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	Input resistance: 1 MΩ ±1%, input capacitance: 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* Analog input accuracy guarantee conditions	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 Accuracy at one year	±(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, EaM1U, EaM1I, EaM3U, EaM3I, Aux1 to 8

*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), accuracy at 1 year
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/Chinese/German
Display update interval	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). The display update interval is 1 s when the data update interval is 10 ms. 2) When the data update interval is 10 ms, 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 10 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. *The 10 ms data update is available if the firmware version of WT5000 is 3.01 or later.
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, User
	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/div0.01 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 8 items when the data update interval is 10 ms. 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	
Custom display	The user registers up to five screen configurations.	
	Register tab	Custom 1 to 5
	Register Name	14 characters
	Register	Registers the current screen configuration as a new configuration
	Over Write	Registers the current screen configuration by overwriting
	Clear	Deletes registered contents
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	Measurement method Select sync source period average or digital filter average.	
	Fixed-period update	Data update interval: 10 m/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.
IEC harmonic measurement	Display screen: Displays one screen of measured values Measuring function: Harmonic measurement, frequency	
IEC flicker measurement	Update interval: 2 s Display screen: Displays one screen of dedicated measured values Measurement function: Flicker function	

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 290% of the lower range (range to decrease to) (less than equal to 580% 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): 10% 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]
Phase difference polarity	The phase difference φ between the voltage and current indicates the current phase relative to the voltage of each element. Select the signs to apply to the lead and lag of this phase difference. • Lead (–) /Lag (+) Lead: Negative (–) Lag: Positive (+)
	• Lead (+) /Lag (–) Lead: Positive (+) Lag: Negative (–)
	The following measurement functions change signs depending on the phase difference polarity. Phase difference: φ, phase difference between the fundamental components: φ fnd, Phase difference of harmonic measurement: φ (k), φ U1-U2, φ U1-U3, φ U1-I1, φ U2-I2, φ U3-I3 * Other angles, the phase angle between U(1) and U(k): φ U(k), the phase angle between I(1) and I(k): φ I (k), and the electric angles: EaM1U1 to EaM1I7 and EaM3U1 to EaM3I7 are not affected by the phase difference polarity setting. Lead is positive (+), and lag is negative (–).
Phase correction	The phase correction feature of the current of the input element Target element: 30 A High Accuracy Element (760901), 5 A High Accuracy Element (760902), Current Sensor Element (760903) Correction time: –10 µs to 0 to +10 µs Setting accuracy: 1 ns typical
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: 10 ms to 99 h 59 m 59 s File Format: Binary Maximum data file size: 1 GB Saved data conversion: Converts to CSV (CSV file size of up to 2 GB can be converted.)
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: 10 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)
Time synchronization function	Synchronization source: Supports IEEE1588-2008 (PTP v2) (slave only) Supports PTP packets of Layer3 (UDP/IPv4) and Layer2 (Ethernet) Supports Ordinary Clock Supports E2E and P2P delay correction
	Synchronization target: Time data
	Synchronization accuracy: ±10 µs typical (synchronous), ±0.02% (asynchronous)
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*, Custom display setting *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)
Upgrade	Updates the firmware and prompts the user to input the add-on package license keys

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 ——

Delta computation is not possible when the computing method is digital filter average.

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
  10 ms/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 10 m/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.
- Timer accuracy ±0.02% of reading
- Integration accuracy ±[Power accuracy (or current accuracy) + timer accuracy

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: 0xFFFFFFFE
- 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)
  Input resistance: 1 Ω, 10 mA range (760903) (CF3)
  Input resistance: 1.5 Ω, 6.67 mA range (760903) (CF3)
  • Minimum external sensor range
  50 mV range (760901, 760902) (CF3)
  • Minimum current clamp probe input range
  50 mV range (760903) (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

Harmonic analysis is not executed (disabled) when the update interval is 10 ms.

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 upper harmonic limit is 100 when the update interval is 50 ms.
Further, harmonic analysis is not executed (disabled) when the update interval is 10 ms.

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 upper harmonic limit is 100 when the update interval is 50 ms.
Further, harmonic analysis is not executed (disabled) when the update interval is 10 ms.

IEC Harmonic Measurement Feature (G7 option)

Item	Specifications
Supported standards	IEC61000-4-7 Ed1.0/Ed2.0/Ed2.0 A1
Target element	30 A High Accuracy Element (760901), 5 A High Accuracy Element (760902)
Measured Item	Select one of the input elements or ∑ wiring units.
Method	PLL synchronization method
Frequency range	Fundamental frequency: 45 Hz to 66 Hz Analysis frequency: 45 Hz to 10 kHz
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. Frequency filter: 100 Hz ON
Number of FFT points	32768
Window function	Rectangular
Window spacing	No gap, no overlap
Anti-aliasing filter	Set using a line filter (Butterworth 30 kHz: Ed2.0/E2.0A1, 20 kHz: Ed1.0)
Interharmonic measurement	• Select the grouping function Type1, Type2, or none. (IEC 61000-4-7 Ed 2.0/Ed 2.0 A1) • No grouping function. (IEC 61000-4-7 Ed 1.0)

IEC61000-4-7 Ed 2.0/Ed 2.0 A1

Fundamental frequency	Sample rate	Window width	Upper limit of harmonic analysis
45 Hz to 55 Hz	f × 3276.8	10 waves	200th
55 Hz to 66 Hz	f × 2730.67	12 waves	170th

IEC61000-4-7 Ed 1.0

Fundamental frequency	Sample rate	Window width	Upper limit of harmonic analysis
45 Hz to 66 Hz	f × 2048	16 waves	120th

Data update interval	Depends on the PLL source Approx. 200 ms (Ed 2.0/Ed 2.0 A1), approx. 320 ms (Ed 1.0) when the PLL source frequency is 50 Hz Approx. 200 ms (Ed 2.0/Ed 2.0 A1), approx. 267 ms (Ed 1.0) when the PLL source frequency is 60 Hz

IEC Voltage Fluctuation/Flicker Measurement Function (G7 option)

Item	Specifications
Flicker meter class	F2
Applicable standards	IEC 61000-4-15 Ed 1.1/Ed 2.0

Normal Voltage Fluctuation/Flicker Measurement Mode

Item	Specifications	
Measured item	dc	Relative steady-state voltage change
	dmax	Maximum relative voltage change
	Tmax	Time during which the relative voltage change exceeds the threshold level in a single voltage change period
	Pst	Short-term flicker value
	Plt	Long-term flicker value
One observation period	30 s to 15 min	
Number of observation periods	1 to 99	

"Measurement of dmax caused by manual switching" Mode

Item	Specifications	
Measured item	dmax	Maximum relative voltage change
One observation period	1 min	
Number of observation periods	24 (outputs 22 average values excluding the maximum and minimum values)	

Items Common to Both Measurement Modes

Item	Specifications
Target voltage/frequency	230 V/50 Hz, 230 V/60 Hz, 120 V/50 Hz, 120 V/60 Hz
Measurement target input	Voltage (no current measurement function)
Target element	30 A High Accuracy Element (760901), 5 A High Accuracy Element (760902)
Number of measurement elements	Up to three elements
Voltage input level	At least 50% of the range rating
Flicker scale	0.0001-6400 P.U. (20%) divided logarithmically into 1400
Display update	2 s (dc, dmax, Tmax) At the end of each observation period (Pst)
Communication output	dc, dmax, Tmax, Pst, Plt, instantaneous flicker sensation (Pinst), cumulative probability function (CPF)
External storage output	Screen image

Data Streaming Feature (DS option)

Item	Specifications
Waveform sampling	Select from 10 kS/s to 2 MS/s (1-2-5 steps, simple decimation), 1 MS/s maximum during integration
Waveform data to be streamed	All inputs (U, I, Motor)
Numeric data to be saved	All numeric data (normal data, harmonic data)
Data update interval	Operates in constant-interval update mode at an update interval of 50 ms, 100 ms, 200 ms, 500 ms, or 1 s
Time data	IEEE1588 compatible
Data format	32-bit single precision floating point

*The 50 ms data update under the Data Streaming function is available if the firmware version of WT5000 is 3.01 or later.

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 + phase correction time)

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, Socket), SNTP, FTP client, Modbus/TCP server, and web server

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

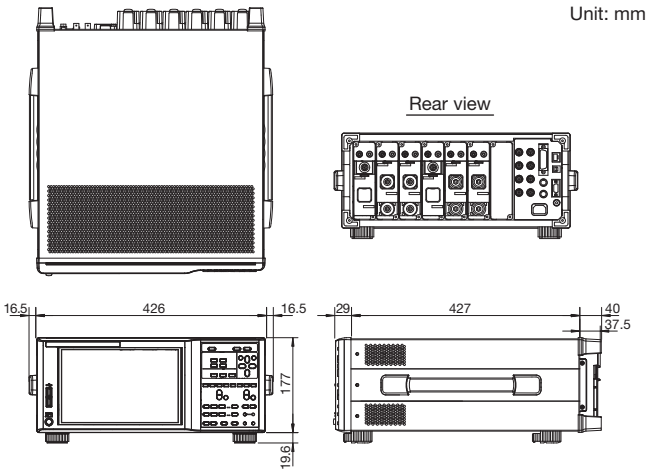
General Specifications

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	
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*2 Measurement category CAT II*3 Pollution degree 2*4	

*1 Applies to products with CE marks. For information on other products, contact your nearest YOKOGAWA dealer.
*2 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.
*3 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.
*4 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.

IF CLASS 1 LASER PRODUCT MODULE IS AVAILABLE
クラス1レーザモジュール実装時
安装Class 1激光模块时

CLASS 1 LASER PRODUCT
クラス1レーザ製品
1类激光产品
(EN 60825-1:2014)
(IEC 60825-1:2007, GB 7247.1-2012)

Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No.50, dated June 24, 2007
4-9-8 Myojin-cho, Hachioji-shi, Tokyo 192-8566, 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%, input capacitance: approx. 15 pF

Current
Direct input: 6.5 mΩ ±10% + approx. 0.3 µH

External current sensor input: input resistance:
1 MΩ ± 1%, input capacitance: 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	
10 ms	200 Hz
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)

Minimum display

Depending on the measurement range, the following are the minimum values that are displayed:
- Urms, Uac, Irms, and Iac: 0.3% (0.6% when the crest factor is set to CF6 or CF6A)
- Umn, Urmn, Imn, and Irmn: 2% (4% when the crest factor is set to CF6 or CF6A)

When input level is lower than above, the display shows zero if rounding to zero setting is ON, otherwise measured value will be shown. Current integration value q also depends on the current value.

Accuracy

Accuracy (6 months)

For the 1 year accuracy, multiply the reading of the accuracy at 6 months by 1.5.

Condition
Temperature: 23°C±5°C
Input waveform: Sine wave
λ (power factor): 1
Voltage to ground: 0 V
Crest factor: CF3
Line filter: OFF
Sync source 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
  $\{\sqrt{1/\text{range}} + 0.5\}$% of range + 10 mA
  External current sensor input range
  $\{\sqrt{0.01/\text{range}} + 0.5\}$% of range (50 mV to 200 mV range)
  $\{\sqrt{0.1/\text{range}} + 0.5\}$% of range (500 mV to 10 V range)
- 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 range)
    ±200 µV/°C (0.5 V to 10 V range)

  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 µA
    Power: 0.00002 × I²% of reading + 3 × 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
  10 ms: 0.03% of reading
  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.
The unit of f in the accuracy equations is kHz.	
Temperature coefficient	±0.01% of reading/°C (5°C to 18°C or 28°C to 40°C)
Influence of humidity	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 +150% when the voltage measurement range is 1000 V, 0 to +130% otherwise* 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 “Filter Function”.
Frequency measurement	Frequency measurement range

Data update interval	Measurement range
10 ms	200 Hz ≤ f ≤ 2 MH
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 mA/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 CF3 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.

IEC 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

Frequency	Voltage, current
45 Hz ≤ f ≤ 66 Hz	±(0.2% of reading + 0.04% of range)
66 Hz < f ≤ 440 Hz	±(0.2% of reading + 0.05% of range)
440Hz < f ≤ 1 kHz	±(0.2% of reading + 0.05% of range)
1 kHz < f ≤ 2.5 kHz	±(0.3% of reading + 0.05% of range)
2.5 kHz < f ≤ 3.3 kHz	±(0.4% of reading + 0.05% of range)
3.3 kHz < f ≤ 10 kHz	±(1% of reading + 0.05% of range)

Frequency	Power
45 Hz ≤ f ≤ 66 Hz	±(0.4% of reading + 0.05% of range)
66 Hz < f ≤ 440 Hz	±(0.4% of reading + 0.1% of range)
440Hz < f ≤ 1 kHz	±(0.4% of reading + 0.1% of range)
1 kHz < f ≤ 2.5 kHz	±(0.6% of reading + 0.1% of range)
2.5 kHz < f ≤ 3.3 kHz	±(0.8% of reading + 0.1% of range)
3.3 kHz < f ≤ 10 kHz	±(2% of reading + 0.1% of range)

- When the 30 kHz Butterworth line filter is on
- When the crest factor is set to CF3
- When λ (the power factor) is 1
- When group is off
- The neighboring harmonic orders may be affected by the side lobes from the input harmonic order.
  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.
- The accuracy when the crest factor is CF6 or CF6A is the same as the accuracy when the crest factor is CF3 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 guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for normal measurement.
- Influence of self-generated heat caused by current input is the same as with normal measurement.
- The temperature coefficient is the same as with normal measurement.
- Influence of humidity is the same as with normal measurement.
- Accuracy at 1 year is the same as with normal measurement.
- Frequency measurements are reference values.

IEC voltage fluctuation and flicker measurement

Accuracy
dc, dmax: ±4% (at dmax = 4%)
Pst: ±5% (at Pst = 1 to 3), ±0.05 (at Pst = 0.2 to 1)

Conditions for the accuracies above
- Ambient temperature: 23 to 1°C
- Line filter: 10 Hz ON
- Frequency filter: 1 kHz ON

Frequency measurements are reference values.

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**
- **760902 5A High Accuracy Element**
- **760903 Current Sensor 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
4-9-8 Myojin-cho, Hachioji-shi, Tokyo 192-8566, 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%, input capacitance: 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: input resistance: 1 MΩ ± 1%, input capacitance: 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.
±0.01% of range + 0.5 μA 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	
10 ms	200 Hz
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)

Minimum display

Depending on the measurement range, the following are the minimum values that are displayed:
- Urms, Uac, Irms, and Iac: 0.3% (0.6% when the crest factor is set to CF6 or CF6A)
- Umn, Urmn, Imn, and Irmn: 2% (4% when the crest factor is set to CF6 or CF6A)

When input level is lower than above, the display shows zero if rounding to zero setting is ON, otherwise measured value will be shown. Current integration value q also depends on the current value.

Accuracy

Accuracy (6 months)

For the 1 year accuracy, multiply the reading of the accuracy at 6 months by 1.5.

Condition
Temperature: 23°C±5°C
Input waveform: Sine wave
λ (power factor): 1
Voltage to ground: 0 V
Crest factor: CF3
Line filter: OFF
Sync source 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 range)
  {$\sqrt{0.1/\text{range}}$ + 0.5}% of range (500 mV to 10 V range)
- 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 range)
    ±200 μV/°C (0.5 V to 10 V range)
    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.
- Influence of data update interval
  Add the following value for signal sync period average
  10 ms: 0.03% of reading
  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. The unit of f in the accuracy equations is kHz.
Temperature coefficient	±0.01% of reading/°C (5°C to 18°C or 28°C to 40°C)
Influence of humidity	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 +150% when the voltage measurement range is 1000 V, 0 to +130% otherwise* 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 “Filter Function”.

Frequency measurement

Frequency measurement range

Data update interval	Measurement range
10 ms	200 Hz ≤ f ≤ 2 MHz
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 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 CF3 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.

IEC 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

Frequency	Voltage, current
45 Hz ≤ f ≤ 66 Hz	±(0.2% of reading + 0.04% of range)
66 Hz < f ≤ 440 Hz	±(0.2% of reading + 0.05% of range)
440Hz < f ≤ 1 kHz	±(0.2% of reading + 0.05% of range)
1 kHz < f ≤ 2.5 kHz	±(0.3% of reading + 0.05% of range)
2.5 kHz < f ≤ 3.3 kHz	±(0.4% of reading + 0.05% of range)
3.3 kHz < f ≤ 10 kHz	±(1% of reading + 0.05% of range)

Frequency	Power
45 Hz ≤ f ≤ 66 Hz	±(0.4% of reading + 0.05% of range)
66 Hz < f ≤ 440 Hz	±(0.4% of reading + 0.1% of range)
440Hz < f ≤ 1 kHz	±(0.4% of reading + 0.1% of range)
1 kHz < f ≤ 2.5 kHz	±(0.6% of reading + 0.1% of range)
2.5 kHz < f ≤ 3.3 kHz	±(0.8% of reading + 0.1% of range)
3.3 kHz < f ≤ 10 kHz	±(2% of reading + 0.1% of range)

- When the 30 kHz Butterworth line filter is on
- When the crest factor is set to CF3
- When λ (the power factor) is 1
- When group is off
- The neighboring harmonic orders may be affected by the side lobes from the input harmonic order.
  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.
- The accuracy when the crest factor is CF6 or CF6A is the same as the accuracy when the crest factor is CF3 after doubling the measurement range.
- The guaranteed accuracy ranges for frequency, voltage, and current, are the same as the guaranteed ranges for normal measurement.
- Influence of self-generated heat caused by current input is the same as with normal measurement.
- The temperature coefficient is the same as with normal measurement.
- Influence of humidity is the same as with normal measurement.
- Accuracy at 1 year is the same as with normal measurement.
- Frequency measurements are reference values.

IEC voltage fluctuation and flicker measurement

Accuracy
dc, dmax: ±4% (at dmax = 4%)
Pst: ±5% (at Pst = 1 to 3), ±0.05 (at Pst = 0.2 to 1)

Conditions for the accuracies above
- Ambient temperature: 23 to 1°C
- Line filter: 10 Hz ON
- Frequency filter: 1 kHz ON

Frequency measurements are reference values.

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

- **760901 30A High Accuracy Element**
- **760902 5A High Accuracy Element**
- **760903 Current Sensor 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
4-9-8 Myojin-cho, Hachioji-shi, Tokyo 192-8566, Japan

760903 Current Sensor Element* Specifications

* The 760903 Current Sensor Element is available if the firmware version of WT5000 is 3.01 or later.

Output terminal type
Sensor power: D-sub 9-pin socket
Probe power: Dedicated connector

Output voltage
Sensor power: ±15 V
Probe power: ±12 V, but output is off when Terminal is set to Sensor

Output current
Sensor power: 1.8 A
Probe power: 0.8 A, but output is off when Terminal is set to Sensor
Total output when multiple elements are used
- Sensor power: 8 A
- Probe power supply: The total absolute value of the positive and negative currents of the power supply is included in the positive sensor power supply current.

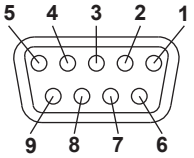
Input terminal type
Voltage
Plug-in terminal (safety terminal)

Current
- Sensor input: D-sub 9-pin socket
- Probe input: BNC connector

Input type
Voltage
Floating input through resistive voltage divider

Current
- Sensor input: Input through shunt
- Probe input: Input through resistive voltage divider

D-sub 9 pin pecifications
The pinout and signal names of the current sensor (CT series) compatible with the current sensor connection terminal are shown below.



760903		CT1000A example	
Pin No.	Signal	Pin No.	Signal
1	RETURN	1	OUTPUT RETURN
2	N.C.	2	(DON'T USE)
3	GND (ST)	3	GND STATUS
4	GND	4	0 V
5	V-	5	-15 V DC
6	INPUT	6	OUTPUT
7	CT-ID	7	(DON'T USE)
8	ST	8	NORMAL OP STATUS
9	V+	9	+15 V DC

The connector shell of the current sensor connection terminal is connected to the WT5000 case.
GND (pin 4) and GND (ST) (pin 3) of the current sensor connection terminal are connected to the WT5000 case inside the 760903.
For the detailed specifications of the current sensor (CT series), see the relevant IM.
The sensor cable (sold separately) is a straight cable.

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/CF6A)

Current
Sensor input
- Input resistance: 1 Ω
  10 mA, 25 mA, 50 mA, 100 mA, 250 mA, 500 mA, 1 A (crest factor CF3)
  5 mA, 12.5 mA, 25 mA, 50 mA, 125 mA, 250 mA, 500 mA (crest factor CF6/CF6A)
- Input resistance: 1.5 Ω
  6.67 mA, 16.7 mA, 33.3 mA, 66.7 mA, 167 mA, 333 mA, 667 mA (crest factor CF3)
  3.33 mA, 8.33 mA, 16.7 mA, 33.3 mA, 83.3 mA, 167 mA, 333 mA (crest factor CF6/CF6A)
- Input resistance: 5 Ω
  5 mA, 10 mA, 20 mA, 50 mA, 100 mA, 200 mA (crest factor CF3)

2.5 mA, 5 mA, 10 mA, 25 mA, 50 mA, 100 mA (crest factor CF6/CF6A)
• Input resistance: 10 Ω
5 mA, 10 mA, 25 mA, 50 mA, 100 mA (crest factor CF3)
2.5 mA, 5 mA, 12.5 mA, 25 mA, 50 mA (crest factor CF6/CF6A)
Probe 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/CF6A)

Instrument loss
Voltage
Input resistance: 10 MΩ ± 1%, input capacitance: approx. 15 pF

Input impedance
Current
Sensor input:
Input resistance: 1 Ω Approx.1 Ω + approx. 0.2 µH
Input resistance: 1.5 Ω Approx. 1.5 Ω + approx. 0.2 µH
Input resistance: 5 Ω Approx. 5 Ω + approx. 0.2 µH
Input resistance: 10 Ω Approx. 10 Ω + approx. 0.2 µH
Probe input: Input resistance: 1 MΩ ± 1%, input capacitance: approx. 50 pF

Instantaneous maximum allowable input
Voltage
Peak value of 2.5 kV or rms value of 1.5 kV, whichever is less (within 1 s)

Current
Sensor input:
Input resistance: 1 Ω
Peak value of 1.8 A or rms value of 1.2 A, whichever is less.
Input resistance: 1.5 Ω
Peak value of 1.2 A or rms value of 0.84 A, whichever is less.
Input resistance: 5 Ω
Peak value of 0.36 A or rms value of 0.25 A, whichever is less.
Input resistance: 10 Ω
Peak value of 0.18 A or rms value of 0.12 A, whichever is less. (with in 0.1 s)
Probe input:
Peak value at 10 times the range or 25 V, whichever is less (with in 0.1 s)

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
Sensor input:
Input resistance: 1 Ω
Peak value of 1.5 A or rms value of 1.1 A, whichever is less.
Input resistance: 1.5 Ω
Peak value of 1.0 A or rms value of 0.73 A, whichever is less.
Input resistance: 5 Ω
Peak value of 0.3 A or rms value of 0.22 A, whichever is less.
Input resistance: 10 Ω
Peak value of 0.15 A or rms value of 0.11 A, whichever is less.
Probe input:
Peak value at 5 times the range or rms value of 25 V, whichever is less

Maximum rated voltage to earth (DC to 50/60 Hz)
Voltage input terminal
1000 V CAT II

Influence of voltage to earth
1000 Vrms is applied between an input terminal and WT5000 with the voltage input terminals shorted.
50/60 Hz: ±0.01% of range or less.
Reference values up to 200 kHz:
Voltage: ±{(maximum rated range)/(rated range) × 0.001 × f% of range} or less
However, 0.01% or greater.
The maximum range rating in the equation is 1000 V.
The unit of f in the equations is kHz.

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	
10 ms	200 Hz
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% only for the 1000 V range
105% only for the maximum rated range of the current sensor input
280% of the voltage and current range rating for CF6A
320% only for the 500 V range
210% only for the maximum sensor input range

Minimum display
Depending on the measurement range, the following are the minimum values that are displayed:
• Urms, Uac, Irms, and Iac: 0.3% (0.6% when the crest factor is set to 6)
• Umn, Urmn, Imn, and Irmn: 2% (4% when the crest factor is set to 6)
When input level is lower than above, the display shows zero if rounding to zero setting is ON, otherwise measured value will be shown. Current integration value q also depends on the current value.

Accuracy

Accuracy (6 months)
Conditions
Temperature: 23°C ± 5°C
Humidity: 30 to 75%RH
Input waveform: Sine wave
λ (power factor): 1
Voltage to ground: 0 V
Crest factor: CF3
Line filter: OFF
Sync source period average method
Frequency filter: Used for signal frequencies at 1 kHz or less
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 + 0.03% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.03% of reading + 0.03% 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 bandwidth	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 + 0.03% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.03% of reading + 0.03% 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 ≤ 500 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	Sensor input: DC to 5 MHz (typical) Probe 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	±(0.04% of reading + 0.04% of range)
30 Hz ≤ f < 45 Hz	±(0.04% of reading + 0.04% of range)
45 Hz ≤ f ≤ 66 Hz	±(0.01% of reading + 0.02% of range)
66 Hz < f ≤ 1 kHz	±(0.04% of reading + 0.04% 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}

*Accuracy for when used in conjunction with AC/DC current sensor or current clamp probe: Add the accuracy of the power analyzer and that of the AC/DC current sensor or current clamp probe.

• For the current sensor input range, add the following values to the accuracies listed above:
Input resistance: 1 Ω
DC current accuracy: 24 µA
DC power accuracy: (24 µA/rated value of the sensor input range) × 100% of range
Input resistance: 1.5 Ω
DC current accuracy: 15 µA
DC power accuracy: (15 µA/rated value of the sensor input range) × 100% of range
Current and power accuracies (45 Hz ≤ f ≤ 66 Hz, 6.67 mA/16.7 mA/33.3 mA range): 0.01% of reading

Input resistance: 5 Ω
DC current accuracy: 4 μA
DC power accuracy: (4 μA/rated value of the sensor input range) × 100% of range
Current and power accuracies (45 Hz ≤ f ≤ 66 Hz, 5 mA/10 mA range): 0.01% of reading
Input resistance: 10 Ω
DC current accuracy: 1 μA
DC power accuracy: (1 μA/rated value of the sensor input range) × 100% of range
Current and power accuracies (45 Hz ≤ f ≤ 66 Hz, 5 mA/10 mA range): 0.01% of reading
The rated value of the sensor input range is a range rated value selected with a Input resistance setting, with scaling set to off.

- For the probe input range, add the following values to the accuracies listed above:
  Current and power accuracies (45 Hz ≤ f ≤ 66 Hz, 50 mV range): 0.01% of reading
  Current and power accuracies (45 Hz ≤ f ≤ 66 Hz, 100 mV range): 0.005% of reading

- 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
  Sensor input:
  Input resistance: 1 Ω
  $\{\sqrt{0.06/\text{range}} + 0.5\}$% of range (100 mA range or less)
  $\{\sqrt{0.3/\text{range}} + 0.5\}$% of range (250 mA range or more)
  Input resistance: 1.5 Ω
  $\{\sqrt{0.06/\text{range}} + 0.5\}$% of range (66.7 mA range or less)
  $\{\sqrt{0.3/\text{range}} + 0.5\}$% of range (167 mA range or more)
  Input resistance: 5 Ω
  $\{\sqrt{0.06/\text{range}} + 0.5\}$% of range (20 mA range or less)
  $\{\sqrt{0.3/\text{range}} + 0.5\}$% of range (50 mA range or more)
  Input resistance: 10 Ω
  $\{\sqrt{0.06/\text{range}} + 0.5\}$% of range (10 mA range or less)
  $\{\sqrt{0.3/\text{range}} + 0.5\}$% of range (25 mA range or more)
  Probe input:
  $\{\sqrt{0.01/\text{range}} + 0.5\}$% of range (50 mV to 200 mV range)
  $\{\sqrt{0.1/\text{range}} + 0.5\}$% of range (500 mV to 10 V range)

- 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)
  - Sensor input DC accuracy:
    Input resistance: 1 Ω
    ±0.06% of range/°C (10 mA to 50 mA range)
    ±0.02% of range/°C (100 mA to 1A range)
    Input resistance: 1.5 Ω
    ±0.06% of range/°C (6.67 mA to 33.3 mA range)
    ±0.02% of range/°C (66.7 mA to 667 mA range)
    Input resistance: 5 Ω
    ±0.04% of range/°C (5 mA to 20 mA range)
    ±0.02% of range/°C (50 mA to 200 mA range)
    Input resistance: 10 Ω
    ±0.03% of range/°C (5 mA to 10 mA range)
    ±0.02% of range/°C (20 mA to 100 mA range)
  - Probe input DC accuracy: ±50 μV/°C (50 mV to 200 mV range)
    ±200 μV/°C(0.5 V to 10 V range)
  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 and power accuracies:
  Input resistance 1 Ω: ± 0.1 × I^2 [% of reading]
  Input resistance 1.5 Ω: ± 0.15× I^2 [% of reading]
  Input resistance 5 Ω: ± 0.5 × I^2 [% of reading]
  Input resistance 10 Ω: ± 1.0 × I^2 [% of reading]
  I is the CT's secondary 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.
- Influence of data update interval
  Add the following value for signal sync period average
  10 ms: 0.03% of reading
  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. The unit of f in the accuracy equations is kHz.
Accuracy at 1 year	1.5 times the accuracy at 6 months
Temperature coefficient	At 5°C to 18°C or 28°C to 40°C, add the following value to the voltage measurement accuracy. ±0.01% of reading/°C At 5°C to 18°C or 28°C to 40°C, add the following value to the current and power measurement accuracy. When the input resistance is 10 Ω or 5 Ω ±0.01% of reading/°C ±0.3 μA/°C (for DC measurement values) When the input resistance is 1.5 Ω or 1 Ω ±0.01% of reading/°C ±3 μA/°C (for DC measurement values)
Influence of humidity	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 ±150% when the voltage measurement range is 1000 V; 0 to ±130% otherwise* 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 sync source period average method 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, cutoff frequency fc: 1 MHz • When the advanced line filter setting is off When the line filter is on, add the following to the voltage, current, and active power accuracies. Voltage, current f ≤ (fc/10): ± (20 × f/fc) % of reading Active power f ≤ (fc/10): ± (40 × f/fc) % of reading For the filter specifications for fc less than or equal to 100 kHz, see "Filter Function". • When the advanced line filter setting is on When the anti-aliasing filter function (AAF) is on, add the following to the voltage, current, active power accuracies. Voltage, current f ≤ (fc/10): ± (20 × f/fc) % of reading Active power f ≤ (fc/10): ± (40 × f/fc) % of reading For the filter specifications for fc less than or equal to 100 kHz, see "Filter Function". When the high frequency rejection function (HFR) is on, add the following to the voltage, current, active power accuracies. However, if the AAF is set to ON simultaneously, the accuracy addition of the AAF takes precedence. Current 50 kHz ≤ f ≤ 100 kHz: ± (0.006 × f – 0.1) % of reading 100 kHz<f ≤ 300 kHz: ± (0.035 × f – 2.0) % of reading 300 kHz<f ≤ 500 kHz: ± (0.040 × f + 2.0) % of reading Active power (power factor 1) 10 kHz ≤ f ≤ 50 kHz: ± (0.005 × f – 0.05) % of reading 50 kHz ≤ f ≤ 100 kHz: ± (0.013 × f – 0.3) % of reading 100 kHz<f ≤ 500 kHz: ± (0.050 × f – 3.0) % of reading Influence of power factor (λ) λ = 0: ± (0.01 × f) % of apparent power reading However, be aware that these figures are reference values. The unit of fc and f in the accuracy equations is kHz.

Frequency measurement

Frequency measurement range

Data update interval	Measurement range
10 ms	200 Hz ≤ f ≤ 2 MHz
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:
Crest factor CF3: At least 30% of the measurement range
Crest factor CF6/CF6A: 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 current sensor input range, add 200 µA to the current accuracy and (200 µA/current range rating) × 100% of range to the power accuracy.
• For the probe input range, add 2 mV to the current accuracy and (2 mV/rated value of the probe input 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 CF3 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.

Notes

Limitations when used in combination with the CT1000
Use within the following ambient temperature derating.
CT ambient temperature 45°C or more: Primary current 900 Apk or less
CT ambient temperature 45°C or less: Follows the CT1000 specifications
Restrictions when used in combination with the 10 m sensor cable 761956
CT2000A primary current: 2100 Apk or less

Dimensions

Dimensions	Approx. 145 mm (H) × 42 mm (W) × 298 mm (D) * The depth includes the slide cover (295 mm if slide cover is excluded).
Weight	Approx. 740 g
Connection	50-pin B to B connector

• 760901 30A High Accuracy Element
• 760902 5A High Accuracy Element
• 760903 Current Sensor 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
4-9-8 Myojin-cho, Hachioji-shi,
Tokyo 192-8566, Japan

Model and suffix code

Model	Suffix Code	Descriptions
WT5000		Precision Power Analyzer
Language Menu	-HC	Chinese/English Menu
	-HE	English Menu
	-HG	German/English Menu
	-HJ	Japanese/English Menu
Power Cord	-B	Indian Standard
	-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
	-U	IEC Plug Type B
Option	/M1	32 GB Built-in Memory
	/MTR1	Motor Evaluation 1
	/DA20*	20 CH D/A Output
	/MTR2*	Motor Evaluation 2
	/DS	Data Streaming
	/G7	IEC Harmonic/Flicker Measurement

*Select only one of these options. /MTR2 option requires installation of /MTR1 option.

Model	Suffix Code	Descriptions
760901		30 A High Accuracy Element
760902		5 A High Accuracy Element
760903		Current Sensor 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)*1, safety terminal adapter A1650JZ/A1651JZ (provided black/red two adapters in a set, times of 30 A input element number)*2, safety terminal adapter B8213YA/B8213YB (provided black/red two adapters in a set, times of 5 A input element number)*3

760903*4
Safety terminal adapter B9317WB/B9317WC (provided black/red two adapters in a set times input element number)*1

User's manuals: Start guide (booklet), function/operation, communication manuals (electric file)

*1: When additional standard accessories are needed, order accessory products, 758931.
*2: When additional standard accessories are needed, order accessory products, 761951.
*3: When additional standard accessories are needed, order accessory products, 761953.
*4: Cable for current sensor is sold separately.

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.

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

Accessories (sold separately)

Model	Product name	Descriptions
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	WTViewerE	Application 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)
761954	Cable for Current Sensor Element (3 m)	Dedicated cable for current sensor element, total length 3 m
761955	Cable for Current Sensor Element (5 m)	Dedicated cable for current sensor element, total length 5 m
761956	Cable for Current Sensor Element (10 m)	Dedicated cable for current sensor element, total length 10 m
751552	Clamp-on probe	30 Hz to 5 kHz, 1400 Apeak (1000 Arms)
CT2000A	AC/DC Current Sensor	DC to 40 kHz, 3000 Apeak (2000 Arms)
CT1000A	AC/DC Current Sensor	DC to 300 kHz, 1500 Apeak (1000 Arms)
CT1000	AC/DC Current Sensor	DC to 300 kHz, 1000 Apeak
CT200	AC/DC Current Sensor	DC to 500 kHz, 200 Apeak
CT60	AC/DC Current Sensor	DC to 800 kHz, 60 Apeak

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. There is a risk of electric shock - use this product with caution.
*1 Use these products with low-voltage circuits (42 V or less).

Additional option license*

Model	Suffix Code	Descriptions
760991	-DS	Data Streaming
	-G7	IEC Harmonic/Flicker Measurement

*Separately sold license product (customer-installable).

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https://tmi.yokogawa.com/ YMI-KS-MI-SE08

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