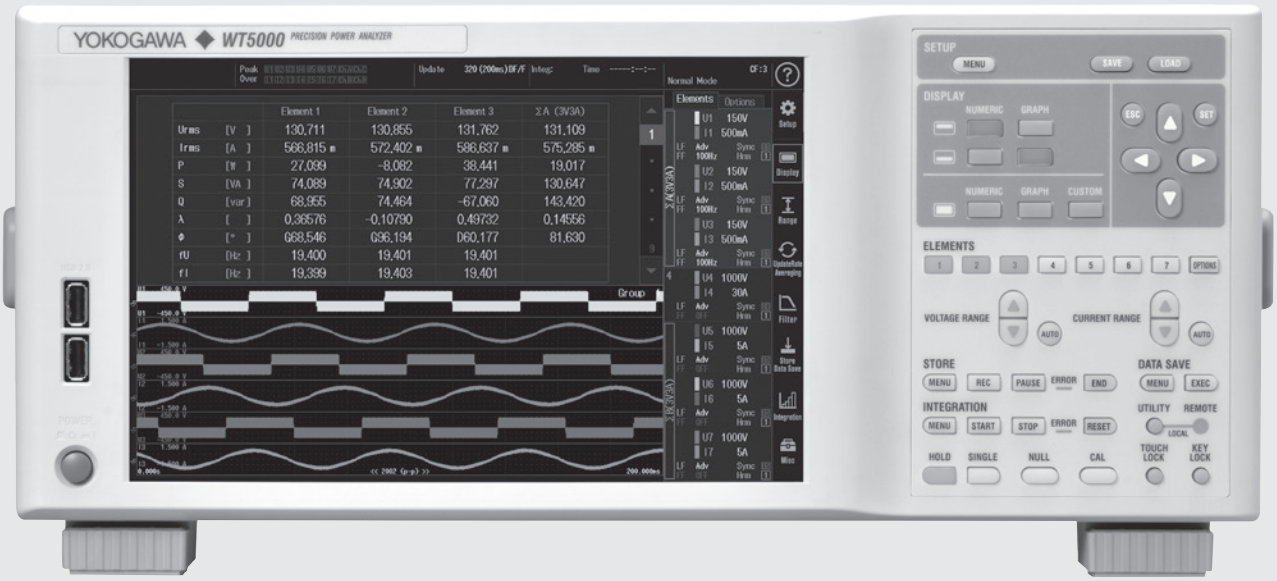
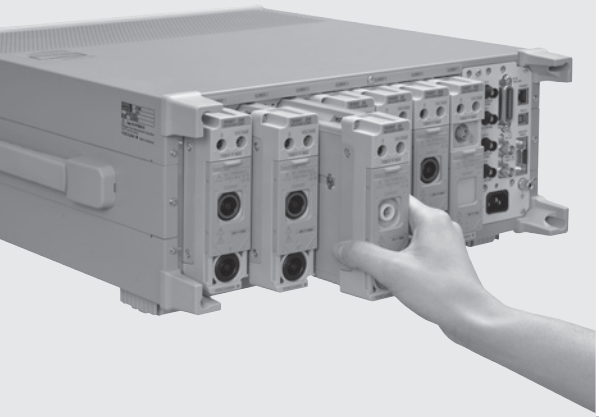
Test&Measurement

YOKOGAWA



Specifications



WT5000
Precision Power Analyzers

Precision Making

Bulletin WT5000-02EN

WT5000 Precision Power Analyzers

Signal Input Section

Power Measurement

Element	Plug-in input unit
Number of elements	7
Installable input elements	Elements exclusive to the WT5000
Input element mixing	Allowed
Empty element	Allowed However, element 1 to the element before the first empty element can be used. Elements installed after the empty element number cannot be used.
Hot swapping	Not allowed

Motor Evaluation Function (Option)

Input connector type	Isolated BNC
Input type	Unbalanced, functional isolation
Input resistance	1 MΩ ±1%, Approx. 47 pF
Continuous maximum allowable input	±22 V
Maximum voltage to earth	±42 Vpeak
Input channels	MTR1: ChA (Torque1/Aux1): Analog/Pulse input ChB (Speed1/Aux3): Pulse input ChC (B/Torque2/Aux2): Analog/Pulse input ChD (Z/Speed2/Aux4): Pulse input
	MTR2: ChE (Torque3/Aux5): Analog/Pulse input ChF (Speed3/Aux7): Pulse input ChG (B/Torque4/Aux6): Analog/Pulse input ChH (Z/Speed4/Aux8): Pulse input

Input type: Analog input

Range	1/2/5/10/20 V
Range setting	Fixed/Auto Auto range Range increase: When the measured value exceeds 110% of the range When the peak value exceeds approximately 150% Range decrease: When the measured value is 30% of the range or less and the peak value is less than 125% of the next lower range
Input range	±110%
Bandwidth	20 kHz (–3 dB)
Sample rate	Approx. 200 kS/s
Resolution	16 bit
Accuracy*	For the 6 months accuracy ±(0.03% of reading + 0.03% of range) For the 1 year accuracy, multiply the reading of the accuracy at 6 months by 1.5
Temperature coefficient	±0.03% of range/°C
Line filter	Low-pass filter Filter response: Butterworth fc: 100 Hz, 500 Hz, 1 kHz

Pulse input

Range	10 V
Input range	±12 Vpeak
Detection level	H level: approx. 2 V or higher L level: approx. 0.8 V or less
Pulse width	250 ns or more However, 50% duty ratio for detecting forward rotation
Frequency measurement range	2 Hz to 2 MHz
Rotation direction detection	2 Hz to 1 MHz When the pulse noise filter is in use: 10 kHz: 2 Hz to 3 kHz 100 kHz: 2 Hz to 30 kHz 1 MHz: 2 Hz to 300 kHz
Accuracy	±(0.03 + f/10000) % of reading ±1 mHz The unit of f is kHz. However, the waveform display data accuracy is ±(0.03 + f/500) % of reading ±1 mHz The unit of f is kHz.
Pulse noise filter	Low-pass filter fc: 10 kHz, 100 kHz, 1 MHz
Z pulse delay correction	Corrects the time setting delay

Peak over-range detection	150% of the range or more

*Analog input accuracy guarantee conditions:
Humidity: 30% RH to 75% RH
Voltage to ground: 0 V
In a wired condition after warm-up time has passed and after zero-level compensation.
For 5°C to 18°C and 28°C to 40°C, add the temperature coefficient.

Measurement Output Section

D/A Output (/DA20 option)

Output connector type	Micro ribbon connector (Amphenol 57LE connector), 36-pin
Output source	The set measurement function Normal measurement Voltage, current, power: U/I rms, mn, dc, rmn, ac P/S/Q/λ/Φ/Pc and Σ Peak value : U/I/P, ±pk Frequency: fU/fI/f2U/f2I/fPLLx Integration: ITime/WPx/qx/WS/WQ Efficiency, user-defined function, user-defined event Harmonic measurement Voltage, current, power harmonics: U/I/P/S/Q/λ/ and Σ UI, inter-harmonic, inter-element phase difference: Φxx Load circuit constant: Z/Rs/Xs/Rp/Xp Relative harmonic content, strain: U/I/P Telephone harmonic factor: U/I Telephone influence factor: U/I K-factor Delta computation U/I/P and ΣU, P Motor evaluation function Speed, Torque, SyncSp, Slip, Pm, EaMxU, EaMxI, Auxx

*0 V to +5 V when the phase angle display setting is 360°
*The % output measurement function is +5 V at 100%.
*Rated integrated value is range rating × set integration time
*Approx. 7.5 V for setting function errors.
However, U/I –pk is approx. –7.5 V.
*x consists of characters and numbers.

D/A resolution	16 bit
Output type	Voltage output, functional isolation
Output voltage	Rating: ±5 V, maximum output voltage: approx. ±7.5 V
Range mode	Fixed: ±5 V FS Manual: Maximum range value: 9.999T, minimum range value: –9.999T
Number of channels	20
Accuracy	±(output source measurement accuracy + 0.1% of FS), 1 year accuracy
Output resistance	Approx. 100 Ω
Minimum load	100 kΩ
Temperature coefficient	±0.05% of FS/°C
Maximum voltage to earth	±42 Vpeak or less
Output update interval	Same as the data update interval Synchronizes to the trigger when the measurement mode is trigger
Remote control	See Auxiliary I/O

Display

Display	10.1-inch color TFT LCD with a capacitive touch screen
Resolution of the entire screen*	1280 × 800 dots (H × V)
Language	Japanese/English
Display update rate	Same as the data update interval However, 1) When the data update interval is 50 ms, 100 ms, or 200 ms and only numeric display is in use, the display is updated every 200 ms to 500 ms (depends on the number of displayed parameters). 2) When the data update interval is 50 ms, 100 ms, 200 ms, or 500 ms and parameters other than those of numeric display are shown, the display is updated every 1 s. 3) When the measurement mode is normal measurement trigger mode, measurement is executed over the time interval specified by the data update interval from when a trigger is detected. The amount of time shown below is required for the instrument to compute the measured data, process it for displaying, and so on, and become ready for the next trigger. • When the data update interval is 50 ms to 500 ms: Approx. 1 s • When the data update interval is 1 s to 20 s: Data update interval +500 ms In this case, storage, communication output, and D/A output operate in sync with the triggers. If the measurement mode display is set to normal measurement mode, storage, communication output, and D/A output operate in sync with the data update interval.
LCD adjustment	Turning off the LCD Manual (default): Off: Panel key operation On: Key operation and panel touch Auto-off on: Off: When the panel and keys are not accessed for a given period On: Key operation and panel touch Auto-off time: 1 min to 60 min
Brightness adjustment	10 levels
Grid intensity	8 levels
Color	Waveform, trend, and vector display colors are fixed

	Background color	Gray
Measurement display	Number of displayed digits If the value is less than or equal to 60000: Six digits. If the value is greater than 60000: Five digits.	
	Display format	All, 4, 8, 16, Matrix, Hrm List Single, Hrm List Dual
	No-data display symbol	—
	Error display symbol	Error For errors that occur when the frequency measurement or motor or AUX pulse measurement is less than the lower limit, Error or zero can be selected.
Waveform display	Peak-to-peak compressed data Waveform display item	
	Voltage, current	elements 1 to 7
	Torque, speed	motor 1 and 2 (/MTR1), motor 3 and 4 (/MTR2)
	Auxiliary Input	Aux 1 to 4 (/MTR1), Aux 5 to 8 (/MTR2)
	Screen division	Single, Dual, Triad, Quad, Hexa
	Vertical axis	Auto, Manual (set the zoom and position)
	Time axis: Time/div	0.01 ms to 2 s, 1-2-5 steps
	Trigger	
	Trigger type	Edge
	Trigger mode	Select auto or normal.
	Trigger source	Select voltage, current, or Ext Clk (external clock).
	Trigger slope	Select rising, falling, or rising and falling. Fixed to rising when the trigger source is Ext Clk (external clock)
	Trigger level	When the trigger source is a voltage or current applied to an input element Set to a value that is within the range defined by the middle of the screen ±100% (to the top and bottom edges of the screen). Resolution: 0.1% Trigger delay: Within 2 µs When the trigger source is Ext Clk (external clock) TTL level
	Time axis zoom feature	None
	Amplitude zoom feature	Can be set between 0.1x to 100x
	Display interpolation	Off, two-point linear interpolation
	Grid	Selectable (frame, grid, X-Y)
Trend display	Time series graph of a measurement function's data updates	
	Display items	Up to 16 items, most recent measured values
	Screen division	Single, Dual, Triad, Quad
	Vertical axis	Auto or Manual (set the upper and lower limits)
	Time axis	Time/div, 3 s to 1 day
Bar graph display	Displays a bar graph of the amplitude and phase of each harmonic	
	Graph division	Single, Dual, Triad
	Vertical scale	Log, Linear
	Range setting	Auto or Manual (set the upper and lower limits)
	Display range	Starting harmonic: 0 to 499, ending harmonic: 10 to 500
Vector display	Displays the phase difference between the fundamental voltage signal and fundamental current signal as a vector. Divisions: 2 Screen zoom feature: 0.1 to 100x Numeric display: Allowed	
Other measurement screen display items	Setup menu Measurement mode, time, data update interval, data update count, peak over-range information, integration settings/status, storage status, crest factor, averaging, element settings/status, option settings/status	

*Relative to the total number of pixels, 0.002% of the LCD screen may be defective.

Control area	
Control devices	Power switch, control keys, capacitive touch panel
Key operation features	Features controlled directly with keys Direct control items: Setup menu display, display format change, range change, storage, data save, integration start/stop/reset, remote clear, key lock, touch lock Panel menus can be controlled using the arrow keys and SET key.
Touch panel	Controls all features Touch lock: Stops the touch panel operation feature

Wiring Systems	
Method	Single-phase two-wire (1P2W) Single-phase three-wire (1P3W) Three-phase three-wire (3P3W, 3V3A) Three-phase four-wire (3P4W)

Measuring Mode		
Normal measurement	Select sync source period average or digital filter average.	
Fixed-period update	Data update interval: 50 m/100 m/200 m/500 m/1/2/5/10/20 s	
	Display screen: Single, split screen and the measurement display of the trend Numeric, waveform (free run), trend, bar, vector	
	Measurement function: Normal, harmonic	
	Trigger update	Display screen: Single, split screen and the measurement display of the trend Numeric, waveform (triggered), trend, bar, vector
		Measurement function: Normal, harmonic However, the integration feature is not available.

Features		
General Features		
Crest factor setting	Select CF3, CF6, or CF6A.	
Element range setting	Can be set for each input element and wiring unit	
Fixed/auto range setting		
	Fixed range setting Manually set the range of your choice (except only the ranges selected by the valid measurement range selection feature). Range Σ link: ON: Set the range for each wiring unit. OFF: Set the range for each element.	
	Auto range setting Auto range setting feature Range increase When Urms or Irms exceeds 110% of the measurement range (220% for crest factor CF6A). When the peak value of the input signal exceeds approximately 310% (approximately 620% for crest factor CF6 or CF6A) of the range.	
	Range decrease When the measured Urms or Irms value is less than or equal to 30% of the range, Upk and Ipk are less than equal to 300% of the lower range (range to decrease to) (less than equal to 600% for crest factor CF6 or CF6A), and Urms and Irms are less than 105% Changes the range directly to the appropriate range when the range-decrease conditions are met.	
	A feature for changing to the specified range when a peak over-range occurs *The null value is not used for peak over-range detection.	
	Valid measurement range selection feature A feature for selecting the valid measurement range according to the usage conditions Only the selected ranges are used.	
Element scaling	A feature that allows direct reading by setting the current sensor conversion ratio, VT ratio, CT ratio, and power coefficient SF • Auto CT ratio configuration is possible by selecting the CT series model name. Source measurement function Set voltage U, current I, power (P, S, Q), maximum voltage (U+pk)/minimum voltage (U–pk), maximum current (I+pk)/minimum current (I–pk), maximum power (P+pk)/minimum power (P–pk), and VT ratio in the following range. Selectable range: 0.0001 to 99999.9999	
Averaging	Type: Exponential average, moving average Source: Normal measurement function Urms, Umn, Udc, Urmn, Uac, Irms, Imn, Idc, Irmn, Iac, P, S, Q, fU, fI, f2U, f2I, ΔU1 to ΔPΣ, Torque, Speed, Pm, Aux(/MTR1/MTR2 option)	
	Harmonic measurement function U(k), I(k), P(k), S(k), Q(k) Exponential averaging, attenuation constant: 2 to 64 Moving average, average count: 8 to 64	
	Data reset: Data being computed is reset if a setting of any of the functions below is changed. Averaging type, averaging attenuation constant Range, crest factor, range Σ link, wiring Scale value Line filter, frequency filter Data update interval, averaging method, sync source Zero-level compensation Maximum harmonic order, minimum harmonic order, harmonic window span Waveform observation time	
Hold	Measurement hold: Suspends the measurement and display operations and holds the data display of each measurement function. However, measurement is not suspended during integration. Only the display is held. D/A output, communication output, and the like are also held. However, if only the display is held and measurement is continuing during integration, the storage function saves the measured values that are being updated.	
Single measurement	A single measurement is performed at the specified data update rate while a measurement is being held and the hold state is maintained. If you press SINGLE when the measurement is not being held, measurement is performed again from that point.	
Zero-level compensation (Cal)	Measurement element's circuit offset correction feature Manual: Executed under the current settings through a key operation or communication. Auto: Automatically execute when the measurement range is changed or the filter is changed.	

Zero-level compensation (Null)	Offset correction feature for all measurement circuits including measurement elements Executed under the current settings through a key operation or communication.
	Null status: Can be set separately for each function ON: Updates the null value every time a null is executed. HOLD: Holds the null value set once. OFF: Disables null correction. [Upper null limit] Analog input (Pwr/Motor/Aux): 0% of range rating Pulse input (Motor/Aux): Speed: 10% of [60/PulseN × 10000 Hz] [rpm] Torque: 10% of the absolute value of Rated Upper [Nm] Rated Upper: The larger of "Nm-Hz coordinates × 2 points" for determining the linear scaling value Aux: 10% of the upper pulse input specification limit 2 MHz [Hz]
Storage	Stores numeric data to internal memory and a USB memory device
	Save Interval: Data update interval, specified time, or specified interval
	Synchronization: Manual, real time, integration, event
	Storage count: 1 to 9999999
	Time interval: 50 ms to 99 h 59 m 59 s
	File Format: Binary
	Maximum data file size: 1 GB
	Saved data conversion: Converts to CSV
Data save	Save numeric data, waveform data, and screen images to the internal memory, a USB memory device, or a network drive
Saving and loading setup parameters	Save setup parameters to the internal memory, a USB memory device, or a network drive Load saved setup parameters.
File operations	Create folder, copy, move, rename, protect, delete
Master and slave synchronized measurement	A feature for synchronizing the measurement start on slave devices to the master device
	Connector type: BNC: Same for master and slaves
	I/O level: TTL: Same for master and slaves
	Output logic: Negative logic, falling edge: Applies to the master
	Output hold time: Low level, 500 ns or more: Applies to the master
	Input logic: Negative logic, falling edge: Applies to slaves
	Minimum pulse width: Low level, 500 ns or more: Applies to slaves
	Measurement start output signal delay Applies to the master: Within 1 µs
	Measurement start delay: Applies to slaves: Within 2 µs
	Maximum number of connected units 4 unit
	Data update interval: 50 ms to 20 s
	Measuring Mode: Normal measurement
User-Defined Function	A feature for performing computation by combining measurement function symbols
	Number of computations: 20
	Maximum number of operands 16
	Number of characters in an expression Up to 60 characters
	Number of unit characters Up to 8 characters
	Operators: +, −, ×, ÷, ABS, SQR, SQRT, LOG, LOG10, EXP, NEG, SIN, COS, TAN, ASIN, ACOS, ATAN
	Parameters: Element, Σ unit, harmonic order
MAX hold	Can be defined using the user-defined function
Efficiency equation	Efficiency computation of up to 4 systems is possible.
User-defined events	Uses measurement functions as trigger conditions
	Event: Measurement condition
	Judgment condition: <, <=, =, >, >=, !=
	Number of events: 8
Peak over-range detection	Elements, Motor (/MTR1/MTR2) Displays over-range information on the screen when the allowable range of each element and motor (/MTR1/MTR2) is exceeded.
System configuration	Date and time, message language, menu language
Time setting	Sets the time at startup using the Simple Network Time Protocol (SNMP)
Initialization feature	Returns the settings to their factory default values Settings that are not initialized: date and time, communication settings, menu language, message language, environmental settings*
	*Environmental settings (Preference): Indication that appears when the frequency or motor pulse frequency is less than the lower limit, decimal point and separator used when saving to ASCII format (.csv)
	*Starting the instrument with the ESC key held down returns all settings except the date and time to their factory default values.
Help	Displays explanations of features
Self-test	Memory, key test (keyboard)

Delta Math Function

Voltage (V) (E is the element number.)	difference	ΔUE Differential voltage UE between UE+1 determined through computation
	3P3W->3V3A	ΔUE Unmeasured line voltage computed in a three-phase three-wire system
	DELTA->STAR	ΔUE, ΔUE+1, ΔUE+2 Phase voltage computed in a three-phase three-wire (3V3A) system
	STAR->DELTA	ΔUE, ΔUE+1, ΔUE+2 Line voltage calculated in a three-phase four-wire system
Current (A)	difference	ΔI Differential current iE between iE+1 determined through computation
	3P3W->3V3A	ΔI Unmeasured phase current
	DELTA->STAR	ΔI Neutral line current
	STAR->DELTA	ΔI Neutral line current
Power (W)	difference	——
	3P3W->3V3A	——
	DELTA->STAR	ΔPE, ΔPE+1, ΔPE+2 Phase power computed in a three-phase three-wire system
	STAR->DELTA	——

Averaging Function

Sync source period average

Averaging performed over a specified period
Set the calculation period using the set reference signal (sync source) (excluding WP and DCq)

Sync source: Ux, Ix, EXT CLK, Z (/MTR1/MTR2 option)
The period of UE and IE is detected using a specified trigger value from the waveform sampling data
(E is the element number.)

Data update interval
50 ms/100 ms/200 ms/500 ms/1 s/2 s/5 s/10 s/20 s

Averaging period: Data update interval or less

Digital filter average

Digital low-pass filter
Filter form: FIR

Filter response	Attenuation characteristics (<−100 dB)	Computation rate	Settling time
FAST	100 Hz	10 kHz	40 ms
MID	10 Hz	1 kHz	400 ms
SLOW	1 Hz	100 Hz	4 s
VSLOW	0.1 Hz	10 Hz	40 s

Averaging period: Continuous computation
However, the computed value is reset to 0 when a range change, line filter change, zero cal, filter response change, or data update interval change is executed.

Data update interval: 50 m/100 m/200 m/500 m/1/2/5/10/20 s

Filter Function

Line filter

For elements 1 to 7
Can be set separately for each element
Computation rate Filter response Maximum computation rate: 10 MS/s

Bessel
Filter form: IIR
Filter type: LPF
Filter order: 4
LPF
Cutoff frequency: 100 Hz to 100 kHz, 1 MHz*
Resolution: 100 Hz
Cutoff characteristic: −24 dB/Oct (typical)

Butterworth
Filter form: IIR
Filter type: LPF
Filter order: 4
LPF
Cutoff frequency: 100 Hz to 100 kHz, 1 MHz*
Resolution: 100 Hz
Cutoff characteristic: −24 dB/Oct (typical)

*Anti-aliasing filter: element's internal analog filter, Bessel

For MOTOR (/MTR1/MTR2 option)
Can be used during analog input

Computation rate: Maximum computation rate: 200 kS/s

Filter response
Butterworth
Filter form: IIR
Filter type: LPF
Filter order: 4
LPF Cutoff frequency: 100 Hz, 500 Hz, 1 kHz
Cutoff characteristic: −24 dB/Oct (typical)

For harmonic measurement
Stable measurement is possible through the anti-aliasing filter provided for each sampling frequency.
Harmonic analysis in an area different from normal measurement is possible.

When the line filter advanced setting is off
According to the element's line filter

When the line filter advanced setting is on
Filter exclusive to harmonic measurement (independent of the element's line filter)

Filter response

Bessel
Filter form: IIR
Filter type: LPF
Filter order: 4
LPF Cutoff frequency: 100 Hz to 100 kHz
Resolution: 100 Hz
Cutoff characteristic: –24 dB/Oct (typical)

Butterworth
Filter form: IIR
Filter type: LPF
Filter order: 4
LPF Cutoff frequency: 100 Hz to 100 kHz
Resolution: 100 Hz
Cutoff characteristic: –24 dB/Oct (typical)

Frequency filter
Elements 1 to 7, for frequency measurement and sync source
Can be set separately for each element
Computation rate: Maximum computation rate: 10 MS/s
The computation rate is selected automatically based on the set frequency 100, 1 k, 10 k, 100 k, 1 M, 5 M, or 10 MHz.

Filter response
Butterworth
Filter form: IIR
Filter type: LPF, HPF, (BPF)*
Filter order: 4
LPF Cutoff frequency: 100 Hz to 100 kHz
Resolution: 100 Hz
HPF
When the line filter advanced setting is off
Fixed to 0.1 Hz
When the line filter advanced setting is on
Cutoff frequency: 0.1 Hz, 1 Hz, 10 Hz, 100 Hz to 100 kHz
Resolution: 100 Hz (fc ≥ 100 Hz)
Cutoff characteristic: –24 dB/Oct (typical)

*BPF is possible by setting HPF and LPF simultaneously.
LPF, BPF, and HPF can be set for the first frequency and for the sync source.
Default setting: HPF, 0.1 Hz
HPF only for the second frequency.
Default setting: Off

Integration Function

Sampling frequency: 5 MS/s

Calculation period: Manual, integration time, real-time control
Integration time repetition, real-time control repetition
Integration timer range: 0 h 00 m 00 s to 10000 h 00 m 00 s
Count over: When the maximum integration time (10000 hours) is reached or when an integrated value reaches the maximum or minimum displayable integrated value (±999999 MWh, ±999999 MAh, ±999999 MVAh, ±999999 Mvarh), the integration time and value at that point are held and integration is stopped.

Power failure recovery: Resumes integration if a power failure occurs during integration.

Independent integration: Integration can be executed separately for each element.

External control: With the /DA20 option, start, stop, and reset are possible through external signals.

Auto calibration: Auto offset calibration feature
Zero-level compensation is performed at the current range of all elements approximately every hour.

Frequency Measurement Function

Measured item: Measures the frequency of the voltage or current applied to all input elements.

Measurement system: A/D data level trigger gate generation
Reciprocal method

Display resolution: 99999

Minimum frequency resolution
0.0001 Hz

Measurement range: 0.1 Hz ≤ f ≤ 2 MHz
For the relationship between the data update interval and the measurement range. See specifications of each element.
*Measurement frequency range is limited by the element.
*The display limit is 1.1 times the upper limit of the measurement range (2.2 MHz).
Display: Error, 32-bit floatingpoint value: 0 × FFFFFFFF

Accuracy: Depends on the element

Condition: When the input signal level is 30% or more (60% or more when the crest factor is set to CF6 or CF6A) of the measurement range.
However,
1) Input condition for 50% of the range or more
- Twice the lower frequency limit above or less
- Minimum current range
  500 mA range (760901) (CF3)
  5 mA range (760902) (CF3)
- Minimum external sensor range
  50 mV range (760901, 760902) (CF3)

2) Frequency filter setup conditions
0.1 Hz to 100 Hz: fc = 100 Hz
100 Hz to 1 kHz: fc = 1 kHz
1 kHz to 100 kHz: fc = 100 kHz

Frequency detection signal level setting
Selectable range
HPF: ON: Auto
HPF: OFF: Rectifier OFF: ±100% of range
Rectifier ON: 0% to +100% of range

Harmonic Measurement Feature

Measured item: All installed elements

Method: PLL synchronization method

Frequency range: Fundamental frequency: 0.1 Hz to 300 kHz
Analysis frequency: 0.1 Hz to 1.5 MHz

PLL source: Select the input element's voltage or current or external clock.
Input level: 50% or more of the rated measurement range when the crest factor is CF3.
100% or more of the rated measurement range when the crest factor is CF6 or CF6A.
The conditions in which frequency filters are turned on
0.1 Hz ≤ f < 100 Hz: 100 Hz
100 Hz ≤ f < 1 kHz: 1 kHz
1 kHz ≤ f < 10 kHz: 10 kHz
10 kHz ≤ f < 100 kHz: 100 kHz

Number of FFT points: Select 1024 or 8192.

Window function: Rectangular

Anti-Aliasing Filter: Set using a line filter or harmonic filter

When the number of FFT points is 1024

Fundamental frequency	Sample rate	Window width	Upper limit of harmonic analysis	
			U, I, P, Φ, ΦU, ΦI	Other measured values
0.1 Hz to 3 kHz	f×1024	1 wave	100th	100th
3 kHz to 7.5 kHz	f×512	2 waves	100th	100th
7.5 kHz to 15 kHz	f×256	4 waves	50th	50th
15 kHz to 30 kHz	f×128	8 waves	20th	20th
30 kHz to 75 kHz	f×64	16 waves	10th	10th
75 kHz to 150 kHz	f×32	32 waves	5th	5th

When the number of FFT points is 8192 (at 10 MS/s)

Fundamental frequency	Sample rate	Window width	Upper limit of harmonic analysis	
			U, I, P, Φ, ΦU, ΦI	Other measured values
0.5 Hz to 3 kHz	f×1024	8 waves	500th harmonic	100th
3 kHz to 7.5 kHz	f×1024	8 waves	200th	100th
7.5 kHz to 15 kHz	f×512	16 waves	100th	100th
15 kHz to 30 kHz	f×256	32 waves	50th	50th
30 kHz to 75 kHz	f×128	64 waves	20th	20th
75 kHz to 150 kHz	f×64	128 waves	10th	10th
150 kHz to 300 kHz	f×32	256 waves	5th	5th

The maximum order is 100 when the update interval is 50 ms or less.

When the number of FFT points is 8192 (at 5 MS/s)

Fundamental frequency	Sample rate	Window width	Upper limit of harmonic analysis	
			U, I, P, Φ, ΦU, ΦI	Other measured values
0.5 Hz to 1.2 kHz	f×1024	8 waves	500th harmonic	100th
1.2 kHz to 3 kHz	f×1024	8 waves	200th	100th
3 kHz to 7.5 kHz	f×512	16 waves	100th	100th
7.5 kHz to 15 kHz	f×256	32 waves	50th	50th
15 kHz to 30 kHz	f×128	64 waves	20th	20th
30 kHz to 75 kHz	f×64	128 waves	10th	10th
75 kHz to 150 kHz	f×32	256 waves	5th	5th

The maximum order is 100 when the update interval is 50 ms or less.

Measurement Function Computation

Normal Measurement

Voltage (V): Urms: true rms value, Umn: rectified mean value calibrated to the rms value, Urmn: current rectified mean value, Udc: simple average, Uac: AC component

Current (A): Irms: true rms value, Imn: rectified mean value calibrated to the rms value, Irmn: current rectified mean value, Idc: simple average, Iac: AC component

Active power (W): P, Pfnd: fundamental component

Apparent power (VA): S, Sfnd: fundamental component

Reactive power (var): Q, Qfnd: fundamental component

Power factor: λ, λfnd: fundamental component

Phase difference (°): Φ, Φfnd: fundamental component

Frequency (Hz): fU (FreqU): voltage frequency, fI (FreqI): current frequency
The fU and fI of elements 1 to 7 can be measured simultaneously.

f2U (Freq2U): voltage frequency, f2I (Freq2I): the current frequency when the second frequency filter is applied

Corrected Power(W): Pc
Applicable standards
IEC76-1 (1976), IEC76-1 (2011)

Voltage max. and min. (V)	U+pk: maximum voltage, U–pk: minimum voltage
Current max. and min. (A)	I+pk: maximum current, I–pk: minimum current
Power max. and min. (W)	P+pk: maximum power, P–pk: minimum power
Crest factor (peak-to-rms ratio)	CfU: voltage crest factor, CfI: current crest factor
Integration	ITime: integration time WP: sum of positive and negative watt hours WP+: sum of positive P (consumed watt hours) WP–: sum of negative P (watt hours returned to the power supply) q: sum of positive and negative ampere hours q+: sum of positive I (ampere hours) q–: sum of negative I (ampere hours) WS: volt-ampere hours WQ: var hours By using the current mode setting, you can select to integrate the ampere hours using Irms, Imn, Idc, Iac, or Irmn.
Voltage measurement range	RngU
Current measurement range	RngI

• Measurement Functions (Σ Functions) Determined for Each Wiring Unit (ΣA, ΣB, ΣC)
For details about how Σ function values are computed and determined, see appendix 1.

Voltage (V)	UrmsΣ: true rms value, UmnΣ: rectified mean value calibrated to the rms value, UrmnΣ: current rectified mean value, UdcΣ: simple average, UacΣ: AC component
Current (A)	IrmsΣ: true rms value, ImnΣ: rectified mean value calibrated to the rms value, IrmnΣ: current rectified mean value, IdcΣ: simple average, IacΣ: AC component
Active power (W)	PΣ
Apparent power (VA)	SΣ
Reactive power (var)	QΣ
Power factor	λΣ
Phase difference (°)	ΦΣ
Corrected Power (W)	PcΣ Applicable standards IEC76-1 (1976), IEC76-1 (2011)
Integration	WPΣ: sum of positive and negative watt hours WP+Σ: sum of positive P (consumed watt hours) WP–Σ: sum of negative P (watt hours returned to the power supply) qΣ: sum of positive and negative ampere hours q+Σ: sum of positive I (ampere hours) q–Σ: sum of negative I (ampere hours) WSΣ: Integration of SΣ WQΣ: Integration of QΣ

Harmonic Measurement Computation Feature

• Measurement Functions Determined for Each Input Element

Voltage (V)	U (k): rms voltage value of harmonic order k*1 U: total rms voltage*2
Current (A)	I (k): rms current value of harmonic order k I: total rms current*2
Active power (W)	P (k): active power of harmonic order k P: total active power*2
Apparent power (VA)	S (k): apparent power of harmonic order k S: total apparent power*2
Reactive power (var)	Q (k): reactive power of harmonic order k Q: total reactive power*2
Power factor	λ (k): power factor of harmonic order k λ: total power factor*2
Phase difference (°)	Φ (k): phase difference between the voltage and current of harmonic order k, Φ: total phase difference ΦU (k): phase difference between harmonic voltage U (k) and the fundamental wave U (1) ΦI (k): phase difference between harmonic current I (k) and the fundamental wave I (1)
Load circuit impedance (Ω)	Z (k): impedance of the load circuit in relation to harmonic order k
Load circuit resistance and reactance (Ω)	Rs (k): resistance of the load circuit in relation to harmonic order k when resistor R, inductor L, and capacitor C are connected in series Xs (k): reactance of the load circuit in relation to harmonic order k when resistor R, inductor L, and capacitor C are connected in series Rp (k): resistance of the load circuit in relation to harmonic order k when R, L, and C are connected in parallel Xp (k): reactance of the load circuit in relation to harmonic order k when R, L, and C are connected in parallel
Fundamental component of voltage (V)	Ufnd: U (1)
Fundamental component of current (A)	Ifnd: I (1)
Fundamental active power (W)	Pfnd: P (1)
Fundamental apparent power (VA)	Sfnd: S (1)
Fundamental reactive power (var)	Qfnd: Q (1)
Fundamental power factor	λfnd: λ (1)
Phase difference between the fundamental voltage and current (°)	Φfnd: Φ (1)
Harmonic distortion factor (%)	Uhdf (k): ratio of harmonic voltage U (k) to U (1) or U Ihdf (k): ratio of harmonic current I (k) to I (1) or I Phdf (k): ratio of harmonic active power P (k) to P (1) or P
Total harmonic distortion (%)	Uthd: ratio of the total harmonic voltage to U (1) or U*3 Ithd: ratio of the total harmonic current to I (1) or I*3 Pthd: ratio of the total harmonic active power to P (1) or P*3
Telephone harmonic factor [applicable standard: IEC34-1 (1996)]	Uthf: voltage telephone harmonic factor, Ithf: current telephone harmonic factor
Telephone influence factor [applicable standard: IEEE Std 100 (1996)]	Utif: voltage telephone influence factor, Itif: current telephone influence factor
Harmonic voltage factor*4	hvf: harmonic voltage factor
Harmonic current factor*4	hcf: harmonic current factor
K-factor	Ratio of the squared sum weighted harmonic components to the squared sum of the harmonic currents

• Measurement Functions (Σ Functions) Determined for Each Wiring Unit (ΣA, ΣB, ΣC)

Voltage (V)	UΣ (1): rms voltage of harmonic order 1	UΣ: total rms voltage*5
Current (A)	IΣ (1): rms current of harmonic order 1	IΣ: total rms current*5
Active power (W)	PΣ (1): active power of harmonic order 1	PΣ: total active power*5
Apparent power (VA)	SΣ (1): apparent power of harmonic order 1	SΣ: total apparent power*5
Reactive power (var)	QΣ (1): reactive power of harmonic order 1	QΣ: total reactive power*5
Power factor	λΣ (1): power factor of harmonic order 1	λΣ: total power factor*5

*1 Harmonic order k is an integer from 0 to the upper limit of harmonic analysis. The 0th order is the DC component. The upper limit is determined automatically according to the PLL source frequency. It can go up to the 500th harmonic order.
*2 The total value is determined according to the equation on page 4 of the appendix from the fundamental wave (1st harmonic) and all harmonic components (2nd harmonic to the upper limit of harmonic analysis). The DC component can also be included.
*3 Total harmonic values are determined from all harmonic components (the 2nd harmonic to the upper limit of harmonic analysis) according to the equations on page 5 of the appendix.
*4 The expression may vary depending on the definitions in the standard. For details, see the corresponding standard.
*5 The total value is determined according to the equation on page 4 of the appendix from the fundamental wave (1st harmonic) and all harmonic components (2nd harmonic to the upper limit of harmonic analysis). The DC component can also be included.

• Measurement Functions that Indicate Fundamental Voltage and Current Phase Differences between Input Elements
These measurement functions indicate the phase differences between the fundamental voltage U (1) of the smallest numbered input element in a wiring unit and the fundamental voltages U (1) or currents I (1) of other input elements. The following table indicates the measurement functions for a wiring unit that combines elements 1, 2, and 3.

Phase angle U1-U2 (°)	ΦU1-U2: phase angle between U1 (1) and the fundamental voltage of element 2, U2 (1)
Phase angle U1-U3 (°)	ΦU1-U3: phase angle between U1 (1) and the fundamental voltage of element 3, U3 (1)
Phase angle U1-I1 (°)	ΦU1-I1: phase angle between U1 (1) and the fundamental current of element 1, I1 (1)
Phase angle U2-I2 (°)	ΦU2-I2: phase angle between U2 (1) and the fundamental current of element 2, I2 (1)
Phase angle U3-I3 (°)	ΦU3-I3: phase angle between U3 (1) and the fundamental current of element 3, I3 (1)
EAM1U1 to EAM1U7 (°), EAM1I1 to EAM1I7 (°)	Phase angles of the fundamental waves of U1 to I7 with the rising edge of the signal received through the Motor1 (MTR1) Z terminal of the motor evaluation function as the reference.
EAM3U1 to EAM3U7 (°), EAM3I1 to EAM3I7 (°)	Phase angles of the fundamental waves of U1 to I7 with the rising edge of the signal received through the Motor3 (MTR2) Z terminal of the motor evaluation function as the reference.

Motor Evaluation Function (Option)

Motor rotating speed	Speed
Motor torque	Torque
Synchronous speed	SyncSp
Slip (%)	Slip
Motor output	Pm
Auxiliary input	AUX

Auxiliary I/O

External Clock Input Section

Input connector type	BNC
Input level	TTL
Sync signal input	Normal measurement: Frequency range: Same as the frequency measurement range Harmonic measurement: Frequency range: 0.1 Hz to 300 kHz *Input waveform: 50% duty ratio rectangular wave
Trigger input	Input logic: Negative logic, falling edge Minimum pulse width: 1 µs Trigger delay: Within (2 µs +12 µs)

External Monitor

Input connector type	D-sub 15 pin (receptacle)
Output format	Analog RGB output
Output resolution	WXGA output, 1280 × 800 dots Approx. 60 Hz Vsync (66 MHz dot clock frequency)

Remote, D/A (Option)

Input connector type	Micro ribbon connector (Amphenol 57LE connector), 36-pin
Control signal	Integration RESET: $\overline{\text{EXT RESET}}$ START: $\overline{\text{EXT START}}$ STOP: $\overline{\text{EXT STOP}}$ BUSY: $\overline{\text{INTEG BUSY}}$ Updating Data HOLD: $\overline{\text{EXT HOLD}}$ SINGLE: $\overline{\text{EXT SINGLE}}$
Input	0 to 5 V
Output	0 to 5 V

Peripheral Device Connection

USB

Connector type	Type A connector (receptacle)
Ports	2
Electrical and mechanical	Complies with USB Rev. 2.0
Supported transfer modes	HS (High Speed) mode (480 Mbps), FS (Full Speed) mode (12 Mbps), LS (Low Speed) mode (1.5 Mbps)
Compatible devices	Mass storage devices that comply with USB Mass Storage Class Ver. 1.1 Usable capacity: 8 TB, partition format: MBR/GPT, format type: FAT32/FAT16/exFAT 104 or 109 keyboards that comply with USB HID Class Ver. 1.1 Mouse devices that comply with USB HID Class Ver. 1.1
Power supply	5 V, 500 mA (each port) You cannot connect devices whose maximum current consumptions exceed 100 mA to two different ports on the instrument at the same time.

Computer Interface

GP-IB Interface

Input connector type	24-pin connector
Electrical and mechanical	Complies with IEEE St'd 488-1978 (JIS C 1901-1987)
Functional specifications	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, and C0
Protocol	Conforms to IEEE St'd 488.2-1992
Code	ISO (ASCII) code
Mode	Addressable mode
Address	0 to 30
Clear remote mode	Press UTILITY (LOCAL) to clear remote mode (except during Local Lockout).

Ethernet interface

Connector type	RJ-45 connector
Ports	1
Electrical and mechanical	IEEE802.3 compliant, Auto-MDIX
Transmission system	Ethernet1000Base-T/100BASE-TX/10BASE-T
Communication protocol	TCP/IP
Supported services	FTP server, DHCP, DNS, remote control (VXI-11), SNTP, and FTP client

USB PC Interface

Connector type	Type B connector (receptacle)
Ports	1
Electrical and mechanical	Complies with USB 3.0
Supported transfer modes	SS (SuperSpeed) mode (5 Gbps), HS (High Speed) mode (480 Mbps), FS (Full Speed) mode (12 Mbps)
Supported protocols	USBTMC-USB488 (USB Test and Measurement Class Ver. 1.0)
PC system requirements	A PC with a USB port, running Windows 7, Windows 8.1, or Windows 10. A separate device driver is required to enable the connection with the PC.

System Maintenance Processing

Alarm Generation and Operation

Fan stop	Fan stop alarm indication Emergency operation stop after about 60 seconds*
Internal temperature error	Temperature error alarm indication Emergency operation stop*

*Emergency operation stop
Stops the power supply for running the instrument
Stops the power supply to elements, motor (/MTR1/MTR2), and D/A output (/DA20)
Generates intermittent beeps, MENU key in the SETUP area blinks in red
Continues the fan operation

General Specifications

Warm-up time	Approx. 30 minutes	
Operating environment	Temperature	5°C to 40°C
	Humidity	20% RH to 80% RH (no condensation)
	Operating altitude	2000 m or less
	Installation location	Indoors
Storage environment	Temperature	–25°C to 60°C (no condensation)
	Humidity	20% RH to 80% RH (no condensation)
Rated supply voltage	100 VAC to 120 VAC, 220 VAC to 240 VAC	
Permitted supply voltage range	90 VAC to 132 VAC, 198 VAC to 264 VAC	
Rated supply frequency	50/60 Hz	
Permitted supply frequency range	48 Hz to 63 Hz	
Maximum power consumption	560 VA	
Power fuse	Built in, not replaceable	
Cooling method	Forced air cooling, air vents on the left, right, and top panels	
Installation orientation	Horizontal, tilted (using the stand)	
External dimensions	177 mm (H) × 426 mm (W) × 496 mm (D) (excluding the handles and protrusions)	
Weight	Approx. 12.5 kg (main unit only with /M1/MTR1/DA20 installed)	
Battery backup	Setup parameters and the internal clock are backed up with a lithium battery.	
Safety standards[1]	Compliant standards EN 61010-1, EN 61010-2-030, EN 61010-031, EN 60825-1 Installation category (overvoltage category) CAT II*1 Measurement category CAT II*2 Pollution degree 2*3 Approved (WT5000, 760901, 760902)	

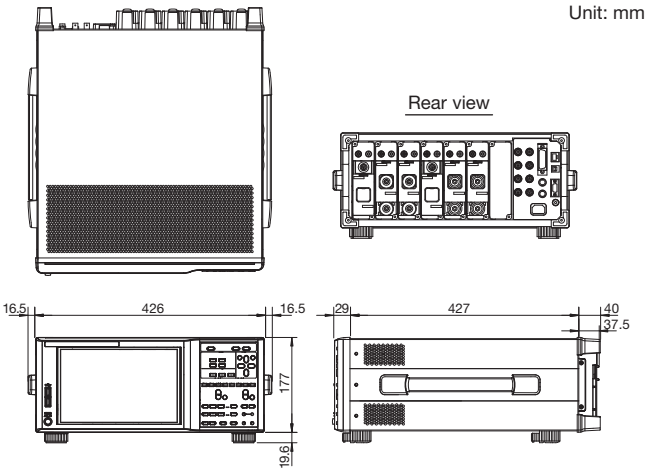
*1 The overvoltage category (installation category) is a value used to define the transient overvoltage condition and includes the rated impulse withstand voltage. CAT II applies to electrical equipment that is powered through a fixed installation, such as a wall outlet wired to a distribution board.

*2 This instrument is a measurement category II product. Do not use it for measurement category III or IV measurements.
Measurement category O applies to measurement of other types of circuits that are not directly connected to a main power source.
Measurement Category II applies to electrical equipment that is powered through a fixed installation, such as a wall outlet wired to a distribution board, and to measurement performed on such wiring.
Measurement category III applies to measurement of facility circuits, such as distribution boards and circuit breakers.
Measurement category IV applies to measurement of power source circuits, such as entrance cables to buildings and cable systems, for low-voltage installations.

*3 Pollution Degree applies to the degree of adhesion of a solid, liquid, or gas that deteriorates withstand voltage or surface resistivity. Pollution Degree 2 applies to normal indoor atmospheres (with only non-conductive pollution).

External Dimensions

Unit: mm



WT5000
The following information is printed on the top.

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007
2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan

760901 30A High Accuracy Element

Input terminal type	Voltage Plug-in terminal (safety terminal)
	Current Direct input: Plug-in terminal (safety terminal) External current sensor input: isolated BNC
Input type	Voltage Floating input through resistive voltage divider
	Current Floating input through shunt
Measurement range	Voltage 1.5/3/6/10/15/30/60/100/150/300/600/1000 V (crest factor CF3) 0.75/1.5/3/5/7.5/15/30/50/75/150/300/500 V (crest factor CF6) 0.75/1.5/3/5/7.5/15/30/50/75/150/300/500 V (crest factor CF6A)
	Current Direct input 500 mA, 1 A, 2 A, 5 A, 10 A, 20 A, 30 A (crest factor CF3) 250 mA, 500 mA, 1 A, 2.5 A, 5 A, 10 A, 15 A (crest factor CF6) 250 mA, 500 mA, 1 A, 2.5 A, 5 A, 10 A, 15 A (crest factor CF6A)
	External current sensor input 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V (crest factor CF3) 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V, 2.5 V, 5 V (crest factor CF6) 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V, 2.5 V, 5 V (crest factor CF6A)
Input impedance	Voltage 10 MΩ ±1%//approx. 15 pF
	Current Direct input: 6.5 mΩ ±10% + approx. 0.3 μH
	External current sensor input: 1 MΩ ±1%//approx. 50 pF
Instantaneous maximum allowable input (within 1 s)	Voltage Peak value of 2.5 kV or RMS value of 1.5 kV, whichever is less
	Current Direct input Peak value of 150 A or rms value of 50 A, whichever is less.
	External current sensor input Peak value 10 times the range or 25 V, whichever is less
Continuous maximum allowable input	Voltage Peak value of 1.6 kV or RMS value of 1.5 kV, whichever is less If the frequency of the input voltage exceeds 100 kHz, (1200 – f) Vrms or less. f is the frequency of the input voltage in units of kHz.
	Current Direct input Peak value of 90 A or rms value of 33 A, whichever is less.
	External current sensor input Peak value 5 times the range or 25 V, whichever is less
Maximum rated voltage to earth (DC to 50/60 Hz)	Voltage input terminal 1000 V CAT II
	Current input terminal 1000 V CAT II
	External current sensor input connector 1000 V CAT II
Influence of voltage to earth	When 1000 Vrms is applied between the input terminal and the WT5000 case with the voltage input terminals shorted, current input terminals open and external current sensor input terminals shorted. 50/60 Hz: ±0.01% of range or less. Reference value for up to 200 kHz Voltage ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less
	Current Direct input ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less
	External current sensor input ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less However, 0.01% or greater. The unit of f is kHz. The maximum range rating in the equation is for a voltage of 1000 V, direct current input of 30 A, and external current sensor input of 10 V.
A/D converter	Simultaneous conversion of voltage and current inputs. Resolution: 18 bits Sample rate: 10 MS/s max.
Measurement frequency bandwidth	DC, 0.1 Hz to 2 MHz

Lower limit of measurement frequency

Sync source period average method

Data update interval	
50 ms	45 Hz
100 ms	20 Hz
200 ms	10 Hz
500 ms	5 Hz
1 s	2 Hz
2 s	1 Hz
5 s	0.5 Hz
10 s	0.2 Hz
20 s	0.1 Hz

Digital filter average method	
FAST	100 Hz
MID	10 Hz
SLOW	1 Hz
VSLOW	0.1 Hz

Maximum display: 140% of the rated voltage or current range (160% for the 1000 V range)
280% of the voltage and current range rating for CF6A (except 320% for the 500 V range)

Accuracy

Accuracy (6 months)

For the 1 year accuracy, multiply the 6 month accuracy by 1.5.

Condition
Temperature: 23°C±5°C
Humidity: 30%RH to 75%RH
Input waveform: Sine wave
λ (power factor): 1
Voltage to ground: 0 V
Crest factor: CF3
Line filter: OFF
Period average method
Frequency filter: Used for signal frequencies at 1 kHz or less (for sync source period average method)
Sync source signal level: Same as the frequency measurement conditions
Input range: DC 0% to ±110% of range, AC 1% to 110% of range
Defined using rms values for AC
After the warm-up time has elapsed.
Wired condition after zero-level compensation or measurement range change.
The unit of f in the accuracy equations is kHz.

Voltage	
DC	±(0.02% of reading + 0.05% of range)
0.1 Hz ≤ f < 10 Hz	±(0.03% of reading + 0.05% of range)
10 Hz ≤ f < 45 Hz	±(0.03% of reading + 0.05% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.03% of reading + 0.04% of range)
1 kHz < f ≤ 10 kHz	±(0.1% of reading + 0.05% of range) Add 0.015 × f % of reading (10 V range or less).
10 kHz < f ≤ 50 kHz	±(0.3% of reading + 0.1% of range)
50 kHz < f ≤ 100 kHz	±(0.6% of reading + 0.2% of range)
100 kHz < f ≤ 500 kHz	±{(0.006 × f)% of reading + 0.5% of range}
500 kHz < f ≤ 1 MHz	±{(0.022 × f – 8)% of reading + 1% of range}
Frequency bandwith	DC to 10 MHz (Typical)

Current	
DC	±(0.02% of reading + 0.05% of range)
0.1 Hz ≤ f < 10 Hz	±(0.03% of reading + 0.05% of range)
10 Hz ≤ f < 45 Hz	±(0.03% of reading + 0.05% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.03% of reading + 0.04% of range)
1 kHz < f ≤ 10 kHz	±(0.1% of reading + 0.05% of range)
10 kHz < f ≤ 50 kHz	±(0.3% of reading + 0.1% of range)
50 kHz < f ≤ 100 kHz	±(0.6% of reading + 0.2% of range)
100 kHz < f ≤ 200 kHz	±{(0.00725 × f – 0.125)% of reading + 0.5% of range}
200 kHz < f ≤ 500 kHz	±{(0.00725 × f – 0.125)% of reading + 0.5% of range}
500 kHz < f ≤ 1 MHz	±{(0.022 × f – 8)% of reading + 1% of range}
Frequency bandwidth	Direct input: DC to 5 MHz (typical) External current sensor input: DC to 5 MHz (typical)

Active power (power factor 1)	
DC	±(0.02% of reading + 0.05% of range)
0.1 Hz ≤ f < 10 Hz	±(0.08% of reading + 0.1% of range)
10 Hz ≤ f < 30 Hz	±(0.08% of reading + 0.1% of range)
30 Hz ≤ f < 45 Hz	±(0.05% of reading + 0.05% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.05% of reading + 0.05% of range)
1 kHz < f ≤ 10 kHz	±(0.15% of reading + 0.1% of range) Add 0.01 × f % of reading (10 V range or less).
10 kHz < f ≤ 50 kHz	±(0.3% of reading + 0.2% of range)
50 kHz < f ≤ 100 kHz	±(0.7% of reading + 0.3% of range)
100 kHz < f ≤ 200 kHz	±{(0.008 × f)% of reading + 1% of range}
200 kHz < f ≤ 500 kHz	±{(0.008 × f)% of reading + 1% of range}
500 kHz < f ≤ 1 MHz	±{(0.048 × f – 20)% of reading + 1% of range}

- For the direct current input range, add the following values to the accuracies listed above
  DC current accuracy: 0.1 mA
  DC power accuracy: (0.1 mA/rated value of the direct current input range) × 100% of range
- For the accuracies of waveform data functions Upk and Ipk
  Add the following values (reference values) to the accuracies listed above
  The effective input range is within ±300% (±600% when the crest factor is set to CF6 or CF6A) of the range.
  Voltage input: {$\sqrt{1.5/\text{range}}$ + 0.5}% of range
  Direct current input range
  {$\sqrt{1/\text{range}}$ % of range + 10 mA}
  External current sensor input range
  {$\sqrt{0.01/\text{range}}$ + 0.5}% of range (50 mV to 200 mV)
  {$\sqrt{0.1/\text{range}}$ + 0.5}% of range (500 mV to 10 V)
- Influence of temperature changes after zero-level compensation or range change
  Add the following values to the accuracies listed above.
  - DC voltage accuracy: ±0.02% of range/°C (1.5 V to 10 V range)
    ±0.005% of range/°C (15 V to 1000 V range)
  - Direct current input DC accuracy: ±0.1 mA/°C
  - External current sensor input DC accuracy: ±50 µV/°C (50 mV to 200 mV)
    ±200 µV/°C (0.5 V to 10 V)

  For the DC power accuracy, add the voltage influence × I and the current influence × U.
  U is the voltage reading (V).
  I is the current reading (A).
- Influence of self-generated heat caused by current input
  Add the following values to the current accuracy:
  For the power accuracy, add the voltage and the current influence.
  - AC input signal
    Current, active power, apparent power: 0.00002 × I²% of reading
  - DC input signal
    Current: 0.00002 × I²% of reading + 3 × I² mA
    Power: 0.00002 × I² % of reading + 3 × I² mA × U

  U is the voltage reading (V).
  I is the current reading (A).
  Even if the current input decreases, the influence from self-generated heat continues until the temperature of the shunt resistor decreases.
- Guaranteed accuracy ranges for frequency, voltage, and current
  All accuracy figures for 0.1 Hz to 10 Hz are reference values.
  The voltage and power accuracy figures for 30 kHz to 100 kHz when the voltage exceeds 750 V are reference values.
  The current and power accuracy figures for DC, 10 Hz to 45 Hz, and 400 Hz to 100 kHz when the current exceeds 20 A are reference values.
- Influence of data update interval
  Add the following value for signal sync period average
  50 ms: 0.03% of reading
  100 ms: 0.02% of reading
- Accuracy when the crest factor is set to CF6 or CF6A:
  The same as the accuracy when the crest factor is CF3 after doubling the range.

Power factor (λ) influence	When λ = 0 Apparent power reading × 0.02% in the range of 45 Hz to 66 Hz. For other frequency ranges, see below. However, note that these figures are reference values. Apparent power reading × (0.02 + 0.05 × f)% When 0 < λ < 1 (Power reading) × [(power reading error %) + (power range error %) × (power range/indicated apparent power value) + {tan φ × (influence when λ = 0)%}], where φ is the phase angle between the voltage and current.
Temperature coefficient	±0.01% of reading/°C (5°C to 18°C or 28°C to 40°C)
Influence of humidity	l Add to the voltage and active power accuracies: ±0.00022 × |HUM – 50| × f % of reading: f ≤ 40 kHz ±0.0087 × |HUM – 50| % of reading: f > 40 kHz Reference: Add to the power factor error. When λ = 0 Apparent power reading × 0.00002 × |HUM – 50| × f% When 0 < λ < 1 (Power reading) × {(power reading error %) + (power range error %) × (power range/indicated apparent power value) + [tan φ × (influence when λ = 0)%]}, HUM: Relative humidity [%RH] The unit of f in the accuracy equations is kHz.
Effective input range	Udc, Idc: 0% to ±130% of the measurement range (excluding the 1000 V range)* Udc 1000 V range: 0% to ±150%* Urms, Irms: 1% to 130% of the measurement range* Umn, Imn: 10% to 130% of the measurement range* Urmn, Irmn: 10% to 130% of the measurement range* Power DC measurement: 0% to ±130%* AC measurement: 1% to 130%* of the voltage and current ranges; up to ±130%* of the power range *The accuracy for 110% to 130% of the measurement range (excluding the 1000 V range) is range error × 1.5. If the input voltage exceeds 600 V, add 0.02% of reading. However, the signal level for the signal sync period average must meet the input signal level for frequency measurement. When the crest factor is set to CF6 or CF6A, double the lower limit.
Accuracy of apparent power S	Voltage accuracy + current accuracy
Accuracy of reactive power Q	Accuracy of apparent power + ($\sqrt{1.0002 - \lambda^2} - \sqrt{1 - \lambda^2}$) × 100% of range

Accuracy of power factor λ	±[(λ – λ/1.0002) + |cosφ – cos{φ + sin⁻¹((influence from the power factor when λ = 0)%/100)}|] ±1 digit The voltage and current must be within their rated ranges.
Accuracy of phase difference Φ	±[|φ – {cos⁻¹(λ/1.0002)}| + sin⁻¹{(influence from the power factor when λ = 0)%/100}] deg ±1 digit The voltage and current must be within their rated ranges.
Lead and lag detection	Phase difference: ±(5° to 175°) Frequency: 20 Hz to 10 kHz Condition: Sine wave At least 50% of the measurement range (at least 100% for CF6 and CF6A)
Line filter	Bessel, 5th order LPF, fc: 1 MHz Voltage, current Up to 100 kHz: Add (20 × f/fc)% of reading Power Up to 100 kHz: Add (40 × f/fc)% of reading For LPFs less than or equal to 100 kHz, see “Line filter”.
Frequency measurement	Frequency measurement range

Data update interval	Measurement range
50 ms	45 Hz ≤ f ≤ 2 MHz
100 ms	20 Hz ≤ f ≤ 2 MHz
200 ms	10 Hz ≤ f ≤ 2 MHz
500 ms	5 Hz ≤ f ≤ 2 MHz
1 s	2 Hz ≤ f ≤ 2 MHz
2 s	1 Hz ≤ f ≤ 2 MHz
5 s	0.5 Hz ≤ f ≤ 2 MHz
10 s	0.2 Hz ≤ f ≤ 2 MHz
20 s	0.1 Hz ≤ f ≤ 2 MHz

Accuracy: ±0.06% of reading ±0.1 mHz
Conditions:
Input signal level:
CF3: At least 30% of the measurement range
CF6/6A: At least 60% of the measurement range
However, at least 50% of the range if the signal is less than or equal to twice the lower measurement frequency
Frequency filter
0.1 Hz ≤ f < 100 Hz: 100 Hz
100 Hz ≤ f < 1 kHz: 1 kHz
1 kHz ≤ f < 100 kHz: 100 kHz

Harmonic measurement

PLL source input level
50% or more of the rated measurement range when the crest factor is CF3.
100% or more of the rated measurement range when the crest factor is CF6 or CF6A.

Accuracy
Add the following accuracy values to the normal measurement accuracy values.
- When line filters are turned off

Frequency	Voltage, current
0.1 Hz ≤ f < 10 Hz	±(0.01% of reading + 0.03% of range)
10 Hz ≤ f < 45 Hz	±(0.01% of reading + 0.03% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.03% of range)
66 Hz < f ≤ 440 Hz	±(0.01% of reading + 0.03% of range)
440 Hz < f ≤ 1 kHz	±(0.01% of reading + 0.03% of range)
1 kHz < f ≤ 10 kHz	±(0.01% of reading + 0.03% of range)
10 kHz < f ≤ 50 kHz	±(0.05% of reading + 0.1% of range)
50 kHz < f ≤ 100 kHz	±(0.1% of reading + 0.2% of range)
100 kHz < f ≤ 500 kHz	±(0.1% of reading + 0.5% of range)
500 kHz < f ≤ 1.5 MHz	±(0.5% of reading + 2% of range)

Frequency	Power
0.1 Hz ≤ f < 10 Hz	±(0.02% of reading + 0.06% of range)
10 Hz ≤ f < 45 Hz	±(0.02% of reading + 0.06% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.02% of reading + 0.06% of range)
66 Hz < f ≤ 440 Hz	±(0.02% of reading + 0.06% of range)
440 Hz < f ≤ 1 kHz	±(0.02% of reading + 0.06% of range)
1 kHz < f ≤ 10 kHz	±(0.02% of reading + 0.06% of range)
10 kHz < f ≤ 50 kHz	±(0.1% of reading + 0.2% of range)
50 kHz < f ≤ 100 kHz	±(0.2% of reading + 0.4% of range)
100 kHz < f ≤ 500 kHz	±(0.2% of reading + 1% of range)
500 kHz < f ≤ 1.5 MHz	±(1% of reading + 4% of range)

- When line filters are turned on
  Add the line filter influence to the accuracy values when the line filters are turned off.
- When the crest factor is set to CF3
- When λ (the power factor) is 1
- Power figures that exceed 10 kHz are reference values.
- For the voltage range, add 25 mV to the voltage accuracy and (25 mV/current range rating) × 100% of range to the power accuracy.
- For the direct current input range, add 20 mA to the current accuracy and (20 mV/current range rating) × 100% of range to the power accuracy.

- For the external current sensor range, add 2 mV to the current accuracy and (2 mV/rated value of the external current sensor range) × 100% of range to the power accuracy.
- When the number of FFT points is 1024, add ±0.2% to the voltage and current range errors and ±0.4% to the power range error.
- Add (n/500)% of reading to the n^{th} component of the voltage and current, and add (n/250)% of reading to the n^{th} component of the power.
- The accuracy when the crest factor is CF6 or CF6A is the same as the accuracy when the crest factor is 3 after doubling the measurement range.
- The guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for normal measurement.
- The neighboring harmonic orders may be affected by the side lobes from the input harmonic order.

When FFT points is set to 8192
When the frequency of the PLL source is 2 Hz or greater, for n^{th} order component input, add {[n/(m + 1)]/50}% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the voltage and current, and add {[n/(m + 1)]/25}% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the power.

When the frequency of the PLL source is less than 2 Hz, for n^{th} order component input, add {[n/(m + 1)]/20}% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the voltage and current, and add {[n/(m + 1)]/10}% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the power.

When FFT points is set to 1024
When the frequency of the PLL source is 75 Hz or greater, for n^{th} order component input, add ({n/(m + 1)}/50)% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the voltage and current, and add ({n/(m + 1)}/25)% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the power.

When the frequency of the PLL source is less than 75 Hz, for n^{th} order component input, add ({n/(m + 1)}/5)% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the voltage and current, and add (2 × {n/(m + 1)}/5)% of (the n^{th} order reading) to the n + m^{th} order and n – m^{th} order of the power.

Dimensions

Dimensions	Approx. 145 mm (H) x 42 mm (W) x 297 mm (D) *The depth includes the slide cover (293 mm if slide cover is excluded).
Weight	Approx. 900 g
Connection	50-pin B to B connector

• 760901 30A High Accuracy Element
The following information is printed on the side.

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007
2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan

760902 5A High Accuracy Element

Input terminal type	Voltage Plug-in terminal (safety terminal)
	Current Direct input: Plug-in terminal (safety terminal) External current sensor input: isolated BNC
Input type	Voltage Floating input through resistive voltage divider
	Current Floating input through shunt
Measurement range	Voltage 1.5/3/6/10/15/30/60/100/150/300/600/1000 V (crest factor CF3) 0.75/1.5/3/5/7.5/15/30/50/75/150/300/500 V (crest factor CF6) 0.75/1.5/3/5/7.5/15/30/50/75/150/300/500 V (crest factor CF6A)
	Current Direct input 5 mA, 10 mA, 20 mA, 50 mA, 100 mA, 200 mA, 500 mA, 1 A, 2 A, 5 A (crest factor CF3) 2.5 mA, 5 mA, 10 mA, 25 mA, 50 mA, 100 mA, 250 mA, 500 mA, 1 A, 2.5 A (crest factor CF6) 2.5 mA, 5 mA, 10 mA, 25 mA, 50 mA, 100 mA, 250 mA, 500 mA, 1 A, 2.5 A (crest factor CF6A)
	External current sensor input 50 mV, 100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V (crest factor CF3) 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V, 2.5 V, 5 V (crest factor CF6) 25 mV, 50 mV, 100 mV, 250 mV, 500 mV, 1 V, 2.5 V, 5 V (crest factor CF6A)
Input impedance	Voltage 10 MΩ ±1%//approx. 15 pF
	Current Direct input: 0.5 Ω ±10% + approx. 0.3 μH (200 mA or lower ranges) 0.11 Ω ±10% + approx. 0.3 μH (500 mA or higher ranges)
	External current sensor input: 1 MΩ ±1%//approx. 50 pF
Instantaneous maximum allowable input (within 1 s)	Voltage Peak value of 2.5 kV or RMS value of 1.5 kV, whichever is less
	Current Direct input Peak value of 30 A or rms value of 15 A, whichever is less.
	External current sensor input Peak value 10 times the range or 25 V, whichever is less

Continuous maximum allowable input	Voltage Peak value of 1.6 kV or RMS value of 1.5 kV, whichever is less If the frequency of the input voltage exceeds 100 kHz, (1200 – f) Vrms or less. f is the frequency of the input voltage in units of kHz.
	Current Direct input Peak value of 10 A or rms value of 7 A, whichever is less.
	External current sensor input Peak value 5 times the range or 25 V, whichever is less
Maximum rated voltage to earth (DC to 50/60 Hz)	Voltage input terminal 1000 V CAT II
	Current input terminal 1000 V CAT II
	External current sensor input connector 1000 V CAT II
Influence of voltage to earth	When 1000 Vrms is applied between the input terminal and the WT5000 case with the voltage input terminals shorted, current input terminals open and external current sensor input terminals shorted. 50/60 Hz: ±0.01% of range or less. Reference value for up to 200 kHz Voltage ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less
	Current Direct input ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less
	External current sensor input ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less However, 0.01% or greater. The unit of f is kHz. The maximum range rating in the equation is for a voltage of 1000 V, direct current input of 5 A, and external current sensor input of 10 V.
A/D converter	Simultaneous conversion of voltage and current inputs. Resolution: 18 bits Sample rate: 10 MS/s max.
Measurement frequency bandwidth	DC, 0.1 Hz to 2 MHz

Lower limit of measurement frequency

Sync source period average method

Data update interval	
50 ms	45 Hz
100 ms	20 Hz
200 ms	10 Hz
500 ms	5 Hz
1 s	2 Hz
2 s	1 Hz
5 s	0.5 Hz
10 s	0.2 Hz
20 s	0.1 Hz

Digital filter average method	
FAST	100 Hz
MID	10 Hz
SLOW	1 Hz
VSLOW	0.1 Hz

Maximum display: 140% of the rated voltage or current range (160% for the 1000 V range)
280% of the voltage and current range rating for CF6A (except 320% for the 500 V range)

Accuracy

Accuracy (6 months)

For the 1 year accuracy, multiply the 6 month accuracy by 1.5.

Condition
Temperature: 23°C±5°C
Humidity: 30%RH to 75%RH
Input waveform: Sine wave
λ (power factor): 1
Voltage to ground: 0 V
Crest factor: CF3
Line filter: OFF
Period average method
Frequency filter: Used for signal frequencies at 1 kHz or less (for sync source period average method)
Sync source signal level: Same as the frequency measurement conditions
Input range: DC 0% to ±110% of range, AC 1% to 110% of range
Defined using rms values for AC
After the warm-up time has elapsed.
Wired condition after zero-level compensation or measurement range change.
The unit of f in the accuracy equations is kHz.

Voltage	
DC	±(0.02% of reading + 0.05% of range)
0.1 Hz ≤ f < 10 Hz	±(0.03% of reading + 0.05% of range)
10 Hz ≤ f < 45 Hz	±(0.03% of reading + 0.05% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.03% of reading + 0.04% of range)
1 kHz < f ≤ 10 kHz	±(0.1% of reading + 0.05% of range) Add 0.015 × f % of reading (10 V range or less).
10 kHz < f ≤ 50 kHz	±(0.3% of reading + 0.1% of range)
50 kHz < f ≤ 100 kHz	±(0.6% of reading + 0.2% of range)
100 kHz < f ≤ 500 kHz	±{(0.006 × f)% of reading + 0.5% of range}
500 kHz < f ≤ 1 MHz	±{(0.022 × f – 8)% of reading + 1% of range}
Frequency bandwith	DC to 10 MHz (Typical)

Current	
DC	±(0.02% of reading + 0.05% of range)
0.1 Hz ≤ f < 10 Hz	±(0.03% of reading + 0.05% of range)
10 Hz ≤ f < 45 Hz	±(0.03% of reading + 0.05% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range) ± 0.5 μA (Direct input only)
66 Hz < f ≤ 1 kHz	±(0.03% of reading + 0.04% of range)
1 kHz < f ≤ 10 kHz	±(0.1% of reading + 0.05% of range)
10 kHz < f ≤ 50 kHz	±(0.3% of reading + 0.1% of range)
50 kHz < f ≤ 100 kHz	±(0.6% of reading + 0.2% of range)
100 kHz < f ≤ 200 kHz	±{(0.00725 × f – 0.125)% of reading + 0.5% of range}
200 kHz < f ≤ 500 kHz	±{(0.00725 × f – 0.125)% of reading + 0.5% of range}
500 kHz < f ≤ 1 MHz	±{(0.022 × f – 8)% of reading + 1% of range}
Frequency bandwidth	Direct input: DC to 5 MHz (typical) External current sensor input: DC to 5 MHz (typical)

Active power (power factor 1)	
DC	±(0.02% of reading + 0.05% of range)
0.1 Hz ≤ f < 10 Hz	±(0.08% of reading + 0.1% of range)
10 Hz ≤ f < 30 Hz	±(0.08% of reading + 0.1% of range)
30 Hz ≤ f < 45 Hz	±(0.05% of reading + 0.05% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.05% of reading + 0.05% of range)
1 kHz < f ≤ 10 kHz	±(0.15% of reading + 0.1% of range) Add 0.01 × f % of reading (10 V range or less).
10 kHz < f ≤ 50 kHz	±(0.3% of reading + 0.2% of range)
50 kHz < f ≤ 100 kHz	±(0.7% of reading + 0.3% of range)
100 kHz < f ≤ 200 kHz	±{(0.008 × f)% of reading + 1% of range}
200 kHz < f ≤ 500 kHz	±{(0.008 × f)% of reading + 1% of range}
500 kHz < f ≤ 1 MHz	±{(0.048 × f – 20)% of reading + 1% of range}

- For the direct current input range, add the following values to the accuracies listed above
  DC current accuracy: 1 μA
  DC power accuracy: (1 μA/rated value of the direct current input range) × 100% of range
- For the accuracies of waveform data functions Upk and Ipk
  Add the following values (reference values) to the accuracies listed above
  The effective input range is within ±300% (±600% when the crest factor is set to CF6 or CF6A) of the range.
  Voltage input: $\{\sqrt{1.5/\text{range}} + 0.5\}$% of range
  Direct current input range
  $\{[\sqrt{0.01/\text{range}} + 0.5]$% of range + 100 μA} (200 mA or lower ranges)
  $\{[\sqrt{0.1/\text{range}} + 0.5]$% of range + 100 μA} (500 mA or higher ranges)
  External current sensor input range
  $\{\sqrt{0.01/\text{range}} + 0.5\}$% of range (50 mV to 200 mV)
  $\{\sqrt{0.05/\text{range}} + 0.5\}$% of range (500 mV to 10 V)
- Influence of temperature changes after zero-level compensation or range change
  Add the following values to the accuracies listed above.
  - DC voltage accuracy: ±0.02% of range/°C (1.5 V to 10 V range)
    ±0.005% of range/°C ±(15 V to 1000 V range)
  - Direct current input DC accuracy: ±1 μA/°C
  - External current sensor input DC accuracy: ±50 μV/°C (50 mV to 200 mV)
    ±200 μV/°C (0.5 V to 10 V)

  For the DC power accuracy, add the voltage influence × I and the current influence × U.
  U is the voltage reading (V).
  I is the current reading (A).
- Influence of self-generated heat caused by current input
  Add the following values to the current accuracy:
  For the power accuracy, add the voltage and the current influence.
  - AC input signal
    Current, active power, apparent power: 0.004 × I²% of reading
  - DC input signal
    Current: 0.004 × I²% of reading + 6 × I² μA
    Power: 0.004 × I² % of reading + 6 × I² μA × U

  U is the voltage reading (V).
  I is the current reading (A).
  Even if the current input decreases, the influence from self-generated heat continues until the temperature of the shunt resistor decreases.
- Guaranteed accuracy ranges for frequency, voltage, and current
  All accuracy figures for 0.1 Hz to 10 Hz are reference values.
  The voltage and power accuracy figures for 30 kHz to 100 kHz when the voltage exceeds 750 V are reference values.
  The current and power accuracy figures for DC, 10 Hz to 45 Hz, and 400 Hz to 100 kHz when the current exceeds 20 A are reference values.
- Influence of data update interval
  Add the following value for signal sync period average
  50 ms: 0.03% of reading
  100 ms: 0.02% of reading
- Accuracy when the crest factor is set to CF6 or CF6A:
  The same as the accuracy when the crest factor is CF3 after doubling the range.

Power factor (λ) influence

When λ = 0
Apparent power reading × 0.02% in the range of 45 Hz to 66 Hz.
For other frequency ranges, see below. However, note that these figures are reference values.
Apparent power reading × (0.02 + 0.05 × f)%

When 0 < λ < 1
(Power reading) × [(power reading error %) + (power range error %) × (power range/indicated apparent power value) + {tan φ × (influence when λ = 0)%}],
where φ is the phase angle between the voltage and current.

Temperature coefficient: ±0.01% of reading/°C (5°C to 18°C or 28°C to 40°C)

Influence of humidity

I Add to the voltage and active power accuracies:
±0.00022 × |HUM – 50| × f % of reading: f ≤ 40 kHz
±0.0087 × |HUM – 50| % of reading: f > 40 kHz
Reference: Add to the power factor error.
When λ = 0
Apparent power reading × 0.00002 × |HUM – 50| × f%
When 0 < λ < 1
(Power reading) × {(power reading error %) + (power range error %) × (power range/indicated apparent power value) + [tan φ × (influence when λ = 0)%]},
HUM: Relative humidity [%RH]
The unit of f in the accuracy equations is kHz.

Effective input range

Udc, Idc: 0% to ±130% of the measurement range (excluding the 1000 V range)*
Udc 1000 V range: 0% to ±150%*
Urms, Irms: 1% to 130% of the measurement range*
Umn, Imn: 10% to 130% of the measurement range*
Urmn, Irmn: 10% to 130% of the measurement range*
Power
DC measurement: 0% to ±130%*
AC measurement: 1% to 130%* of the voltage and current ranges; up to ±130%* of the power range

*The accuracy for 110% to 130% of the measurement range (excluding the 1000 V range) is range error × 1.5.
If the input voltage exceeds 600 V, add 0.02% of reading.
However, the signal level for the signal sync period average must meet the input signal level for frequency measurement.
When the crest factor is set to CF6 or CF6A, double the lower limit.

Accuracy of apparent power S: Voltage accuracy + current accuracy

Accuracy of reactive power Q: Accuracy of apparent power + $(\sqrt{1.0002 - \lambda^2} - \sqrt{1 - \lambda^2})$ × 100% of range

Accuracy of power factor λ	±[(λ – λ/1.0002) + |cosφ – cos{φ + sin^{-1}((influence from the power factor when λ = 0)%/100)}|] ±1 digit The voltage and current must be within their rated ranges.
Accuracy of phase difference Φ	±[|φ – {cos^{-1}(λ/1.0002)}| + sin^{-1}((influence from the power factor when λ = 0)%/100)] deg ±1 digit The voltage and current must be within their rated ranges.
Lead and lag detection	Phase difference: ±(5° to 175°) Frequency: 20 Hz to 10 kHz Condition: Sine wave At least 50% of the measurement range (at least 100% for CF6 and CF6A)
Line filter	Bessel, 5th order LPF, fc: 1 MHz Voltage, current Up to 100 kHz: Add (20 × f/fc)% of reading Power Up to 100 kHz: Add (40 × f/fc)% of reading For LPFs less than or equal to 100 kHz, see “Line filter”.
Frequency measurement	Frequency measurement range

Data update interval	Measurement range
50 ms	45 Hz ≤ f ≤ 2 MHz
100 ms	20 Hz ≤ f ≤ 2 MHz
200 ms	10 Hz ≤ f ≤ 2 MHz
500 ms	5 Hz ≤ f ≤ 2 MHz
1 s	2 Hz ≤ f ≤ 2 MHz
2 s	1 Hz ≤ f ≤ 2 MHz
5 s	0.5 Hz ≤ f ≤ 2 MHz
10 s	0.2 Hz ≤ f ≤ 2 MHz
20 s	0.1 Hz ≤ f ≤ 2 MHz

Accuracy: ±0.06% of reading ±0.1 mHz
Conditions:
Input signal level:
CF3: At least 30% of the measurement range
CF6/6A: At least 60% of the measurement range
However, at least 50% of the range if the signal is less than or equal to twice the lower measurement frequency
Frequency filter
0.1 Hz ≤ f < 100 Hz: 100 Hz
100 Hz ≤ f < 1 kHz: 1 kHz
1 kHz ≤ f < 100 kHz: 100 kHz

Harmonic measurement

PLL source input level
50% or more of the rated measurement range when the crest factor is CF3.
100% or more of the rated measurement range when the crest factor is CF6 or CF6A.

Accuracy
Add the following accuracy values to the normal measurement accuracy values.
• When line filters are turned off

Frequency	Voltage, current
0.1 Hz ≤ f < 10 Hz	±(0.01% of reading + 0.03% of range)
10 Hz ≤ f < 45 Hz	±(0.01% of reading + 0.03% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.03% of range)
66 Hz < f ≤ 440 Hz	±(0.01% of reading + 0.03% of range)
440 Hz < f ≤ 1 kHz	±(0.01% of reading + 0.03% of range)
1 kHz < f ≤ 10 kHz	±(0.01% of reading + 0.03% of range)
10 kHz < f ≤ 50 kHz	±(0.05% of reading + 0.1% of range)
50 kHz < f ≤ 100 kHz	±(0.1% of reading + 0.2% of range)
100 kHz < f ≤ 500 kHz	±(0.1% of reading + 0.5% of range)
500 kHz < f ≤ 1.5 MHz	±(0.5% of reading + 2% of range)

Frequency	Power
0.1 Hz ≤ f < 10 Hz	±(0.02% of reading + 0.06% of range)
10 Hz ≤ f < 45 Hz	±(0.02% of reading + 0.06% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.02% of reading + 0.06% of range)
66 Hz < f ≤ 440 Hz	±(0.02% of reading + 0.06% of range)
440 Hz < f ≤ 1 kHz	±(0.02% of reading + 0.06% of range)
1 kHz < f ≤ 10 kHz	±(0.02% of reading + 0.06% of range)
10 kHz < f ≤ 50 kHz	±(0.1% of reading + 0.2% of range)
50 kHz < f ≤ 100 kHz	±(0.2% of reading + 0.4% of range)
100 kHz < f ≤ 500 kHz	±(0.2% of reading + 1% of range)
500 kHz < f ≤ 1.5 MHz	±(1% of reading + 4% of range)

• When line filters are turned on
Add the line filter influence to the accuracy values when the line filters are turned off.
• When the crest factor is set to CF3
• When λ (the power factor) is 1
• Power figures that exceed 10 kHz are reference values.
• For the voltage range, add 25 mV to the voltage accuracy and (25 mV/current range rating) × 100% of range to the power accuracy.
• For the direct current input range, add 200 µA to the current accuracy and (200 µA/current range rating) × 100% of range to the power accuracy.
• For the external current sensor range, add 2 mV to the current accuracy and (2 mV/rated value of the external current sensor range) × 100% of range to the power accuracy.
• When the number of FFT points is 1024, add ±0.2% to the voltage and current range errors and ±0.4% to the power range error.
• 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.
• The accuracy when the crest factor is CF6 or CF6A is the same as the accuracy when the crest factor is 3 after doubling the measurement range.
• The guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for normal measurement.
• The neighboring harmonic orders may be affected by the side lobes from the input harmonic order.

When FFT points is set to 8192
When the frequency of the PLL source is 2 Hz or greater, 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, and add {[n/(m + 1)]/25}% of (the nth order reading) to the n + mth order and n – mth order of the power.

When the frequency of the PLL source is less than 2 Hz, for nth order component input, add {[n/(m + 1)]/20}% of (the nth order reading) to the n + mth order and n – mth order of the voltage and current, and add {[n/(m + 1)]/10}% of (the nth order reading) to the n + mth order and n – mth order of the power.

When FFT points is set to 1024
When the frequency of the PLL source is 75 Hz or greater, 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, and add ({n/(m + 1)}/25)% of (the nth order reading) to the n + mth order and n – mth order of the power.

When the frequency of the PLL source is less than 75 Hz, for nth order component input, add ({n/(m + 1)}/5)% of (the nth order reading) to the n + mth order and n – mth order of the voltage and current, and add (2 × {n/(m + 1)}/5)% of (the nth order reading) to the n + mth order and n – mth order of the power.

Dimensions

Dimensions	Approx. 145 mm (H) x 42 mm (W) x 297 mm (D) *The depth includes the slide cover (293 mm if slide cover is excluded).
Weight	Approx. 720 g
Connection	50-pin B to B connector

• 760902 5A High Accuracy Element
The following information is printed on the side.

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007
2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan

Model and Suffix code

Model	Suffix Code	Descriptions
WT5000		Precision Power Analyzer
	-HE	English menu
	-D	UL/CSA Standard, PSE compliant
	-F	VDE/Korean Standard
	-H	Chinese Standard
	-N	Brazilian Standard
	-Q	BS Standard
	-R	Australian Standard
	-T	Taiwanese Standard
	/M1	32 GB Built-in Memory
	/MTR1	Motor Evaluation 1
	/DA20*	20 CH D/A Output
	/MTR2*	Motor Evaluation 2

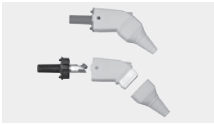
*When select from these options, please select only one. /MTR2 option requires installation of /MTR1 option.

Model	Suffix Code	Descriptions
760901		30 A High Accuracy Element
760902		5 A High Accuracy Element

Standard accessories

WT5000: Power cord, Rubber feet, Cover panel B8216JA 7 sets, User's manual, expanded user's manual, communication interface user's manual, connector (provided only with/DA20),
760901/760902: Safety terminal adapter B9317WB/B9317WC (provided two adapters in a set times input element number) Safety terminal adapter A1650JZ/A1651JZ (provided black/red two adapters in a set, times of 30 A input element number), Safety terminal adapter B8213YA/B8213YB (provided black/red two adapters in a set, times of 5 A input element number)

Safety terminal adapter
B9317WB (B)/B9317WC (R)



High current safety terminal adapter
A1650JZ (B)/A1651JZ (R)

Current safety terminal adapter
B8213YA (R)/B8213YB (B)

User's manuals

Start guide (booklet), function/operation, communication manuals (electric file)

NOTICE

● Before operating the product, read the user's manual thoroughly for proper and safe operation.

Yokogawa's Approach to Preserving the Global Environment

- Yokogawa's electrical products are developed and produced in facilities that have received ISO14001 approval.
- In order to protect the global environment, Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guidelines and Product Design Assessment Criteria.

This is a Class A instrument based on Emission standards EN61326-1 and EN55011 and is designed for an industrial environment.
Operation of this equipment in a residential area may cause radio interference, in which case users will be responsible for any interference which they cause.

Accessory (sold separately)

Model number	Product	Description
366924 ⚠*1	BNC-BNC Cable	1 m
366925 ⚠*1	BNC-BNC Cable	2 m
701901	1:1 Safety BNC Adapter Lead	1000 V CAT II for /MTR1, /MTR2
701902	Safety BNC-BNC Cable	1000 V CAT II, 1 m for /MTR1, /MTR2
701903	Safety BNC-BNC Cable	1000 V CAT II, 2 m for /MTR1, /MTR2
720930	Current clamp probe	40 Hz to 3.5 kHz, AC50 A
720931	Current clamp probe	40 Hz to 3.5 kHz, AC200 A
751542-E4	Rack Mounting Kit	For EIA
751542-J4	Rack Mounting Kit	For JIS
758917	Test Lead Set	A set of 0.75 m long, red and black test leads
758922 ⚠	Small Alligator-clip	Rated at 300 V CAT II two in a set
758923	Safety Terminal Adapter	Two adapters to a set (spring-hold type)
758924	Conversion Adapter	BNC-banana-Jack (female) adapter
758929 ⚠	Large Alligator-clip	Rated at 1000 V CAT II and used in a pair
758931	Safety Terminal Adapter Set	Two adapters to a set (Screw-fastened type), 1.5 mm hex Wrench is attached.
761941*2	WTViewerE	Viewer software for WT series
761951	Safety Terminal Adapter Set	Two adapters to a set for 30 A current (6 mm screw-fastened type)
761952	Safety Terminal Conversion Adapter Set	Two adapters to a set for 5 A current (female-female type)
761953	Safety Terminal Adapter Set	Two adapters to a set for 5 A current (screw-fastened type using B9317WD)
CT60	AC/DC Current Sensor	Maximum 60 Apeak, DC to 800 kHz (–3 dB)
CT200	AC/DC Current Sensor	Maximum 200 Apeak, DC to 500 kHz (–3 dB)
CT1000	AC/DC Current Sensor	Maximum 1000 Apeak, DC to 300 kHz (–3 dB)
CT2000A	AC/DC Current Sensor	Maximum 2000 Arms, DC to 40 kHz (–3 dB)

Parts number	Product	Description	Order Q'ty
B9284LK ⚠	External Sensor Cable	Current sensor input connector, Length 0.5 m	1
B9317WD	Wrench	For 761953	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.
*1: Use these products with low-voltage circuits (42 V or less).
*2: The WT5000 will be supported soon.

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https://tmi.yokogawa.com/

YMI-KS-MI-SE06

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The contents in this catalog is as of October 2018. Subject to change without notice.

[Ed: 01/b]
Printed in Japan, 810(KP)

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