YOKOGAWA

2534 & 2535
Digital Power Meters
WT110 & WT130

WT110 (253401)
213 × 88 × 350 mm 3.0kg
(8-3/8 × 3-1/2 × 13-3/4" 6.6 lbs)

WT130 (253502, 253503)
213 × 132 × 350 mm 5.0kg
(8-3/8 × 5-3/16 × 13-3/4" 11.0 lbs)

CE 3-Year Warranty

RS-232-C GP-IB

★ Safety Standards; EN61010, CATII, Pollution degree 2
EMI Standard; EN55011 Group 1 Class A
Immunity Standard; EN50082-2: 1995

The WT100 series is designed with emphasis on solid performance, functionality, low cost and compact and is the latest digital power meter of YOKOGAWA. The WT110 is single phase model, and the WT130 is 3 phase model.

This model is made from several needs. For example, the request is realized by harmonic analysis function of the WT100 series that is to measure and analyze the harmonic distortion of current wave form because various harmonic-wave problems caused by distorted wave current. Another request is realized by integration function of both polarities that is to measure integrators for positive and negative polarities separately in the charge/discharge testing of battery-driven equipment.

FEATURES

- **0.25% of reading**
- **DC, 10Hz to 50kHz**
- **User caliblation (by remote communications or manually)**
- **Insulation between voltage and current input terminals**
  The double insulation design conforms to the safety standard IEC1010. All models are subjected to withstand voltage tests of 3.7 kV/50 Hz AC for one minute.
- **New surge durability**
  The specifications now include a durability of 2 kVrms, 300 Arms/1 cycle (20 ms).
- **Built-in harmonics analyzer (optional)**
  The new built-in harmonics analyzer less than others in its class. This power meter, together with a clamp sensor, makes this meter ideal for power supplies.

SPECIFICATIONS

Input

Item	Voltage (V)	Current (A)
Input circuit type	Floating input	
	Resistive voltage divider	Shunt input
Rated inputs (range rms)	15/30/60/150/300/600 V	Direct input: 0.5/1/2/5/10/20 A External input (optional): 2.5/5/10 V or 50/100/200 mV
Input impedance	Input resistance approx. 2 MΩ, input capacitance approx. 13 pF	Direct input: approx. 6 mΩ + approx. 0.1 µH External input: 2.5/5/10 V – approx. 100 kΩ; 50/100/200 mV – approx. 20 kΩ
Instantaneous maximum allowable input for 20 ms, 1 cycle	The peak is 2.8 kV or the RMS value is 2.0 kV, whichever is less.	The peak is 450 A or the RMS value is 300 A, whichever is less. External input: Peak value is 10 times the range or less.
Instantaneous maximum allowable input for 1 s	The peak is 2.0 kV or the RMS value is 1.5 kV, whichever is less.	The peak is 150 A or the RMS value is 40 A, whichever is less. External input: Peak value is 10 times the range or less.
Continuous maximum allowable input	The peak is 1.5 kV or the RMS value is 1.0 kV, whichever is less.	The peak is 100 A or the RMS value is 30 A, whichever is less. External input: Peak value is 5 times the range or less.
Continuous maximum common mode voltage (at 50/60 Hz)	600 Vrms	
Common mode rejection ratio at 600 Vrms between input terminals and case	50/60 Hz, better than –80 dB (±0.01% of range maximum) Voltage input terminals: short, Current input terminals: open Reference value: 50 kHz max. ± {(maximum range rating)/(range rating) × 0.001 × f% of range} or less; 0.01% or more; the unit f: kHz	
Input terminals	Binding posts	Direct input: Large binding posts, External input: Safety terminals
A/D conversion	Simultaneous sampling of voltage and current inputs Resolution: 12 bits, Maximum conversion rate: approx. 26 µs (approx. 38 kHz)	
Range switching	Range can be selected manually, automatically or by communication control.	
Automatic range switching	Range up: When the measured value exceeds 110% of the rated range or the peak value exceeds approximately 300% of the rated range Range down: When the measured value becomes less than 30% of the rated range and the peak value is less than approximately 300% of the subordinate range	
Measurement mode switching	The following modes can be set manually or by communication control: RMS: True RMS measurement for both voltage and current; V MEAN: Rectified Mean Calibration to an RMS sine wave measurement for voltage, and true RMS measurement for current; DC: Mean value measurement for voltage and current	

POWER MEASURING INSTRUMENTS

YOKOGAWA

WT110 & WT130

Measurement Functions

Item	Voltage/current	Power
Method	Digital sampling method, summation averaging method	
Frequency range	DC, 10 Hz to 50 kHz	
Crest factor	"3" at rated input	
Display accuracy Accuracy (within 3 months after calibration) (Conditions) Temperature: 23 ±5°C Humidity: 30% to 75% R.H. Supply voltage: Specified Voltage ±5% Input waveform: Sine wave Common mode voltage: 0 V DC Filter: ON at 200 Hz or less Scalling: OFF These accuracy are guaranteed by YOKOGAWA calibration system **Note:** The unit f in accuracy expressions is kHz.	DC : ±(0.2 % of rdg + 0.2 % of rng)* 10 Hz ≤ f < 45 Hz : ±(0.3 % of rdg + 0.2 % of rng) 45 Hz ≤ f ≤ 66 Hz : ±(0.15 % of rdg + 0.1 % of rng) 66 Hz < f ≤ 1 kHz : ±(0.3 % of rdg + 0.2 % of rng) 1 kHz < f ≤ 10 kHz : ±(0.2 % of rdg + 0.3 % of rng) ±{(0.05 × f)% of rdg} 10 kHz < f ≤ 20 kHz : ±(0.5% of rdg + 0.5 % of rng) ±[{0.15 × (f-10)}% of rdg] Reference value 20 kHz < f ≤ 50 kHz : ±(0.5% of rdg + 0.5 % of rng) ±[{0.15 × (f-10)}% of rdg] * DC: ±0.2 % of range is added if the 0.5/1 A range is selected	DC : ±(0.3 % of rdg + 0.3 % of rng)* 10 Hz ≤ f < 45 Hz : ±(0.5 % of rdg + 0.3 % of rng) 45 Hz ≤ f ≤ 66 Hz : ±(0.25 % of rdg + 0.1 % of rng) 66 Hz < f ≤ 1 kHz : ±(0.5 % of rdg + 0.3 % of rng) 1 kHz < f ≤ 10 kHz : ±(0.3 % of rdg + 0.5 % of rng) ±{(0.08 × f)% of rdg} 10 kHz < f ≤ 20 kHz : ±(0.8% of rdg + 0.8 % of rng) ±[{0.19 × (f-10)}% of rdg] Reference value 20 kHz < f ≤ 50 kHz : ±(0.8 % of rdg + 0.8 % of rng) ±[{0.25 × (f-10)}% of rdg] * DC: ±0.2% of range is added if the 0.5/1 A range is selected.
Effect of power factor **Note:** The unit f in accuracy expressions is kHz.	—	cosφ = 0 45 Hz ≤ f ≤ 66 Hz: ±0.25% of range Reference data (50 kHz max.): ±{(0.23 + 0.4 × f)% of range} 1 > cosφ > 0 Value of the influence of cosφ = 0 times tanφ However,φ represents the phase angle between the voltage and current.
Effective input range	With the input range at 10 to 110%, the above specified accuracy is valid. With the input range at 110 to 130%, the above specified reading accuracy increased 0.5 times is added to the accuracy.	
Accuracy (within 12 months after calibration)	The above specified reading accuracy increased 0.5 times is added to the accuracy (within 3 months after calibration).	
Temperature coefficient	±0.03% of range/°C at 5 to 18°C, 28 to 40°C	
Display update rate	4 times/s	

Computing Functions

		Effective Power (W)	Apparent Power (VA)	Reactive Power (var)	Power Factor (PF)	Phase Angle (deg)
Computation	1-phase 2-wire	W	VA=V × A	$\sqrt{(VA)^2 - W^2}$	$\frac{W}{VA}$	$\cos^{-1}(\frac{W}{VA})$
	1-phase 3-wire	W_i i=1, 3 ΣW =W_1+W_3	$VA_i=V_i \times A_i$ i=1, 3 ΣVA =VA_1+VA_3	$var_i=\sqrt{(VA_i)^2 - W_i^2}$ i=1, 3 Σvar =var_1+var_3	$PF_i=\frac{W_i}{VA_i}$ i=1, 3 ΣPF = $\frac{\Sigma W}{\Sigma VA}$	φi =$\cos^{-1}(\frac{W_i}{VA_i})$ i=1, 3 Σφ =$\cos^{-1}(\frac{\Sigma W}{\Sigma VA})$
	3-phase 3-wire (two power meter method)	W_i i=1, 3 ΣW =W_1+W_3	$VA_i=V_i \times A_i$ i=1, 3 ΣVA =$\frac{\sqrt{3}}{2}$ (VA_1+VA_3)	$var_i=\sqrt{(VA_i)^2 - W_i^2}$ i=1, 3 Σvar =var_1+var_3	$PF_i=\frac{W_i}{VA_i}$ i=1, 3 ΣPF =$\frac{\Sigma W}{\Sigma VA}$	φi =$\cos^{-1}(\frac{W_i}{VA_i})$ i=1, 3 Σφ =$\cos^{-1}(\frac{\Sigma W}{\Sigma VA})$
	3-phase 3-wire (three power meter method)	W_i i=1, 2, 3 ΣW =W_1+W_3	$VA_i=V_i \times A_i$ i=1, 2, 3 ΣVA =$\frac{\sqrt{3}}{3}$ ($VA_1+VA_2+VA_3$)	$var_i=\sqrt{(VA_i)^2 - W_i^2}$ i=1, 2, 3 Σvar =var_1+var_3	$PF_i=\frac{W_i}{VA_i}$ i=1, 2, 3 ΣPF =$\frac{\Sigma W}{\Sigma VA}$	φi =$\cos^{-1}(\frac{W_i}{VA_i})$ i=1, 2, 3 Σφ =$\cos^{-1}(\frac{\Sigma W}{\Sigma VA})$
	3-phase 4-wire	W_i i=1, 2, 3 ΣW =$W_1+W_2+W_3$	$VA_i=V_i \times A_i$ i=1, 2, 3 ΣVA =$VA_1+VA_2+VA_3$	$var_i=\sqrt{(VA_i)^2 - W_i^2}$ i=1, 2, 3 Σvar =$var_1+var_2+var_3$	$PF_i=\frac{W_i}{VA_i}$ i=1, 2, 3 ΣPF =$\frac{\Sigma W}{\Sigma VA}$	φi =$\cos^{-1}(\frac{W_i}{VA_i})$ i=1, 2, 3 Σφ =$\cos^{-1}(\frac{\Sigma W}{\Sigma VA})$
Computating Range		Depends on the selected V and A ranges	Depends on the selected V and A ranges	Same as apparent power (var ≥ 0)	-1 to 0 to 1	LEAD 180 to 0 to LAG 180
Display resolution		10000	10000	10000	±1.000	±180.0
Computing accuracy (for the value operated from the measured value)		—	±0.005% of VA range	±0.005% of var range	±0.0005	Resolution (power factor ±0.0005)

Notes:
1: The apparent power (VA), reactive power (var), power factor (PF), and phase angle (deg) measurements in this instrument are computed digitally from the voltage, current and effective power. If the input is non-sinusoidal, the measured values may differ from those obtained with instruments employing different measurement principles.
2: When the current or voltage is less than 0.5% of the range, the VA and var will be displayed as 0, and PF/deg will be displayed as an error.
3: The Lead and Lag are displayed for V and A input at 50% or more. The detected lead/lag accuracy is ±5 degrees over the frequency range of 20 Hz to 2 kHz.
4. In a Σ var calculation, the var value of each phase is calculated as a negatively signed value when the phase of the current input is advanced with respect to the voltage input, and is calculated as a positively signed value when the phase is lagging.

Frequency Measurement

Input: V1, V2, V3, A1, A2, A3
Operating principle: Reciprocal counting method
Frequency ranges: 10 Hz to 50 kHz
Accuracy: ±(0.1% of rdg + 1 digit)
Minimum input is more than 30% of rated range.
When an input frequency is less than 200 Hz, FILTER must be ON to obtain the specification accuracy.
Minimum input frequency is more than 20% of frequency measurement range.

Communication

Communication Specifications (GP-IB & RS-232-C)
GP-IB : Electrical specifications: IEEE St'd 488.2-1987
Mechanical specifications: IEEE St'd 488.2-1987
Interface function: SH1, AH1, T5, L4, SR1, RL1, PP0, DC1, DT1, C0
RS-232-C : Transmission mode: Start stop synchronization
Baud rate: 75, 150, 300, 600, 1200, 2400, 4800, 9600 bps

Display Functions

Display type: 7-segment LED
Number of displays: 3

DISPLAY	Displayed Value	Maximum Reading
A	V, A, W, VA, var (each element), elapsed integration time	V, A, W : 9999
B	V, A, W, PF, deg (each element), % (contents ratio in %, THD)	Wh, Ah : 999999
C	V, A, W, V· AHz, ± Wh, ±Ah (each element)	V, AHz : 9999

Unit: m, k, M, V, A, W, VA, var, Hz, h±, deg, %
Display update rate: 4 times/s
Response time: Approximately 0.5 s (time for displayed value to settle within accuracy specifications of final value after step change from 0 to 100% or 100 to 0% of rated range)
Display scaling function
Significant digits: Selected automatically according to significant digits in the voltage and current ranges
Reassign ratio: 0.001 to 1000

Averaging function: The following two algorithms can be selected:
- Exponential averaging
- Moving averaging

Response can be set; for exponential averaging, the attenuation constant can be selected and for moving averaging, the number of averages (N) can be set to 8, 16, 32, or 64.

Peak over range display: The alarm LED will light up when the RMS value is greater than 140% of the range or the peak value is greater than 300% of the range.

Integrator Function

Display resolution: Depending on elapsed time value, the resolution will be changed.
Maximum display: –99999 to 999999 MWh
Modes:
- Standard integration mode (timer mode)
- Continuous integration mode (repeat mode)
- Manual integration mode

Timer: When the timer is set, integration will be stopped automatically. Setting range: 000 h:00 min to 999 h:59 min (000 h:00 min will be shown when manual integration mode is selected automatically.)
Count overflow: If the integration count flows above 999999 MWh or below –99999 MWh, integration stops and the elapsed time is held on the display.
Accuracy: ±(display accuracy + 0.2% of rdg)
Timer accuracy: ±0.02%
Remote control: Start, stop, and reset can be remotely controlled by external contact signals.
However, the /DA4 or /DA12 options must be installed.

Internal Memory Function

Measurement data
- Number of data that can be stored:
  WT110 (**253401**): 600 blocks
  WT130 (**253502**): 300 blocks
  WT130 (**253503**): 200 blocks
- Each block has following data:
  Measurement setting mode, measurement ranges, V, A, W, Wh+, Wh-, Ah+, Ah-, elapsed time and frequency
  Writing intervals: 250 ms and 1 s to 99 h: 59 min: 59 s
  Reading intervals: 250 ms and 1 s to 99 h: 59 min: 59 s (both intervals can be set on a second basis)

Panel setup information: Four-pattern information can be written/read.

D/A Converter (Optional)

Output voltage: ±5 V DC FS (approximately ±7.5 V maximum) at rated value or range Number of output channels: 12 when the /DA12 option is installed; 4 when the /DA4 option is installed
Output data selection: Can be selected for each channel.
Accuracy: ±(Display accuracy + 0.2% of range)
Update rate: Identical to display update interval
Temperature coefficient: ±0.05% of f.s./ °C

External Input (Optional)

Either /EX1 or /EX2 can be selected as a voltage-output-type current sensor.
/EX1: 2.5/5/10 V
/EX2: 50/100/200 mV
Specifications: Refer to item "Input."

Comparator Output (Optional)

Output method: Normally open and normally closed relay contact outputs (one pair)
Number of output channels and channel setup: 4 (Can be set for each channel.)
Contact capacity: 24 V/0.5 A
D/A output (4 channels): Refer to item "D/A Output (Optional)."

External Control and Input Signals (with combination of the D/A converter and comparator options)

External Control and Input/Output signals
EXT-HOLD, EXT-TRIG, EXT-START, EXT-STOP, EXT-RESET, INTEG-BUSY
(However, the /DA4 or /DA12 options must be installed. Only EXT-HOLD and EXT-TRIG are available if the /CMP option is installed.)
Input level: TTL negative pulse

Total Harmonic Analysis Function (Optional)

Method: Synchronization to the fundamental frequency by using a phase locked loop (PLL) circuit
Frequency range: Fundamental frequency between 40 and 440 Hz
Maximum reading: 9999
Items to be analyzed: V1, V2, V3, A1, A2, A3, W1, W2, W3, deg1, deg2, deg3
Each harmonic components, Total Vrms, Total Arms, Total effective power, PF of the fundamental, Phase-angle of fundamental, For each harmonic phase-angle related to the fundamental, Total harmonic distortion ratio in %, and contents ratio in %.
However, a simultaneous analysis can be made for a specified input module.

Sampling speed/method:
The sampling speed depends on the fundamental frequency to be input:

Input frequency range	Sampling frequency	Window up to the n'th harmonic	Order
40 ≤ f < 70 Hz	f × 512 Hz	1 period of f	50
70 ≤ f < 130 Hz	f × 256 Hz	2 period of f	50
130 ≤ f < 250 Hz	f × 128 Hz	4 period of f	50
250 ≤ f < 440 Hz	f × 64 Hz	8 period of f	30

FFT number of points : 512 points FFT
FFT calculation accuracy:32 bits
Window: Rectangular window
Display update interval: Approx. 3 s
Accuracy: ±0.2% of range is added to the normal display accuracy.

General Specifications

Safety standards: EN61010, CATII, Pollution degree 2
EMI standard: EN55011 Group 1 Class A
EN50082-2: 1995
Warm-up time: Approx. 30 min.
Ambient temperature and humidity range: 5 to 40°C, 20 to 80% R.H. (no condensation)
Insulation resistance: Between voltage input terminals and case
Between current input terminals and output terminals
Between voltage input terminals and current input terminals
Between voltage input terminals of each element
Between current input terminals of each element
Between voltage input terminals and power plug
Between current input terminals and power plug
Between case and power plug
Above: 50 MΩ or more at 500 V DC
Withstanding voltage: Between voltage input terminals and case
Between current input terminals and output terminals
Between voltage input terminals and current input terminals
Between voltage input terminals of each element
Between current input terminals of each element
Between voltage input terminals and power plug
Between current input terminals and power plug
Above: 3700 V AC for 1 minute at 50/60 Hz
Between case and power plug: 1500 V AC for 1 minute at 50/60 Hz
Power supply: Any power supply voltage between 100 and 240 V; frequency: 50/60 Hz
Vibration test condition: Sweep test - Frequency: 8 to 150 Hz sweep, all 3 directions for 1 minute
Endurance test - Frequency: 16.7 Hz, all 3 directions; amplitude of 4 mm for 2 h
Impact condition: Impact test: Acceleration at 490 m/s^2, all 3 directions
Free-fall test - Height: 100 mm, 1 time for each 4 sides
Power consumption: **WT110**: 30 VA maximum; **WT130**: 50 VA maximum
(Power supply : 240 V)
WT110: 20 VA maximum; **WT130**: 32 VA maximum
(Power supply : 100V)
External dimensions: **WT110**: Approx.: 213(W) × 88(H) × 350(D) mm,
8-3/8 × 3-1/2 × 13-3/4 (inch)
WT130: Approx.: 213(W) × 132(H) × 350(D) mm,
8-3/8 × 5-3/16 × 13-3/4 (inch)
Weight: **WT110**: Approx. 3.0 (kg), 6.6 (lbs)
WT130: Approx. 5.0 (kg), 11.0 (Lbs)
Accessories: Power cord: UL/CSA, VDE, SAA or BS standard 1 pc

POWER MEASURING INSTRUMENTS

YOKOGAWA

WT110 & WT130

AVAILABLE MODELS

Model	Suffix Code	Description
253401		**WT110**, 1-Input element model
253502		**WT130**, 2-Input elements model
253503		**WT130**, 3-Input elements model
Interface	**-C1**	GP-IB
	-C2	RS-232-C
Power requirement	**-0**	Any power supply voltage between 100 and 240 V
Power cord	**-D**	UL/CSA standard
	-F	VDE standard
	-R	SAA standard
	-J	BS standard
Optional features	**/EX1**	External input 2.5/5/10 V
	/EX2	External input 50/100/200 mV
	/HRM	Harmonic analysis
	/DA12	12 ch D/A output
	/CMP	Comparator and D/A outputs, each 4ch

Notes: 1. Select either the /EX1 or /EX2 option.
2. For the **WT110**, you can select either the /DA4 or /CMP option.
3. For the **WT130**, you can select either the /DA12 or /CMP option.

■ Wiring and Model

Wiring \ Model	253401	253502	253503
Single-phase, 2-wire	O	O	O
Single-phase, 3-wire	–	O	O
3-phase, 3-wire (2-power-meter method)	–	O	O
3-phase, 3-wire (3-power-meter method)	–	–	O
3-phase, 4-wire	–	–	O

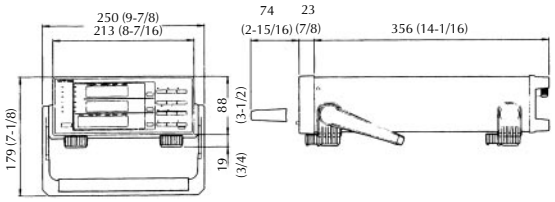
■ Accessories

Name	Model or Part Number	Specification	Order Q'ty
Rack mounting kit	**751533-E2**	Single-mounted **WT110** for EIA	1
Rack mounting kit	**751533-J2**	Single-mounted **WT110** for JIS	1
Rack mounting kit	**751534-E2**	Dual-mounted **WT110** for EIA	1
Rack mounting kit	**751534-J2**	Dual-mounted **WT110** for JIS	1
Rack mounting kit	**751533-E3**	Single-mounted **WT130** for EIA	1
Rack mounting kit	**751533-J3**	Single-mounted **WT130** for JIS	1
Rack mounting kit	**751534-E3**	Dual-mounted **WT130** for EIA	1
Rack mounting kit	**751534-J3**	Dual-mounted **WT130** for JIS	1

DIMENSIONS

Unit: mm (inch)

WT110



WT130