTERISTICS

## Example of basic characteristics showing the WT500's high precision



## WT500 Specifications

### Inputs

| Item | Specification |
|---|---|
| Input terminal type | Voltage<br>Plug-in terminal (safety terminal)<br>Current<br>• Direct input: Large binding post<br>• External sensor input: Insulated BNC connector |
| Input type | Voltage<br>Floating input, resistive potential method<br>Current<br>Floating input, shunt input method |
| Measurement range | Voltage<br>15 V, 30 V, 60 V, 100 V, 150 V, 300 V, 600 V, 1000 V (for crest factor 3)<br>7.5 V, 15 V, 30 V, 50 V, 75 V, 150 V, 300 V, 500 V (for crest factor 6)<br>Current<br>• Direct input<br>500 mA, 1 A, 2 A, 5 A, 10 A, 20 A, 40 A (for crest factor 3)<br>250 mA, 500 mA, 1 A, 2.5 A, 5 A, 10 A, 20 A (for crest factor 6)<br>• External sensor input<br>50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V (for crest factor 3)<br>25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V, 2.5 V, 5 V (for crest factor 6) |
| Instrument loss (input impedance) | Voltage<br>Approximately 2 MΩ, 13 pF<br>Current<br>• Direct input: Approximately 5 mΩ + approximately 0.1 μH<br>• External sensor input: Approximately 100 kΩ |
| Instantaneous maximum allowable input (20 m second or less) | Voltage<br>Peak voltage of 2.8 kV or RMS of 2 kV, whichever is lower<br>Current<br>• Direct input: Peak current of 450 A or RMS of 300 A, whichever is lower<br>• External sensor input: Peak not to exceeded 10 times the range |
| Instantaneous maximum allowed input (1 second or less) | Voltage<br>Peak voltage of 2 kV or RMS of 1.5 kV, whichever is lower<br>Current<br>• Direct input: Peak current of 150 A or RMS of 45 A, whichever is lower<br>• External sensor input: Peak not to exceed 10 times the range |
| Continuous maximum allowed input | Voltage<br>Peak voltage of 1.5 kV or RMS of 1 kV, whichever is lower<br>Current<br>• Direct input: Peak current of 100 A or RMS of 45 A, whichever is lower<br>• External sensor input: Peak not to exceed 5 times the range |
| Continuous maximum common mode voltage (50/60 Hz) | 1000 Vrms |
| Influence from common mode voltage | Apply 1000 Vrms with the voltage input terminals shorted and the current input terminals open.<br>• 50/60 Hz: ±0.01% of range or less<br>• Reference value up to 100 kHz<br>± (max. range/range)* 0.001 * f% of range or less.<br>However, 0.01% or more. The units of f are kHz. Current Sensor Input is 10 times of above equations. The maximum rated range within equations is 1000 V or 40 A or 10V. |
| Line filter | Select OFF, 500 Hz, 5.5 kHz. |
| Frequency filter | Select OFF, or ON (Cut off frequency: 500 Hz) |
| A/D converter | Simultaneous voltage and current conversion and 16-bit resolution.<br>Conversion speed (sampling rate): Approximately 10 μs. See harmonic measurement items for harmonic display. |
| Range switching | Can be set for each input element. |
| Auto range functions | Increasing range value<br>• When the measured values of U rms and I rms exceed 110% of the range rating<br>• When the peak value exceeds approximately 330% of the range rating (or approximately 660% for crest factor 6)<br>Decreasing range value<br>• When the measured values of U rms and I rms fall to 30% or less of the range rating, and Upk and Ipk are 300% or less of the lower range value (or 600% for crest factor 6) |

### Display

| | |
|---|---|
| Display | 5.7-inch color TFT LCD monitor |
| Total number of pixels* | 640 (horiz.) × 480 (vert.) dots |
| Waveform display resolution | 501 (horiz.) × 432 (vert.) dots |
| Display update rate | Same as the data update rate.<br>Exceptions are listed below.<br>• The display update interval of numeric display (4, 8, and 16 items) is 200 ms when the data update rate is 100 ms.<br>• The display update interval of numeric display (ALL, Single List, and Dual List) is 500 ms when the data update rate is 100 ms or 200 ms.<br>• The display update rate of the trend display, bar graph display, and vector display is 1 s when the data update rate is 100 ms to 500 ms.<br>• The display update interval of the waveform display is approximately 1 s when the data update rate is 100 ms to 1 s. However, it may be longer depending on the trigger setting.<br>• At the setting of SLAVE mode, display update rate depends on the External clock. However it is adopted under faster external condition than data update rate. |

* Up to 0.02% of the pixels on the LCD may be defective.

### Calculation Functions

| Measurement functions | Equations |
|---|---|
| WP [Wh] | Power integration<br>$\frac{1}{N}\sum_{n=1}^{N}$<br>N: sampling times during the elapsed period<br>Time: unit is h<br>WPTYPE: CHARGE/DISCHARGE |
| WP+<br>WP- | WP+ is summation of product of u (n) × i(n) equation which is only positive value<br>WP- is summation of product of u (n) × i (n) equation which is only negative value<br>WP is sum of WP+ and WP-<br>WPTYPE: BOUGHT/SOLD<br>WP+ is summation of average P which is only positive value<br>WP- is summation of average P which is only negative value<br>WP is sum of WP+ and WP- |

| | | | Single-phase, 3 wire | 3 phase, 3 wire | 3 phase, 3 wire (3 voltage 3 current) | 3 phase, 4 wire |
|---|---|---|---|---|---|---|
| UΣ | [V] | | (U1+U2)/2 | | (U1+U2+U3)/3 | |
| IΣ | [A] | | (I1+I2)/2 | | (I1+I2+I3)/3 | |
| PΣ | [W] | | P1+P2 | | | P1+P2+P3 |
| SΣ | [VA] | TYPE1, TYPE2 | S1+S2 | $\frac{\sqrt{3}}{2}$ (S1+S2) | $\frac{\sqrt{3}}{3}$ (S1+S2+S3) | S1+S2+S3 |
| | | TYPE3 | $\sqrt{P\Sigma^2+Q\Sigma^2}$ | | | |
| QΣ | [var] | TYPE1 | Q1+Q2 | | | Q1+Q2+Q3 |
| | | TYPE2 | $\sqrt{S\Sigma^2-P\Sigma^2}$ | | | |
| | | TYPE3 | Q1+Q2 | | | Q1+Q2+Q3 |
| WPΣ | [Wh] | | WP1+WP2 | | | WP1+WP2+WP3 |
| WP+Σ | [Wh] | | CHARGE/DISCHARGE setting | | | |
| | | | WP+1+WP+2 | | | WP+1+WP+2+WP+3 |
| | | | When WPTYPE is set to SOLD/BOUGHT, only positive WPΣ value is added | | | |
| WP–Σ | [Wh] | | CHARGE/DISCHARGE setting | | | |
| | | | WP–1+WP–2 | | | WP-1+WP-2+WP-3 |
| | | | When WPTYPE is set to SOLD/BOUGHT, only negative WPΣ value is added | | | |
| qΣ | [Ah] | | q1+q2 | | | q1+q2+q3 |
| q+Σ | [Ah] | | q+1+q+2 | | | q+1+q+2+q+3 |
| q–Σ | [Ah] | | q–1+q-2 | | | q-1+q-2+q-3 |
| WQΣ | [varh] | | $\frac{1}{N}\sum_{n=1}^{N}$ \| QΣ(n) \| ×Time<br>QΣ(*n*) is the nth reactive power Σ function , and N is the number of data updates. Unit of Time is h. | | | |
| WSΣ | [VAh] | | $\frac{1}{N}\sum_{n=1}^{N}$ SΣ(*n*)×Time<br>SΣ(*n*) is the nth apparent power Σ function, and N is the number of data updates. Unit of Time is h. | | | |
| λΣ | | | $\frac{P\Sigma}{S\Sigma}$ | | | |
| ØΣ | [°] | | $\cos^{-1}\left(\frac{P\Sigma}{S\Sigma}\right)$ | | | |

Note1) The instrument's apparent power (S), reactive power (Q), power factor (l), and phase angle (Ø) are calculated using measured values of voltage, current, and active power. (However, reactive power is calculated directly from sampled data when TYPE3 is selected.) Therefore, when distorted waveforms are input, these values may be different from those of other measuring instruments based on different measuring principals.
Note 2) The value of Q in the QS calculation is calculated with a preceding minus sign (-) when the current input leads the voltage input, and a plus sign when it lags the voltage input, so the value of QS may be negative.

| | |
|---|---|
| η [%] | Set a efficiency calculation up to 2 |
| User-defined functions F1–F8 | Create equations combining measurement function symbols, and calculate up to eight numerical data. |

### Accuracy

[Conditions]
Temperature: 23±5°C, Humidity: 30 to 75%RH, Input waveform: Sine wave, Common mode voltage: 0 V, Crest factor: 3, Line filter: OFF, Frequency filter: 440 Hz ON, λ (power factor): 1, After warm-up. After zero level compensation or range value change while wired. f is frequency, 6-month
* These conditions are all accuracy condition in this section.

Accuracy ±(reading error + measurement range error) (for crest factor 3)

| Frequency | Voltage | Current | Power |
|---|---|---|---|
| DC | 0.1% of reading + 0.1% of range | 0.1% of reading + 0.1% of range | 0.1% of reading + 0.1% of range |
| 0.5 Hz≦f<45 Hz | 0.1% of reading + 0.2% of range | 0.1% of reading + 0.2% of range | 0.3% of reading + 0.2% of range |
| 45 Hz≦f≦66 Hz | 0.1% of reading + 0.1% of range | 0.1% of reading + 0.1% of range | 0.1% of reading + 0.1% of range |
| 66 Hz<f≦1 kHz | 0.1% of reading + 0.2% of range | 0.1% of reading + 0.2% of range | 0.2% of reading + 0.2% of range |
| 1 kHz<f≦10 kHz | {0.1 + 0.05 × (f-1)}% of reading + 0.2% of range | {0.1 × f}% of reading + 0.2% of range | {0.2 + 0.1 × (f-1)}% of reading + 0.2% of range |
| 10 kHz<f≦50 kHz | {0.5 + 0.04 × (f-10)}% of reading + 0.3% of range | {1 + 0.08 × (f-10)}% of reading + 0.3% of range | {0.2 + 0.1 × (f-1)}% of reading + 0.3% of range |
| 50 kHz<f≦100 kHz | {0.5 + 0.04 × (f-10)}% of reading +0.3% of range | {1 + 0.08 × (f-10)}% of reading + 0.3% of range | {5.1 + 0.18 × (f-50)}% of reading + 0.3% of range |

- Unit of f of reading error is kHz
  External Sensor Input, add 50 μV to DC Current accuracy and add
  (50 μV / external sensor input rated range) × 100% of range to DC power accuracy
  Direct current Input, add 500 μA to DC Current accuracy and add
  (500 μA / direct current input rated range) × 100% of range to DC power accuracy
- Accuracy of waveform display data, Upk and Ipk (reference value)
  Voltage: Add 1.5 × $\sqrt{15/\text{range rated}}$ % of range
  Current: Direct-add 3 × $\sqrt{0.5/\text{range rated}}$ % of range + 5 mA
  External input-add 3 × $\sqrt{0.05/\text{range rated}}$ % of range + 2 mV.
  Effective input range is within ±300% (within ±600% for crest factor 6)
- Influenced by changes in temperature after zero level correction or range value changes.
  Add 0.02% of range/°C to the voltage DC accuracy, 500 μA/°C to the current DC accuracy, 50 μV/°C to the external current DC accuracy, and influence of voltage times influence of current to the power DC accuracy.
- Influence of self heating due to current input
  When the input signal is current, for AC add 0.00013 × I²% of rdg, and for DC add 0.00013 × I²% of rdg + 0.004 × I² mA to the current and power accuracy. I is the reading value of current (A). Please note that the influence of self-heating is present until the shunt resistance temperature drops, even when the current input value is small.
- Additions to accuracy according to the data update rate
  Add 0.05% of rdg when it is 100 ms.
- Range of guaranteed accuracy by frequency, voltage, and current
  All accuracies between 0.5 Hz and 10 Hz are reference values.
  If the voltage exceeds 750 V at 30 kHz–100 kHz, the voltage and power values are reference values.
  If the current exceeds 20 A at DC, 10 Hz–45 Hz, or 400 Hz–100 kHz; the current and power accuracies are reference values.
- Accuracy for crest factor 6: Range accuracy of crest factor 3 for two times range of crest factor 6.
- Influence of self heating due to voltage input
  When the input signal is voltage, for AC add 0.0000001 × u²% of reading, and for DC add 0.0000001 × u²% of reading + 0.0000001 × u²% of range. u is the reading value of voltage. Please note that the influence of self heating is present until the resistance temparature drops, ever when the voltage input value is small.

| | Voltage/current | Power |
|---|---|---|
| Total power error with respect to the range for an arbitrary power factor λ (exclude λ = 1) | – | When λ = 0<br>Apparent power reading × 0.2% in the 45 to 66 Hz range<br>All other frequencies are as follows (however, these are only reference values):<br>Apparent power reading × (0.2 + 0.2 × f (kHz))%<br>0 < λ < 1<br>(Power reading) × [(Power reading Error (%)) + (power range error (%) × (Power range/Apparent power reading)+power reading × {tanØ × (influence when λ = 0%)] Ø is the phase difference of voltage and current |
| Influence of line filter | When cutoff frequency is 500 Hz<br>"45 to 66 Hz: Add 0.2% of reading<br>Under 45 Hz: Add 0.5% of reading"<br>When cutoff frequency is 5.5 kHz<br>"66 Hz or less: Add 0.2% of reading<br>66 to 500 Hz: Add 0.5% of reading" | When cutoff frequency is 500 Hz<br>"45 to 66 Hz: Add 0.3% of reading<br>Under 45 Hz: Add 1% of reading"<br>When cutoff frequency is 5.5 kHz<br>"66 Hz or less: Add 0.4% of reading<br>66 to 500 Hz: Add 1.2% of reading" |
| Lead/Lag Detection (d (LEAD) /G (LAG) of the phase angle and symbols for the reactive power QΣ calculation)<br>* The s symbol shows the lead/lag of each element, and "-" indicates leading. | The phase lead and lag are detected correctly when the voltage and current signals are both sine waves, the lead/lag is 50% of the range rating (or 100% for crest factor 6), the frequency is between 20 Hz and 2 kHz, and the phase angle is ±(5° to 175°) or more. | |
| Temperature coefficient | ± 0.03% of reading/°C at 5–18° or 28–40 °C. | |
| Effective input range | Udc and Idc are 0 to ±110% of the measurement range<br>Urms and Irms are 1 to 110%* of the measurement range (or 2%–220% for crest factor 6)<br>Umn and Imn are 10 to ±110% of the measurement range<br>Urmn and Irmn are 10 to ±110%* of the measurement range<br>Power is 0 to ±110%* for DC measurement, 1 to 110%* of the voltage and current range for AC measurement, and up to ±110%* of the power range. However, the synchronization source level falls below the input signal of frequency measurement.<br>110% of the voltage range rating. | |
| Max. display | 140% of the voltage and current range rating | |
| Min. display | Urms, Irms, Uac and Iac are up to 0.5% relative to the measurement range (or up to 1% for a crest factor of 6).<br>Umn, Urmn, Imn, and Irmn are up to 2% (or 4% for a crest factor of 6).<br>Below that, zero suppress. Current integration value q also depends on the current value. | |

| Measurement lower limit frequency | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Data update rate | 100 ms | 200 ms | 500 ms | 1 s | 2 s | 5 s |
| | Measurement lower limit frequency | 25 Hz | 12.5 Hz | 5 Hz | 2.5 Hz | 1.25 Hz | 0.5 Hz |

| | |
|---|---|
| Accuracy of apparent power S | Voltage accuracy + current accuracy |
| Accuracy of reactive power Q | Accuracy of apparent power + $(\sqrt{(1.0004 - \lambda^2)} - \sqrt{(1 - \lambda^2)})$ × 100% of range |
| Accuracy of power factor λ | ±[ (λ – λ/1.0002) + \|cosØ – cos {Ø + sin$^{-1}$ (influence of power factor of power when λ = 0%/100) } \| ] ±1digit when voltage and current is at rated input of the measurement range. Ø is the phase difference of voltage and current. |
| Accuracy of phase difference Ø | ±[ \|Ø – cos$^{-1}$ (λ/1.0002) \| + sin$^{-1}$ { (influence of power factor of power when λ=0%) /100 } ] deg ±1digit when voltage and current is at rated input of the measurement range |
| One-year accuracy | Add the accuracy of reading error (Six-month) × 0.5 to the accuracy six-month |

## Functions

**Measurement method** Digital multiplication method

**Crest factor** 3 or 6 (when inputting rated values of the measurement range), and 300 relative to the minimum valid input.

**Measurement period** Interval for determining the measurement function and performing calculations.
Period used to determine and compute the measurement function.
- The measurement period is set by the zero crossing of the reference signal (synchronization source) (excluding watt hour WP as well as ampere hour q during DC mode).
- For harmonic measurement (/G5 option), the measurement period is from the beginning of the data update interval to 1024 points at the harmonic sampling frequency.

**Wiring** You can select one of the following five wiring settings.
1P2W (single phase, two-wire), 1P3W (single phase, 3 wire), 3P3W (3 phase, 3 wire), 3P4W (3 phase, 4 wire), 3P3W(3V3A) (3 phase, 3 wire, 3 volt/3 amp measurement).
However, the number of available wiring settings varies depending on the number of installed input elements. Up to four, or only one, two, or three wiring settings may be available.

**Scaling** When inputting output from external current sensors, VT, or CT, set the current sensor conversion ratio, VT ratio, CT ratio, and power coefficient in the range from 0.0001 to 99999.9999.

**Input filter** Line filter or frequency filter settings can be entered.

**Averaging**
- The average calculations below are performed on the normal measurement parameters of voltage U, current I, power P, apparent power S, reactive power Q. Power factor λ and phase angle Ø are determined by calculating the average of P and S.
  Select exponential or moving averaging.
- Exponential average
  Select an attenuation constant of 2, 4, 8, 16, 32, or 64.
- Moving average
  Select the number of averages from 8, 16, 32, or 64.
- The average calculations below are performed on the harmonic display items of voltage U, current I, power P, apparent power S, reactive power Q. Power factor λ is determined by calculating the average of P and Q.

Only exponential averaging is performed. Select an attenuation constant of 2, 4, 8, 16, 32 or 64

**Data update rate** Select 100 ms, 200 ms, 500 ms, 1 s, 2 s, or 5 s.

**Response time** At maximum, two times the data update rate (only during numerical display)

**Hold** Holds the data display.

**Single** Executes a single measurement during measurement hold.

**Zero level compensation/Null** Compensates the zero level. the range: ±10% of range

## Integration

**Mode** Select a mode of Manual, Standard, Continuous (repeat), Real Time Control Standard, or Real Time Control Continuous (Repeat).

**Timer** Integration can be stopped automatically using the integration timer setting. 0000 h 00 m 00 s~10000 h 00 m 00 s

**Count over** If the count over integration time reaches the maximum integration time (10000 hours), or if the integration value reaches max/min display integration value (±999999 MWh or ±999999 Mah), the elapsed time and value is saved and the operation is stopped.

**Accuracy** Power: ±(power accuracy + 0.02% of WS)
Current: ±(current accuracy + 0.02 × elapsed time (h) % of range) (when select dc)
±(current accuracy + 0.02% of reading) (when selected others)
It does not sample for approximately 70µs at each data update. The period is compensated.

**Time accuracy** ±0.02% of reading

## Display

**• Numerical display function**

**Display resolution** 60000

**Number of display items** Select 4, 8, 16 matrix, all, single list, or dual list.

**• Waveform display items**

**No. of display rasters** 501

**Display format** Peak-peak compressed data

**Time axis** Range from 1 ms – 500 ms/div. However, it must be 1/10 th of the data update rate.

**Sample rate** Approximately 100 ks/s

**Triggers**

**Trigger Type** Edge type

**Trigger Mode** Select Auto or Normal. Triggers are turned OFF automatically during integration.

**Trigger Source** Select voltage, current, or external clock for the input to each input element.

**Trigger Slope** Select (Rising), (Falling), or (Rising/Falling).

**Trigger Level** When the trigger source is the voltage or current input to the input elements. Set in the range from the center of the screen to ±100% (top/bottom edge of the screen). Setting resolution: 0.1%
When the trigger source is Ext Clk, TTL level.

**Vertical axis Zoom** Voltage and current input to the waveform vertical axis zoom input element can be zoomed along the vertical axis.
Set in the range of 0.1 to 100 times.

**ON/OFF** ON/OFF can be set for each voltage and current input to the input element.

**Format** You can select 1, 2, 3 or 4 splits for the waveform display.

**Interpolation** Select dot or linear interpolation.

**Graticule** Select graticule or cross-grid display.

**Other display ON/OFF** Upper/lower limit (scale value), and waveform label ON/OFF.

**Cursor measurements** When you place the cursor on the waveform, the value of that point is measured.

**Zoom function** No time axis zoom function

* Since the sampling frequency is approximately 100 kHz, waveforms that can be accurately reproduced are those of about 5 kHz.

**• Vector Display/Bar Graph Display (/G5 option is required)**

**Vector display** Vector display of the phase difference in the fundamental waves of voltage and current.

**Bar graph display** Displays the size of each harmonic in a bar graph.

**• Trend display**

Number of measurement channels Up to 8 parameters
Displays trends (transitions) in numerical data of the measurement functions in a sequential line graph.
Two windows can be selected (from numerical display,

**• Simultaneous display** Not available

## Storage

**• Saving and Loading Data** Settings, waveform display data, numerical data, and screen image data can be saved to media*.
Saved settings can be loaded from a media*.
*USB memory

## Store function

Internal memory size Approximately 20 MB
Store interval (waveform OFF) Maximum 100 msec to 99 hour 59 minutes 59 seconds.
Guideline for Storage Time (Waveform Display OFF, Integration Function OFF)

| Number of measurement channels | Measured Items (Per CH) | Storage Interval | Storable Amnt. of Data |
|---|---|---|---|
| 1 ch | 3 | 100 ms | Approx. 40 hr |
| 1 ch | 10 | 1 sec | Approx. 120 hr |
| 3 ch | 10 | 100 ms | Approx. 4 hr |
| 3 ch | 20 | 1 sec | Approx. 20 hr |

Note: Depending on the user-defined math, integration, and other settings, the actual measurement time may be shorter than stated above.
Store interval to memory depends on number of stored data and kind og the media

## Added Frequency Measurement (/FQ Optional)

**Device under measurement** Select up to two frequencies of the voltage or current input to the input elements for measurement. If the frequency option (/

FQ) is installed, the frequencies of the voltages and currents being input to all input elements can be measured.

Measurement method: Reciprocal method

Measurement range:

| Data Update Rate | Measuring Range |
|---|---|
| 100 ms | 25 Hz≤f≤100 kHz |
| 200 ms | 12.5 Hz≤f≤100 kHz |
| 500 ms | 5 Hz≤f≤100 kHz |
| 1 s | 2.5 Hz≤f≤100 kHz |
| 2 s | 1.5 Hz≤f≤50 kHz |
| 5 s | 0.5 Hz≤f≤20 kHz |

Accuracy: ±0.06% of reading
When the input signal levels are greater than or equal to 25 mV (current external sensor input) and the signal is greater than or equal to 30% (0.1 Hz–440 Hz, frequency filter ON), of the measurement range.
However, when the measuring frequency is smaller or equal to 2 times of above lower frequency, the input signal is greater than or equal to 50%.
Add 0.05% of reading when current external input is smaller than or equal to 50 mV input signal level for each is double for crest factor 6.

Max. display resolution: 99999
Min. frequency resolution: 0.0001 Hz
Frequency Filter: Select ON/OFF

## Delta Calculation Function (/DT Optional)

| Item | Delta Calculation Setting | Symbols and Meanings |
|---|---|---|
| Voltage | difference | △U1: Differential voltage determined by computed u1 and u2 |
| | 3P3W→3V3A | △U1: Line voltage determined in the calculation for a 3 phase 3 wire connection |
| | DELTA→STAR | △U1, △U2, △U3: Phase voltage determined in the calculation for 3 phase 3 wire (3V3A) connection |
| | STAR→DELTA | △U1, △U2, △U3: Line voltage determined in the calculation for a 3 phase 4 wire connection |
| Current | difference | △ I1: Differential current determined by computation |
| | 3P3W→3V3A | Phase current that are not measured can be computed |
| | DELTA→STAR | Neutral line current |
| | STAR→DELTA | Neutral line current |

## RGB Video Signal (VGA) Output Section (/V1 Optional)

Connector type: 15-pin D-Sub (receptacle)
Output format: VGA compatible

## Harmonic Measurement Function (/G5 Optional)

| | |
|---|---|
| Measure source | All Installed Elements |
| Method | PLL synchronization |
| Frequency range | PLL source of the fundamental frequency is in the range 10 Hz–1.2 kHz. |
| PLL source | Select voltage, current, or external clock for each input element. |
| Data length for FFT | 32 bits |
| Window function | Rectangular |
| Anti-aliasing filter | Set using a line filter (5.5 kHz or OFF) |

Sample rate (sampling frequency), window width, and upper limit of analyzed orders for PLL synchronization.

• During Harmonic Display

| Fundamental Frequency | Sample Rate | Window Width | Upper Limit of Analyzed orders |
|---|---|---|---|
| 10 Hz to 75 Hz | f*1024 | 1 | 50 |
| 75 Hz to 150 Hz | f*512 | 2 | 32 |
| 150 Hz to 300 Hz | f*256 | 4 | 16 |
| 300 Hz to 600 Hz | f*128 | 8 | 8 |
| 600 Hz to 1200 Hz | f*64 | 16 | 4 |

Accuracy ±(reading error + measurement range error) (for crest factor 3)

• When Line Filter is ON (5.5 kHz)

| Sampling Frequency | Voltage Current | Power |
|---|---|---|
| 10 Hz≤f<45 Hz | 0.4% of reading + 0.35% of range | 0.85% of reading + 0.5% of range |
| 45 Hz≤f≤440 Hz | 0.75% of reading + 0.35% of range | 1.5% of reading + 0.5% of range |
| 440 Hz<f≤1 kHz | 1.2% of reading + 0.35% of range | 2.4% of reading + 0.5% of range |
| 1 kHz<f≤2.5 kHz | 5% of reading + 0.35% of range | 10% of reading +0.5% of range |

• When Line Filter is OFF

| Sampling Frequency | Voltage | Current | Power |
|---|---|---|---|
| 10 Hz≤f<45 Hz | 0.15% of reading + 0.35% of range | 0.15% of reading + 0.35% of range | 0.35% of reading + 0.5% of range |
| 45 Hz≤f≤440 Hz | 0.15% of reading + 0.35% of range | 0.15% of reading + 0.35% of range | 0.25% of reading + 0.5% of range |
| 440 Hz<f≤1 kHz | 0.2% of reading + 0.35% of range | 0.2% of reading + 0.35% of range | 0.4% of reading + 0.5% of range |
| 1 kHz<f≤2.5 kHz | 0.8% of reading + 0.35% of range | 0.9% of reading + 0.35% of range | 1.7% of reading + 0.5% of range |
| 2.5 kHz<f≤5 kHz | 3% of reading + 0.35% of range | 3% of reading + 0.35% of range | 6% of reading + 0.5% of range |

However, all the items below apply to all tables.
• When the crest factor is set to 3
• When λ (power factor) = 1
• Power figures that exceed 440 Hz are reference values.
• For nth order component input, add {n/(m+1)}/50% of (the nth order reading) to the n + mth order and n-mth order of the voltage and current.
For the n+mth order and n-mth order of power, add {n/(m+1)/25} of the nth order reading.
• Add (n/500)% of reading to the nth component of the voltage and current, and add (n/250)% of reading to the nth component of the power.
• Accuracy when the crest factor is 6: The same as when the range is doubled for crest factor 3.
• The accuracy guaranteed range by frequency and voltage/current is the same as the guaranteed range of normal measurement. If the amplitude of the high frequency component is large, influence of approximately 1% may appear in certain orders. The influence depends on the size of the frequency component. Therefore, if the frequency component is small with respect to the range rating, this does not cause a problem.

## Ethernet Communications (/C7 Optional)

Number of communication ports: 1
Connector type: RJ-45 connector
Electrical and mechanical specifications: Conforms to IEEE 802.3.
Transmission system: Ethernet 100BASE–TX
Transmission rate: Max.100 Mbps
Protocol: TCP/IP
Supported Services: FTP server, DHCP, DNS, Remote control (VXI-11)

## USB port (PC)

Connector: Type B connector (receptacle)
Electrical and Mechanical Specifications: Conforms to USB Rev.1.1
Speed: Max.12 Mbps
Number of Ports: 1
Supported service: Remote control (USB-TMC)
Supported Systems: Models with standard USB ports that run Windows 2000, Windows XP, or Windows Vista with USB port as a standard.
Power Supply: Self Power

## USB port (Peripheral)

Connector: Type A connector (receptacle)
Electrical and Mechanical Specifications: Conforms to USB Rev.2.0
Speed: Max. 480 Mbps
Number of Ports: 2
Supported keyboards: 104 keyboard (US) and 109 keyboard (Japanese) conforming to USB HID Class Ver.1.1devices
Supported USB memory devices: USB (USB Mass Storage Class) flash memory
Power supply: 5 V, 500 mA (per port)
However, device whose maximum current consumption exceeds 100 mA cannot be connected simultaneously to the two ports.

## Master/Slave Synchronization Signal Input/External Clock Input (Select)

**Master/Slave Synchronization Signals**
Connector type: BNC connector: Both slave and master

**External Clock Input**
Connector type: BNC connector
Input level: TTL
Inputting the synchronization source as the Ext Clk of normal measurement.
Frequency range: Same as the measurement range for frequency
Input waveform: 50% duty ratio square wave
Inputting the PLL source as the Ext Clk of harmonic measurement. (/G5 option is required)
Frequency range: 10 Hz to 1.2 kHz
Input waveform: 50% duty ratio square wave

**For Triggers**
Minimum pulse width: 1 µs
Trigger delay time: Within (1 µs + 1 sample rate)

## GP-IB Interface (/C1 optional)

**Card driver**: Use one of the following by NATIONAL INSTRUMENTS:
• AT-GPIB
• PCI-GPIB, PCI-GPIB+, and PCIe-GPIB
• PCMCIA-GPIB and PCMCIA-GPIB+
Use driver NI-488.2M version 1.60 or later.
Conforms electrically and mechanically: IEEE St'd 488-1978 (JIS C 1901-1987).
Functional specification: SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, and C0.
Conforms to protocol: IEEE St'd 488.2-1992.
Encoding: ISO (ASCII)
Mode: Addressable mode
Address: 0–30
Clear remote mode: Remote mode can be cleared using the LOCAL key (except during Local Lockout).

## General Specifications

Warm-up time: Approximately thirty minutes.
Operating temperature: 5–40°C
Operating humidity: 20–80% (when printer not used)
(No condensation may be present)
Operating altitude: 2000 m or less
Operating area: Inside of room
Storage environment: -25–60°C (no condensation may be present)
Storage humidity: 20 to 80% RH (no condensation)
Rated supply voltage: 100–240 VAC
Allowed supply voltage fluctuation range: 90–264 VAC
Rated supply frequency: 50/60 Hz
Allowed supply frequency fluctuation: 48 to 63 Hz
Maximum power consumption: 80 VA (when using built-in printer)
Weight: Approximately 6.5 kg (including main unit, 3 input elements, and options)

# Model and Suffix Codes

## Power Analyzer WT500

| Model | Suffix Codes | Description |
|---|---|---|
| 760201 | | WT500 1 input element model |
| 760202 | | WT500 2 input elements model |
| 760203 | | WT500 3 input elements model |
| Power cord | -D | UL/CSA standard |
| | -F | VDE standard |
| | -R | SAA standard |
| | -Q | BS standard |
| | -H | GB standard |
| Options | /C1 | GP-IB interface |
| | /C7 | Ethernet interface |
| | /EX1 | External sensor input for 760201 |
| | /EX2 | External sensor input for 760202 |
| | /EX3 | External sensor input for 760203 |
| | /G5 | Harmonic Measurement |
| | /DT | Delta computation (760202/03 only) |
| | /FQ | Add-on Frequency Measurement (760202/03 only) |
| | /V1 | VGA Output |

Note: Adding input modules after initial product delivery will require rework at the factory. Please choose your models and configurations carefully, and inquire with your sales representative if you have any questions.

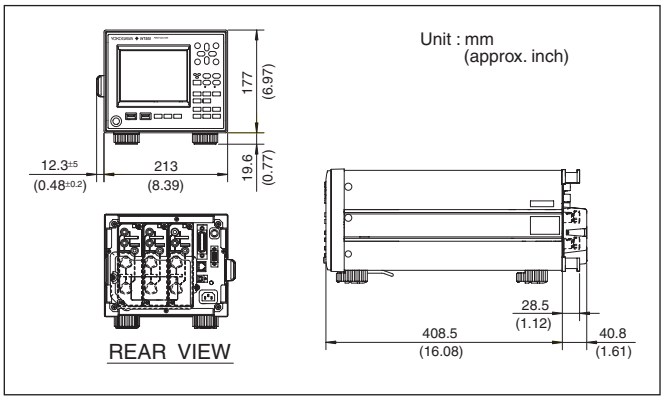
### Standard accessories

Power cord, Rubber feet, current input protective cover, User's manual, Communication interface user's manual (CD-ROM), Safety terminal adapter 758931(provided two adapters in a set times input element number)

* Cable B9284LK (light blue) for external current sensor input is sold separately. Safety terminal adapter 758931 is included with the WT500. Other cables and adapters must be purchased by the user.

**Safety terminal adapter 758931**

# Exterior




## Rack Mount

| Model | Product | Description |
|---|---|---|
| 751533-E4 | Rack mounting kit | For EIA Single mount |
| 751533-J4 | Rack mounting kit | For JIS Single mount |
| 751534-E4 | Rack mounting kit | For EIA Double mount |
| 751534-J4 | Rack mounting kit | For JIS Double mount |

## Accessory (sold separately)

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

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

## Application Software

| Model | Product | Description | Order Q'ty |
|---|---|---|---|
| 760122 | WTViewer | Data acquisition software | 1 |

## Instrument Carts

| Model | Suffix and codes | Description | Description |
|---|---|---|---|
| 701960 | | Compact cart | 500*560*705 mm (W, D, H) |
| | /A | | Key board and mouse table |
| 701961 | | Deluxe cart | 570*580*839 mm (W, D, H) |
| | /A | | Key board and mouse table |
| 701962 | | General-purpose cart | 467*693*713 mm (W, H, D) |

## Current Sensor Unit

| Model | Suffix code | Description | |
|---|---|---|---|
| 751521 | | Single-phase | DC to 100 kHz (-3 dB). -600 A to 0 A to +600 A (DC) Basic accuracy: (0.05% of rdg* + 40 mA) Superior noise withstanding ability and CMRR characteristic due to optimized casing design |
| 751523 | -10 | Three-phase U, V | |
| | -20 | Three-phase U, W | |
| | -30 | Three-phase U, V, W | |
| Supply voltage | -1 | 100 V AC (50/60 Hz) | |
| | -3 | 115 V AC (50/60 Hz) | |
| | -7 | 230 V AC (50/60 Hz) | |
| Power cord | -D | UL/CSA standard | |
| | -F | VDE standard | |
| | -R | SAA standard | |
| | -J | BS standard | |
| | -H | GB standard | |

* 751523-10 is designed for WT500, WT3000, PZ4000 and WT1600. 751523-20 is designed for the WT2000, and WT200 Series.
* 751521/751523 do not conform to CE Marking.

## Clamp on Probe / Current transducer

| Model | Product | Description |
|---|---|---|
| 751552 | Clamp-on probe | 30 Hz to 5 kHz, 1400 Apk (1000 Arms) |
| 751574 | Current transducer | DC to 100 kHz (-3 dB), 600 Apk |

* For detailed information, see Power Meter Accessory Catalog Bulletin 7515-52E

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