

7601 Digital Power Meter WT1600

NEW



WT1600
426 × 177 × 440mm 15.0 kg
(16.77 × 6.97 × 15.75" 33.07 lbs)



★ Safety Standards; EN61010-1 CAT II Pollution degree 2
EMC Standards; EN61326, EN61000-3-2, EN61000-3-3
AU/NZ S2064 Class A
Immunity Standards; EN61326 Annex A

The WT1600 is a power meter designed for measurement of extremely small currents in energy-saving equipment, as well as measurement of large currents for evaluating large-sized loads. The WT1600 works with voltages ranging from 1.5 V up to 1000 V, supporting a wide range of applications. Because it can accept signal inputs for up to six phases, a single WT1600 unit can measure I/O signals on inverters.

FEATURES

- **High Precision and Wide Bandwidth**
Fundamental accuracy: $\pm(0.1\% \text{ of rdg} + 0.05\% \text{ of rng})$
Frequency range: DC, 0.5 Hz to 1 MHz
- **Up to Six-Phase Input on One Unit.**
Synchronized Measurements Between Two Units
A single WT1600 unit can make up to six different power measurements (six inputs each for voltage and current). With the measure start-stop function (synchronized measurement), two WT1600 units (12 inputs) can be synchronized.
- **Wide Current Input Ranges**
The WT1600 has two different input elements. A 5 A input element is provided for measuring extremely small currents, while a 50 A input element serves to measure large currents. Both of the elements can be installed together in the WT1600.
The current for the 5 A input element can be set as low as 10 mA for measuring extremely small currents in energy-saving equipment.
 - Two input elements
 - 5 A input element
10/20/50/100/200/500 mA, 1/2/5 A (DC, 0.5 Hz to 1 MHz)
 - 50 A input element
1/2/5/10/20/50 A (DC, 0.5 Hz to 100 kHz)
Current sensor input range (same for 5 A and 50 A input elements; standard)
50/100/250/500 mV, 1/2.5/5/10 V (DC, 0.5 Hz to 500 kHz)
- **Wide Voltage Range**
1.5/3/6/10/15/30/60/100/150/300/600/1000 V

FUNCTIONS

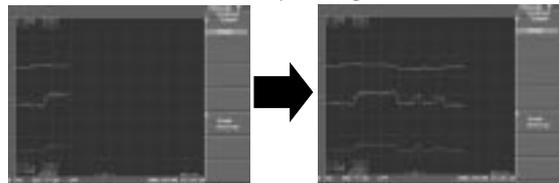
- **Data Storing as Fast as 50 ms (20 Times per Second)**
The data can be stored at intervals as short as 50ms. The WT1600 rapidly calculates input parameters such as voltage rms, current

rms, and power. Measurements can be stored in a 12-MB interval memory, which is helpful for applications such as:

- Evaluation of characteristics at motor startup including torque and rpms (requires the optional motor evaluation function)
- Measurement of rapidly fluctuating secondary voltage and lamp current when a light is turned on

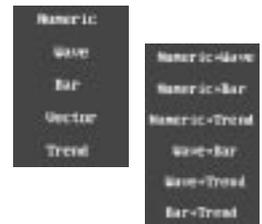
■ Trend Display

The WT1600 displays measurements for each display updating interval in a time series. The time axis (T/div) can be set in the range of 3 seconds to 24 hours (1 day). Changes in up to 16 different parameters, such as voltage, current, active power, and apparent power, can be observed simultaneously in long-term continuous tests.



■ A Variety of Display Formats

In addition to numerical data, the WT1600 can display input signal waveforms. Eleven different display formats can be selected on a single WT1600 unit, so it is not necessary to connect an external waveform viewer to check waveforms.



■ Display Harmonic Data as Bar Graphs, Vectors, and Lists

The harmonic measurement function is a standard feature on the WT1600. It is capable of measuring waveforms with a fundamental frequency ranging from 10 Hz to 1 kHz. Analysis results up to the 100th order from 50/60 Hz fundamental waves can be displayed as numerical values or bar graphs. The WT1600 can display harmonic measurement results as lists, and fundamental waves as vectors.



■ OPTIONAL FUNCTIONS

- **Ethernet Port (10BASE-T) and Internal Hard Drive**
The Ethernet port can be used to exchange files saved to the WT1600's internal hard disk with a PC.
- **D/A Output (30 channels)**
Analog outputs are available for up to 30 measurement parameters. With the 6-element WT1600, as many as five analog outputs are available for each element.
- **Motor Evaluation**
The WT1600 can measure the output from a speed and torque sensor on the output of an electric motor, and calculate torque, rotating speed, mechanical power, synchronous speed, slip, motor efficiency, and total efficiency. Both analog and pulse inputs can be accepted from the sensor. In addition to numerical values, waveforms can be displayed to provide a visual picture of fluctuations in parameter values.
- **Built-In Printer**
- **SCSI Interface**

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WT1600

SPECIFICATIONS

Input

Parameter	Voltage	Current (5A input element)	Current (50A input element)
Input type	Floating input Resistive potential division method	Shunt input method	
Rated value (range-value)	1.5/3/6/10/15/30/60/100/150/300/600/1000V	Direct input: 10m/20m/50m/100m/200m/500m/1/2/5A External input: 50m/100m/250m/500m/1/2.5/5/10V	Direct input: 1/2/5/10/20/50A External input: 50m/100m/250m/500m/1/2.5/5/10V
Instrument loss (input resistance)	Approximately 2MΩ	Direct input: Approximately 100mΩ + Approximately 0.07μH External input: Approximately 100kΩ	Direct input: Approximately 2mΩ + Approximately 0.07μH External input: Approximately 100kΩ
Instantaneous maximum allowed input (1 cycle, for 20 ms)	Peak voltage of 4 kV or rms of 1.5 kV (whichever is lower)	Peak current of 30 A or rms of 15 A (whichever is lower) External input: Peak not to exceed 10 times range-value	Peak current of 450 A or rms of 300 A (whichever is lower) External input: Peak not to exceed 10 times range-value
Continuous maximum allowed input	Peak voltage of 1.5 kV or rms of 1 kV (whichever is lower)	Peak current of 10 A or rms of 7 A (whichever is lower) External input: Peak not to exceed 5 times range-value	Peak current of 150 A or rms of 50 A (whichever is lower) External input: Peak not to exceed 5 times range-value
Continuous maximum in-phase voltage (50/60 Hz)	600 Vrms CATII		
Common mode rejection ratio (600 Vrms)	(with voltage input terminals shorted and current input terminals open) 50/60 Hz: $\pm 0.01\%$ of rng or less ($\pm(0.01 \times 15/(\text{rated value of rng}))\%$ of rng or less for 10-V rng or less). Under other conditions: Reference value $\pm(0.1 \times f\%$ of rng) or less, ($\pm(0.01 \times f \times 15/(\text{rated value of rng}))\%$ of rng or less for 10-V rng or less), but no less than 0.01%; frequency unit: kHz		
Input terminal type	Plug-in terminal (safety terminal)	Direct input: Large binding post External input: BNC	
A/D converter	Voltage/current input simultaneous conversion, 16-bit resolution, conversion speed of approximately 5 μsec		
Switching range-value	Range-value can be set independently for each element, through manual setting, automatic setting, or online setting		
Auto-range function	Increasing range-value: Range-value is increased when rms exceeds 110% of rated value or peak value exceeds approximately 330% of rated value. Decreasing range-value: Range-value is decreased when peak is 300% or less of lower range-value while rms is 30% or less of rated value.		

Measurement Functions

Method	Digital multiplication method		
Crest factor	3 for rated input (2 for voltage 1000 V range)		
Temperature: 23 ± 3°C	Frequency	Voltage/Current	Power
Humidity: 30 to 75%RH	DC	0.1% of rdg + 0.2% of rng	0.1% of rdg + 0.2% of rng
Input waveform: Sinewave	0.5 Hz ≤ f < 10 Hz	0.1% of rdg + 0.2% of rng	0.2% of rdg + 0.3% of rng
In-phase voltage: 0 V	10 Hz ≤ f < 45 Hz	0.1% of rdg + 0.1% of rng	0.1% of rdg + 0.2% of rng
Line filter: OFF	45 Hz ≤ f ≤ 66 Hz	0.1% of rdg + 0.05% of rng	0.1% of rdg + 0.05% of rng
Power factor: cosφ = 1	66 Hz < f ≤ 1 kHz	0.1% of rdg + 0.1% of rng (Voltage 5A input element current direct input and external input) 0.2% of rdg + 0.1% of rng (50A input element current direct input)	0.2% of rdg + 0.1% of rng
Specified following zero level correction or range-value change after warmup period ends. 3-month accuracy Unit for f in accuracy calculation equation: kHz	1 kHz < f ≤ 50 kHz	0.3% of rdg + 0.1% of rng (Voltage, 5A input element current direct input) (0.015 × f + 0.3)% of rdg + 0.1% of rng (External input) (0.1 × f + 2)% of rdg + 0.1% of rng (50A input element current direct input)	0.3% of rdg + 0.2% of rng (Voltage, 5A input element current direct input) (0.02 × f + 0.3)% of rdg + 0.2% of rng (External input) (0.1 × f + 0.2)% of rdg + 0.2% of rng (50A input element current direct input)
	50 kHz < f ≤ 100 kHz	0.6% of rdg + 0.2% of rng (Voltage, 5A input element current direct input) (0.009 × f + 0.6)% of rdg + 0.2% of rng (External input) (0.1 × f + 2)% of rdg + 0.2% of rng (50A input element current direct input)	0.7% of rdg + 0.3% of rng (5A input element current direct input) (0.009 × f + 0.9)% of rdg + 0.3% of rng (External input) (0.3 × f - 9.5)% of rdg + 0.3% of rng (50A input element current direct input)
	100 kHz < f ≤ 500 kHz	0.006 × f% of rdg + 0.5% of rng (Voltage, 5A input element current direct input and external input) (0.03 × f - 1.5)% of rdg + 0.5% of rng (External input)	0.008 × f% of rdg + 1% of rng (5A input element current direct input and external input) (0.06 × f - 4)% of rdg + 1% of rng (External input)
	500 kHz < f ≤ 1 MHz	(0.022 × f - 8) of rng + 1% of rng (Voltage, 5A input element current direct input and external input)	(0.048 × f - 20) of rdg + 2% of rng (5A input element current direct input and external input)
	Power factor effect: Voltage and current phase angle	When cos φ = 0, 45 Hz to 66 Hz: 0.15% of apparent power reading is added to the above power accuracy. For other frequencies: Reference value For 5 A input element current direct input, add (0.15 + 0.05 × f)% of apparent power reading to the above accuracy. For 50 A input element current direct input, add (0.15 + 0.3 × f)% of apparent power reading to the above accuracy. For external input, add (0.15 + 0.1 × f)% of apparent power reading to the above accuracy. When 0 < cos φ < 1, add (tan φ × (influence of power factor = 0)) of power reading.	
Effective input range	Voltage, current: Rms and AC: 1% to 110% of rated range-value, DC: 0% to ±110% of rated range-value, Mean: 10% to 110% of rated range-value Power: DC measurement: 0% to ±110% of rated range-value, AC measurement: Up to ±110% of power range-value, with voltage and current within 1% to 110% of rated range-value (Sync source signal level must be at least 10% of rated range-value) Effective input is in the range up to 1000V at Voltage, 5A at 5A input element, 50A at 50A input element and 10V at External input.		
One-year accuracy	1.5 times tolerance for 3-month accuracy reading		
Line filter function	Measurement can be made with a line filter inserted in the input circuit. Cutoff frequency (fc): 500 Hz or 5.5 kHz		
Line filter on accuracy	Cutoff frequency of 500 Hz: Voltage, current: Add 0.2% of rdg in range of 45 to 66 Hz. Under 45 Hz, add 0.5% of rdg. Power: Add 0.3% of rdg in range of 45 to 66 Hz. Under 45 Hz, add 1% of rdg. Cutoff frequency of 5.5 kHz: Voltage, current: Add 0.2% of rdg under 66 Hz. At 66 Hz to 500 Hz, add 0.5% of rdg. Power: Add 0.3% of rdg under 66 Hz. At 66 Hz to 500 Hz, add 1% of rdg.		
Turn coefficient	±0.03% of rdg/°C at 5 to 20°C and 26 to 40°C		
Leading/lagging phase sensing	Leading/lagging phase is detected when it is ±5° (20 Hz to 10 kHz) with both voltage and current inputs as sinewaves equal to or greater than phase difference is 50% of rated range-value.		
Measurement lower limit frequency	Data update rate	50 msec	100 msec
	Measurement lower limit frequency	45 Hz	25 Hz
		200 msec	15 Hz
		500 msec	5 Hz
		1 sec	2.5 Hz
		2 sec	1.5 Hz
		5 sec	0.5 Hz

Current and power DC accuracy (5 A input element) -----Add 20 μA to current and 20 μA × (voltage reading to power)
 Current and power DC accuracy (50 A input element) -----Add 1 mA to current and 1 mA × (voltage reading to power)
 External input -----Add (0.05/scaling value) A to current and (0.05/scaling value) × (voltage reading to power)
 Zero level correction or as a zero level correction in current and power DC accuracy relating to temperature changes following range-value changes, add 10 μA per degree Celsius to current and add (10 μA × voltage reading) per degree Celsius to power for the 5 A input element. For the 50 A input element, add 1 mA per degree Celsius to current and add (1 mA × voltage reading) per degree Celsius to power. For external input, add (0.05/scaling value) A/°C to current and add ((0.05/scaling value) A × (voltage reading to power))/°C.
 Voltage rms, mean, AC ----- Add 5 mV.
 Current rms, mean, AC -----Accuracy figures are specified with line filter turned ON for 2 mA or less on a 5 A input element, for 200 mA or less on a 50 A input element, for 10/(scaling value) A or less on an external input.
 Add (0.006 × f²)% at 5 A input element.
 Add (0.0006 × f²)% at 50 A input element.
 Add 0.1% of range if the display updating period is 50 msec.
 All accuracy of 0.5 Hz to 10 Hz: Reference values
 Voltage ----- Reference values in cases where (f(Hz) × voltage(V) > 2.2 × 10⁷ at 100 kHz or higher.
 Current ----- Reference values for 20 AAC or higher (except for range of 50 Hz to 400 Hz) or higher
 For currents less than 5 mA with frequencies above 1 kHz, the current accuracy and the power accuracy figures are the reference values. Add 20% of rng to the accuracy above for the accuracy of the waveform display data, voltage peak (Upk), and current peak (Ipk) in the range up to 1 MHz. (Reference Value)
 rdg: reading, rng: range (range-value)

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Calculation Functions

		Single-phase, three-wire	Three-phase, three-wire (2 voltage, 2 current)	Three-phase, three-wire (3 voltage, 3 current)	Three-phase, four-wire
Voltage ΣU		$(U1+U2)/2$		$(U1+U2+U3)/3$	
Current ΣI		$(I1+I2)/2$		$(I1+I2+I3)/3$	
Active power ΣP		$P1+P2$		$P1+P2+P3$	
Reactive power Q, ΣQ	Normal measurement	$Q1=\sqrt{(S^2-P^2)}$		$Q1+Q2$	
	Harmonic measurement	$Q1$		$Q1+Q2+Q3$	
Apparent power S, ΣS	Normal measurement	$S1=U1 \times I1$	$\frac{\sqrt{3}}{2}(S1+S2)$	$\frac{\sqrt{3}}{3}(S1+S2+S3)$	$(S1+S2+S3)$
	Harmonic measurement	$S1=\sqrt{(P1^2+Q1^2)}$	$\sqrt{(\Sigma P^2+\Sigma Q^2)}$		
Power factor $\lambda, \Sigma \lambda$	Power factor $\lambda, \Sigma \lambda$	$\lambda1=P1/S1$	$\Sigma P/\Sigma S$		
Phase angle $\phi, \Sigma \phi$	Phase angle $\phi, \Sigma \phi$	$\phi1=\cos^{-1}(P1/S1)$	$\phi1=\cos^{-1}(\Sigma P/\Sigma S)$		
Calculation precision (of calculated values relative to measured values)	Apparent power (S) and reactive power (Q): $\pm 0.001\%$ of power range-value	Power factor (λ): $\pm 0.001\%$ Phase angle (ϕ): $\pm 0.005^\circ$ relative to calculation from power factor			

Note 1: Apparent power (S), reactive power (Q), power factor (λ), and phase angle (ϕ) for this equipment are calculated from active power. (However, reactive power during harmonic measurement is the sum of every order.) Therefore, in the case of distorted-wave input, these values may be different from those of other instruments based on different measurement principles.

Note 2: If the phase angle display is 0 to 360, there is no accuracy specification for 0 and 180 $\pm 5^\circ$.

Other parameters (during normal measurement)

Upk, Ipk (peak value), CF (crest factor), FF (form factor), |Z| (impedance), Rs and Rp (resistance), Xs and Xp (reactance), η and $1/\eta$ (efficiency), Pc (Corrected Power), F1 to F4 (user-defined functions), delta calculations (three-phase three-wire, 3V3A conversion, Y-A conversion, A-Y conversion)

Wiring settings: Settings can be divided into three groups (ΣA , ΣB , and ΣC).

Each group is selected from the following: 1P2W (single-phase two-wire, one element used), 1P3W (single-phase three-wire, two elements used), 3P3W (three-phase three-wire, two elements used), 3V3A (three-phase three-wire, three elements used), 3P4W (three-phase four-wire, three elements used).

Display Functions

Display	6.4-inch color TFT LCD
Pixels in full screen:	640 x 480 (The LCD unit may contain defects of approximately 0.02% in the pixels of the full screen)
Display type	
Numerical values:	Normal measurement: 4/8/16/42/78/ALL
Harmonic measurement:	4/8/16/Single List/Dual List
Waveforms:	Single/Dual/Triad/Quad
Vector:	Phase diagram for first-order components in harmonic measurement
Bar:	Bar graph up to upper limit of analyzed orders in harmonic measurement
Trend display:	Trend display of measured/calculated values
Data updating rate:	Selected from 50msec/100msec/200msec/500msec/1sec/2sec/5sec. (However, the data update rate indicated above is approximately 500msec when the waveform data acquisition is ON.) The display update cycle is maximum 100msec when the waveform data acquisition is OFF and only in the Numeric display(16 or less value). It is 200msec or more at the other data update rates.
Response type:	Up to data updating rate x 2 (with waveform acquisition off)
Display scaling function:	PT ratio, CT ratio, and power scaling factor can be scaled.
Averaging functions	Normal measurement
Methods:	Exponential average or simple moving average
Exponential average:	Attenuation constant of 2, 4, 8, 16, 32, or 64
Moving average:	Number of averages (N) set to 8, 16, 32, 64, 128, or 256 Harmonic measurement When using an exponential average, the attenuation constant is 5.625 if the frequency of the PLL synchronization source is 55 Hz or greater but less than 75 Hz; otherwise, the attenuation constant is 4.6875. (When data length = 8192)
Display resolution	U,I,P: During rated range-value input, the decimal place and the counting unit are set so that the display does not exceed a count value of 60,000. $\Sigma U, \Sigma I, \Sigma P$: The decimal place and the counting unit are the same as for the maximum range-value of the calculated element.

Frequency Measurement Functions

Measurement input	Three of the following: U1,I1, U2,I2, U3,I3, U4,I4, U5,I5, U6,I6
Measurement method:	Reciprocal method
Frequency range	Data updating rate 50 msec 100 msec 200 msec 500 msec 1 sec 2 sec 5 sec Frequency range 45 Hz $\leq f \leq 1$ MHz 25 Hz $\leq f \leq 1$ MHz 15 Hz $\leq f \leq 500$ kHz 5 Hz $\leq f \leq 200$ kHz 2.5 Hz $\leq f \leq 100$ kHz 1.5 Hz $\leq f \leq 50$ kHz 0.5 Hz $\leq f \leq 20$ kHz Note: Within accuracy-assured range $\pm(0.05\%$ of rdg + 1 digit) for the measurement function parameters. Input signal level is greater than or equal to 0.6 V (voltage input), 25 mV (external input), 5 mA (5-A input element), or 150 mA (50-A input element) and the signal is greater than or equal to 30% (from 0.5 Hz to less than 440

Hz, with zero crossing filter ON), 10% (from 440 Hz to 500 kHz), or 30% (from more than 500 kHz to 1 MHz) of the measurement range.

Integrating Functions

The integrating functions do not work during waveform acquisition or in harmonic analysis mode ON.

Measured parameters: Power (Wp), positive-only power (+Wp), negative-only power (-Wp), current (q), positive-only current (+q), negative-only current (-q) (For current integration, select only one of the following for each element: rms, mean, DC, AC.)

Mode: Standard integration mode (timer mode)
Continuous integration mode (repeat mode)
Manual integration mode

Element-by-element integration: Integration can be started/stopped element by element using GP-IB or serial (RS-232) communications.

Timer: Integration can be stopped automatically according to a timer setting.

Setting range: 0000h00min00sec to 10000h00min00sec
If the integration value exceeds ± 999999 MWh(MAH), the elapsed time is saved and the operation is stopped.

Accuracy: \pm (unit accuracy + 0.05% of rdg)
Timer accuracy: $\pm 0.02\%$

Harmonic Measurement Functions

Measurements: Select one of the following: $\Sigma A, \Sigma B, \Sigma C$
Method: PLL synchronization or external sampling clock
Measurement frequency range: PLL synchronization: Synchronization source fundamental frequency of 10 Hz to 1 kHz
External sampling clock: Fundamental wave of 0.5 Hz to 100 Hz (Input 2048 times the fundamental frequency. The waveform is a square wave with a duty cycle of 50% at the TTL level.)

Analyzed parameters: For each order: U, I, P, S, Q, $\lambda, \phi(U-I), \phi U, \phi I$ (phase difference of harmonic component relative to fundamental wave), |Z|, Rs, Rp, Xs, Xp
Total: U, I, P, S, Q, λ, ϕ
 Σ calculation of fundamental wave and total: U, I, P, S, Q, and λ .

For each order: Harmonic content of U, I, and P
THD of U, I, and P
UTHF (voltage telephone harmonic factor), ITHF (current telephone harmonic factor), UTIF (voltage telephone influence factor), ITIF (current telephone influence factor), HVF (harmonic voltage factor), HIF (harmonic current factor)

FFT data length: 8192, 4096, or 2048
FFT processed word length: 32 bits
Window function: Rectangular
Anti-aliasing filter: Set by line filter ($f_c = 5.5$ kHz)
PLL synchronization

Fundamental frequency (Hz)	Sampling frequency	Window width relative to FFT data length (number of fundamental wave cycles)			Maximum analyzed orders
		8192	4096	2048	
$10 \leq f < 20$	$f \times 2048$	4	2	1	100
$20 \leq f < 40$	$f \times 1024$	8	4	2	100
$40 \leq f < 75$	$f \times 512$	16	8	4	100
$75 \leq f < 150$	$f \times 256$	32	16	8	100
$150 \leq f < 440$	$f \times 128$	64	32	16	50
$440 \leq f \leq 1000$	$f \times 64$	128	64	32	25

External sampling clock

Fundamental frequency (Hz)	Sampling frequency	Window width relative to FFT data length (number of fundamental wave cycles)			Maximum analyzed orders
		8192	4096	2048	
$0.5 \leq f \leq 100$	$f \times 2048$	4	2	1	100

Accuracy (Line filter 5.5 kHz ON)

	Voltage/Current	Power
$0.5 \text{ Hz} \leq f < 10 \text{ Hz}$	0.4% of rdg + 0.2% of rng	0.7% of rdg + 0.3% of rng
$10 \text{ Hz} \leq f < 45 \text{ Hz}$	0.4% of rdg + 0.1% of rng	0.6% of rdg + 0.2% of rng
$45 \text{ Hz} \leq f \leq 66 \text{ Hz}$	0.3% of rdg + 0.05% of rng	0.4% of rdg + 0.05% of rng
$66 \text{ Hz} < f \leq 1 \text{ kHz}$	1% of rdg + 0.1% of rng	1.5% of rdg + 0.1% of rng
$1 \text{ kHz} < f \leq 2.5 \text{ kHz}$	2% of rdg + 0.1% of rng	-----

Line filter OFF: During nth-order component input, add $\{(n/(n+1))/50\}$ % of the nth-order reading to (n-m)th order and (n+m)th order. For normal measurement accuracy, during nth-order component input, add $\{(n/(n+1))/50\}$ % of the nth-order reading to (n-m)th order and (n+m)th order. Add (n/500)% of the nth-order reading to the nth-order component.

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Motor Evaluation Functions (optional)

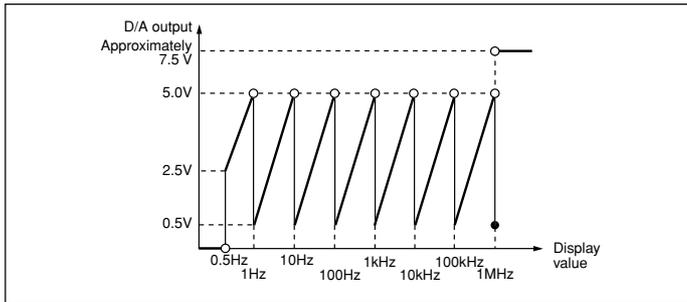
The motor evaluation functions do not work in harmonic measurement mode.
 Calculated parameters Torque, rpms, mechanical power, synchronization speed, slip, motor efficiency, total efficiency

Measured parameters

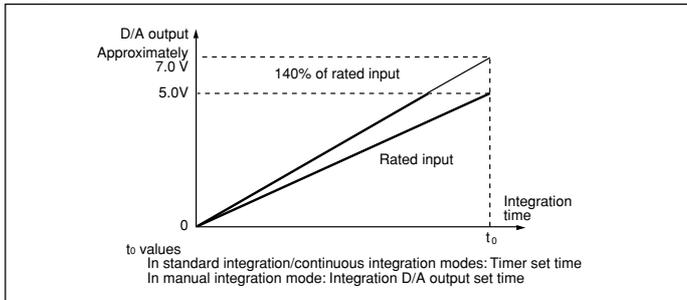
Analog input for calculating torque and rpms	
Input resistance	Approximately 1M Ω
Accuracy	$\pm(0.1\%$ of rdg + 0.2% of rng)
Input range-values	1/2/5/10/20 V
Effective input range	Up to $\pm 110\%$ of range-value
Temperature coefficient	$\pm 0.03\%$ of rng/ $^{\circ}\text{C}$
Pulse input for rpm calculation	
Input resistance	Approximately 1M Ω
Accuracy	$\pm 0.05\%$ of rdg + 1 mHz + 1 digit
Input range	± 5 Vpk
Effective amplitude	1 Vp-p or higher
Input waveform	50% duty ratio rectangular wave
Frequency measurement range	2 Hz to 200 kHz

D/A Output (optional)

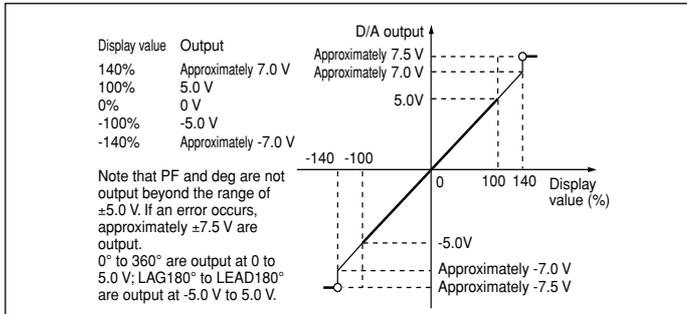
Number of outputs	30 parameters (each channel can be set separately)
Accuracy	\pm (display accuracy +0.2% of F.S.)
Maximum output current	± 0.1 mA
Temperature coefficient	$\pm 0.05\%$ of F.S./ $^{\circ}\text{C}$
Output format	
Frequency	



Integrated values



Other parameters



Waveform Display Functions

Triggers	
Mode	Auto/manual
Type	Edge
Source	U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, external
Slope	Rising/falling/both
Trigger position	0% (fixed)
Sampling frequency	Approximately 200 kHz
Time/Div	0.5 msec to 500 msec (not to exceed 1/10 of display updating period)
No time axis zoom function	
The frequency that allows displaying of waveforms is up to approximately 10 kHz. (Sampling rate is approximately 200 kHz.)	

Internal Printer (optional)

Printing method	Thermal line-dot
Dot density	8 dots/mm
Paper width	80 mm
Effective recording width	72 mm
Recorded information	Screenshots, list of measured values, harmonic bar graph printouts, settings

Ethernet (optional)

Transmission method	Ethernet (10BASE-T)
Supported services	FTP server, FTP client, LPR (network printing), SMTP (automatic mail transfer), DHCP, DNS
Electrical and mechanical specifications	
	As per IEEE802.3
Connector	RJ-45 connector

Internal Hard Drive (optional)

Capacity	10 GB (2 GB \times 5)
SCSI ID	4 (fixed)

External I/O

EXT CLK	(Sync source during normal measurement, PLL source or external sampling clock during harmonic analysis)
Connector	BNC
Input voltage	TTL level EXT MEAS.START (external measurement start I/O), EXT MEAS.STOP (external measurement stop I/O)
Connector	BNC
Synchronized measurement	Connect the EXT MEAS.START terminal of the master unit with the EXT MEAS.START terminal of the slave unit, and connect the EXT MEAS.STOP terminal of the master unit with the EXT MEAS.STOP terminal of the slave unit.
Internal floppy drive	
Size	3.5-inch
Format	1.44 MB
Communication functions	
GP-IB or serial (RS-232)	provided as a standard function.
GP-IB interface	Electrical and mechanical specifications As per IEEE St'd 488-1978 Functional specifications SH1, AH1, T6, L4, SR1, RL1, PR0, DC1, DT0, C0 Protocol: As per IEEE St'd 488.2 1987
Serial (RS-232) interface	
Connector	D-Sub 9-pin
Specification	EIA-574 (specifications for 9-pin interface in EIA-232 (RS-232) standard) 1200, 2400, 4800, 9600, 19200 bps
Transfer rate	
VGA video output	
Connector type	D-Sub 15-pin (VGA VIDEO OUT)
Output format	VGA-compatible
SCSI interface (optional)	
Specification	SCSI (Small Computer System Interface) ANSI X3.131-1986
Connector	D-sub half-pitch 50-pin (pin type)
Connector pin assignments	Unbalanced (single-end), internal terminator

DIGITAL POWER METER



WT1600

General Specifications

Warmup time	Approximately 1 hour
Operating temperature and humidity ranges	5 to 40°C, 20 to 80%RH when not using the printer, 5 to 40°C, 35 to 80%RH when using the printer.(no condensation)
Storage temperature	-25 to 60°C (no condensation)
Operating elevation	2000 meters or less
Insulating resistance	50 MΩ or higher at 500 VDC
	Across casing and power plug
	Across voltage input terminals (ganged) and casing
	Across current input terminals (ganged) and casing
	Across voltage input terminals (ganged) and current input terminals (ganged)
	Across torque/speed input terminals (ganged) and casing
	Across torque input terminals (ganged) and speed input terminals (ganged)
Withstand voltage	1500 VAC for one minute at 50/60 Hz
	Across casing and power plug
	3700 VAC for one minute at 50/60 Hz
	Across voltage input terminals (ganged) and casing
	Across current input terminals (ganged) and casing
	Across voltage input terminals (ganged) and current input terminals (ganged)
Rated supply voltage	100 to 120 VAC, 200 to 240 VAC (switches automatically)
Allowed supply voltage fluctuation range	90 to 132 VAC, 180 to 264 VAC
Rated supply frequency	50/60 Hz
Allowed supply frequency fluctuation range	48 to 63 Hz
Consumed power	Maximum 150 VA (when using internal printer)
External dimensions	Approximately 426 mm (W) × 177 mm (H) × 400 mm (D) (excluding protrusions)
Weight	Approximately 15 kg (main unit with 6 input elements and options installed)

* The WT1600 unit cannot be purchased without any elements. Select an element type (5 A or 50 A) and quantity.
Note: In order to add elements and options after the WT1600 has been delivered, the WT1600 must be modified at the factory. Be aware of this in making your product selections. For further details, see Yokogawa's home page or contact our sales office.

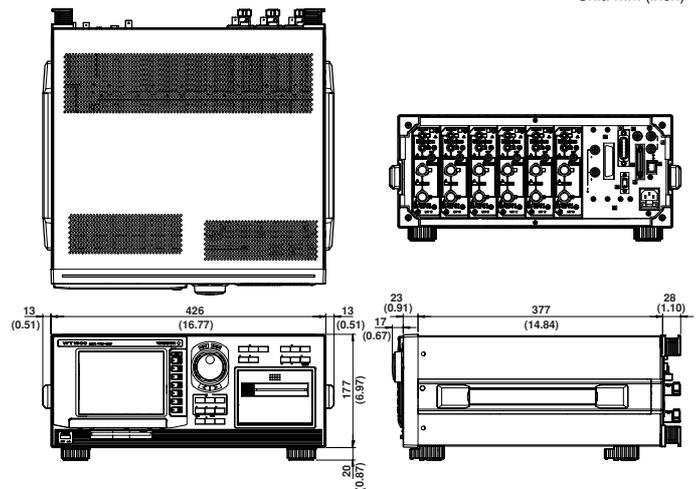
ACCESSORIES (SOLD SEPARATELY)

Product	Model/part number	Description	Order quantity
Rack mounting kit	751535-E4	For EIA	1
Rack mounting kit	751535-J4	For JIS	1
BNC cable	366924	BNC cable BNC-BNC (1 m)	1
BNC cable	366925	BNC cable BNC-BNC (2 m)	1
BNC cable	366926	BNC-alligator cable	1
Adapter	366971	9-pin* to 25-pin** adapter	1
Measurement leads	758917	Red and black, 75 cm; 2 leads in a set	1
Fork terminal adapter set	758921	Converts fork terminal (4 mm) into banana terminal; red and black (one each)	1
Alligator clips adapter (rated voltage: 300 V)	758922	Banana to alligator conversion; 2 in a set	1
Alligator clips adapter (rated voltage: 1000 V)	758929	Banana to alligator conversion; 2 in a set	1
Fuses	A1354EF	250 V, 6.3 Arms, time lag 100 V/200 V	2
External sensor cable	B9284LK	For external input; 50 cm	1
Roll paper for printer	B9316FX	Thermal paper; 10 meters (1 roll)	10

*: EIA-574 standard
**: EIA-232 standard (RS-232)

DIMENSION

Unit: mm (inch)



AVAILABLE MODELS

Model	Suffix codes	Description
760101		WT1600 digital power meter main unit
		Element Number
		1 2 3 4 5 6
Element types and quantities	-01	50
The numbers in the "Description" column have the following meanings. 50: 50 A input element 5: 5 A input element Blank: No element	-02	50 50
	-03	50 50 50
	-04	50 50 50 50
	-05	50 50 50 50 50
	-06	50 50 50 50 50 50
	-10	5
Elements are inserted in the order shown starting on the left side on the back.	-11	5 50
	-12	5 50 50
	-13	5 50 50 50
	-14	5 50 50 50 50
	-15	5 50 50 50 50 50
	-20	5 5
	-21	5 5 50
	-22	5 5 50 50
	-23	5 5 50 50 50
	-24	5 5 50 50 50 50
	-30	5 5 5
	-31	5 5 5 50
	-32	5 5 5 50 50
	-33	5 5 5 50 50 50
	-40	5 5 5 5
	-41	5 5 5 5 50
-42	5 5 5 5 50 50	
-50	5 5 5 5 5	
-51	5 5 5 5 5 50	
-60	5 5 5 5 5 5 5	
Communication functions	-C1	GP-IB
	-C2	Serial (RS-232)
Power cord	-D	UL/CSA Standard
	-F	VDE Standard
	-R	AS Standard
	-Q	BS Standard
Option specifications	/B5	Internal printer
	/C7	SCSI interface
	/C10	Ethernet, HDD, SCSI
	/DA	30-channel DA output
	/MTR	Motor evaluation function

APPLICATION SOFTWARE

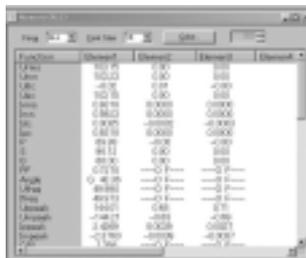
Acquire numeric, waveform and harmonic data via GP-IB or RS-232 with WTVIEWER

WTVIEWER is an application software tool that reads numeric, waveform and harmonic data measured with the WT1600 digital power meter, via GP-IB parallel or RS-232 serial communication or from a magneto-optic or floppy disk, into your personal computer. It lets you view waveforms on your computer, convert numeric or waveform data to data of a specified format, and store the data.

Main Features

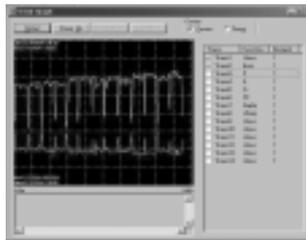
■ Numeric data

You can display the data measured with the WT1600 on your PC from an MO or floppy disk or via GP-IB/RS-232 communication. WTVIEWER can also simultaneously show various parameters for one to six elements and for ΣA to ΣC calculations, for simple channel-by-channel data comparison.



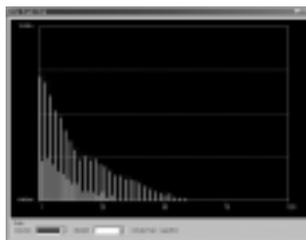
■ Viewing trends

You can capture various types of data measured with the WT1600 into your PC at fixed intervals. Thus, you can view trends graphically. This feature lets you monitor power supply voltage fluctuations, changes in current consumption and other time-based variations.



■ Measuring harmonics

WTVIEWER can numerically or graphically display the results of measured harmonics of up to the 100th order for such parameters as voltage, current, and power and phase angle. The graphic view lets you visualize harmonic components, order by order, with the order of harmonics on the horizontal axis and the magnitude of each harmonic on the vertical axis.



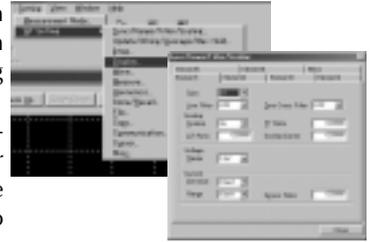
■ Vectorial views

In harmonic measurement, you can have a vectorial view of the fundamental voltage, current and phase angle. This visual presentation of the interphase relationship in a three-phase power system shows the load condition intuitively.



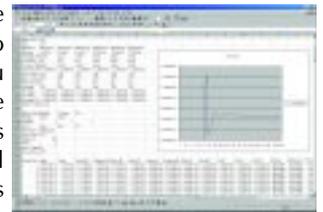
■ Setting up WT1600 from a PC

With WTVIEWER, you can control the WT1600 main unit from your PC, including setting the wiring method, ranges, filters, scaling and so on. WTVIEWER also lets you save or read the settings of the WT1600 onto your PC.



■ Converting data to CSV

With WTVIEWER, you can save waveform and numeric data to your PC, while on the PC you can create WVF files that can be Saved in WTVIEWER, or CSV files that can be imported into Excel spreadsheets. WTVIEWER also lets you save screen images of measured numeric and waveform data.



Performance

Applicable Power Meter: WT1600 Ver. 1.04 or later*

* For upgraded versions of the WT1600, consult your Yokogawa sales office or representative.

Functions:

Measuring mode: Power measurement, integration, and harmonic measurement

Types of file: Waveform file, computation file, harmonic file and setup file

Screen view: Numeric view, waveform view, trend view, vectorial view, and bar-graph view

Data acquisition interval**: Fixed to approximately 500 ms, depending on the processing speed of the PC.

** Note that the interval does not synchronize with the WT1600's data update rate.

System Configuration:

Personal computer:

CPU: Celeron 500 MHz or superior is recommended.

Memory: 128 MB or greater is recommended.

VRAM: 4 MB minimum

Hard disk: Free space of at least 100 MB

OS: Windows 98, Windows Me, Windows NT, or Windows 2000

Display resolution: 800 x 600 pixels or superior

Communication port: RS-232 — The COM port of the PC should be available.

GB-IB — AT-GBIB/TNT (PnP) or later, with driver NI-488.2M Ver 1.60 or later, from National Instruments

WT1600: With 1.04 or later version of firmware in main unit

Product Code

Product Code	Description
760121	WTVIEWER software