

WT5000

Precision Power Analyzer

U S E R ' S M A N U A L

Features Guide

YOKOGAWA 
Yokogawa Test & Measurement Corporation

IM WT5000-01EN
3rd Edition

List of Manuals

Thank you for purchasing the WT5000 Precision Power Analyzer. This manual contains useful information about the features of this instrument. To ensure correct use, please read this manual thoroughly before operation.

Keep this manual in a safe place for quick reference in the event a question arises. The following manuals, including this one, are provided as manuals for this instrument. Please read all manuals.

Manual Title	Manual No.	Description
WT5000 Precision Power Analyzer Features Guide	IM WT5000-01EN	This manual. The supplied CD contains the PDF file of this manual. This manual explains all the instrument's features other than the communication interface features.
WT5000 Precision Power Analyzer User's Manual	IM WT5000-02EN	The supplied CD contains the PDF file of this manual. The manual explains how to operate this instrument.
WT5000 Precision Power Analyzer Getting Started Guide	IM WT5000-03EN	This guide explains the handling precautions, basic operations, and specifications of this instrument.
WT5000 Precision Power Analyzer Communication Interface User's Manual	IM WT5000-17EN	The supplied CD contains the PDF file of this manual. The manual explains the instrument's communication interface features and instructions on how to use them.
WT5000 Precision Power Analyzer	IM WT5000-92Z1	Document for China

The "EN" and "Z1" in the manual numbers are the language codes.

Contact information of Yokogawa offices worldwide is provided on the following sheet.

Document No.	Description
PIM 113-01Z2	List of worldwide contacts

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions. The figures given in this manual may differ from those that actually appear on your screen.
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Revisions

- 1st Edition: September 2018
- 2nd Edition: March 2020
- 3rd Edition: April 2021

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1 Items That This Instrument Can Measure

The items that you can measure with this instrument are listed below. For details about how the values of the measurement functions are determined, see appendix 1 in the Getting Started Guide, IM WT5000-03EN. For explanations of the terms measurement function, input element, and wiring unit, see “What Is a Measurement Function?”

► [Click here.](#)

The input elements and wiring units referred to in each measurement function table are listed below. However, the input elements and wiring units that you can measure vary depending on how many input elements are installed in this instrument.

- Input elements: Element1 to Element7
- Wiring units: ΣA , ΣB , ΣC
- Motor numbers: Motor1 to Motor4

Measurement Functions Used in Normal Measurement

Voltage

Function	Description	Input Element	Wiring Unit
Urms	True rms voltage	Yes	Yes
Umn	Rectified mean voltage calibrated to the rms value	Yes	Yes
Udc	Simple voltage average	Yes	Yes
Urmn	Rectified mean voltage	Yes	Yes
Uac	AC voltage component	Yes	Yes
Ufnd	Fundamental voltage component	Yes	Yes
U+pk	Maximum voltage	Yes	No
U-pk	Minimum voltage	Yes	No
CfU	Voltage crest factor	Yes	No

Current

Function	Description	Input Element	Wiring Unit
Irms	True rms current	Yes	Yes
Imn	Rectified mean current calibrated to the rms value	Yes	Yes
Idc	Simple current average	Yes	Yes
Irmn	Rectified mean current	Yes	Yes
Iac	AC current component	Yes	Yes
Ifnd	Fundamental current component	Yes	Yes
I+pk	Maximum current	Yes	No
I-pk	Minimum current	Yes	No
CfI	Current crest factor	Yes	No

Power

Function	Description	Input Element	Wiring Unit
P	Active power	Yes	Yes
S	Apparent power	Yes	Yes
Q	Reactive power	Yes	Yes
λ	Power factor	Yes	Yes
Φ	Phase difference	Yes	Yes
Pfnd	Fundamental active power	Yes	Yes
Sfnd	Fundamental apparent power	Yes	Yes
Qfnd	Fundamental reactive power	Yes	Yes
λ fnd	Fundamental power factor	Yes	Yes
Φ fnd	Fundamental phase difference	Yes	No
Pc	Corrected Power	Yes	Yes
P+pk	Maximum power	Yes	No
P-pk	Minimum power	Yes	No

1 Items That This Instrument Can Measure

Frequency

Function	Description	Input Element	Wiring Unit
fU	Voltage frequency	Yes	No
fI	Current frequency	Yes	No
f2U	Voltage frequency	Yes	No
f2I	Current frequency	Yes	No
fPLL1	Frequency of PLL1	No	No
fPLL2	Frequency of PLL2	No	No

Integrated Power (Watt hours)

Function	Description	Input Element	Wiring Unit
ITime	Integration time	Yes	No
WP	Sum of positive and negative watt hours	Yes	Yes
WP+	Sum of positive P values	Yes	Yes
WP-	Sum of negative P values	Yes	Yes
q	Sum of positive and negative ampere hours	Yes	Yes
q+	Sum of positive I values	Yes	Yes
q-	Sum of negative I values	Yes	Yes
WS	Volt-ampere hours	Yes	Yes
WQ	Var hours	Yes	Yes

Efficiency

Function	Description
$\eta 1$ to $\eta 4$	Efficiency

User-Defined Functions

Function	Description
F1 to F20	User-defined functions

User-Defined Events

Function	Description
Ev1 to Ev8	User-defined events

Harmonic Measurement Functions

Function	Description	Input Element	Wiring Unit
U(k)	Rms voltage of harmonic order k	Yes	Yes
I(k)	Rms current of harmonic order k	Yes	Yes
P(k)	Active power of harmonic order k	Yes	Yes
S(k)	Apparent power of harmonic order k	Yes	Yes
Q(k)	Reactive power of harmonic order k	Yes	Yes
$\lambda(k)$	Power factor of harmonic order k	Yes	Yes
$\Phi(k)$	Phase difference between the voltage and current of harmonic order k	Yes	No
$\Phi U(k)$	Phase difference between the fundamental signal, U(1), and harmonic voltage U(k)	Yes	No
$\Phi I(k)$	Phase difference between the fundamental signal, I(1), and harmonic current I(k)	Yes	No
Z(k)	Impedance of the load circuit	Yes	No
R _s (k)	Series resistance of the load circuit	Yes	No
X _s (k)	Series reactance of the load circuit	Yes	No
R _p (k)	Parallel resistance of the load circuit	Yes	No
X _p (k)	Parallel reactance of the load circuit	Yes	No
U _{hdf} (k)	Harmonic voltage distortion factor	Yes	No
I _{hdf} (k)	Harmonic current distortion factor	Yes	No
P _{hdf} (k)	Harmonic active power distortion factor	Yes	No
U _{thd}	Total harmonic voltage distortion	Yes	No
I _{thd}	Total harmonic current distortion	Yes	No
P _{thd}	Total harmonic active power distortion	Yes	No
U _{thf}	Telephone harmonic factor of the voltage	Yes	No
I _{thf}	Telephone harmonic factor of the current	Yes	No
U _{tif}	Telephone influence factor of the voltage	Yes	No
I _{tif}	Telephone influence factor of the current	Yes	No
h _{vf}	Harmonic voltage factor	Yes	No
h _{cf}	Harmonic current factor	Yes	No
K-factor	K factor	Yes	No
$\Phi U_i - U_j^1$	Phase difference between the fundamental voltage of element i, U _i (1), and the fundamental voltage of element j, U _j (1)	No	Yes
$\Phi U_i - U_k^1$	Phase difference between U _i (1) and the fundamental voltage of element k, U _k (1)	No	Yes
$\Phi U_i - I_i^1$	Phase difference between U _i (1) and the fundamental current of element i, I _i (1)	Yes ²	Yes
$\Phi U_j - I_j^1$	Phase difference between U _j (1) and the fundamental current of element j, I _j (1)	No	Yes
$\Phi U_k - I_k^1$	Phase difference between U _k (1) and the fundamental current of element k, I _k (1)	No	Yes

¹ i, j, and k are input element numbers. For example, when the number of input elements in wiring unit ΣA is six and the wiring system of elements 1, 2, and 3 is three phase, four wire, i is 1, j is 2, and k is 3. $\Phi U_i - U_j$ represents $\Phi U_1 - U_2$, the difference between the fundamental voltage signal of element 1, U₁(1), and the fundamental voltage signal of element 2, U₂(1). In the same way $\Phi U_i - U_k$, $\Phi U_i - I_i$, $\Phi U_j - I_j$, and $\Phi U_k - I_k$ represent to $\Phi U_1 - U_3$, $\Phi U_1 - I_1$, $\Phi U_2 - I_2$, and $\Phi U_3 - I_3$, respectively.

² Setting i to an input element, is the same as setting k to 1 in $\Phi(k)$.



When the data update interval is set to 10 ms, harmonic measurement is not performed.

1 Items That This Instrument Can Measure

Harmonic Measurement Function Orders

The harmonic orders that you can specify are indicated below.

Input Element Harmonic Measurement Functions

Measurement Function	Characters or Numbers in Parentheses			
	Total Value	0(DC)	1	k
U()	Yes	Yes	Yes	2 to 500
I()	Yes	Yes	Yes	2 to 500
P()	Yes	Yes	Yes	2 to 500
S()	Yes	Yes	Yes	2 to 100
Q()	Yes	Always zero	Yes	2 to 100
λ ()	Yes	Yes	Yes	2 to 100
Φ ()	Yes	No	Yes	2 to 500
ΦU ()	No	No	No	2 to 500
ΦI ()	No	No	No	2 to 500
Z()	No	Yes	Yes	2 to 100
Rs()	No	Yes	Yes	2 to 100
Xs()	No	Yes	Yes	2 to 100
Rp()	No	Yes	Yes	2 to 100
Xp()	No	Yes	Yes	2 to 100
Uhdf()	No	Yes	Yes	2 to 500
Ihdf()	No	Yes	Yes	2 to 500
Phdf()	No	Yes	Yes	2 to 500
Uthd	Yes	No	No	No
Ithd	Yes	No	No	No
Pthd	Yes	No	No	No
Uthf	Yes	No	No	No
Ithf	Yes	No	No	No
Utif	Yes	No	No	No
Itif	Yes	No	No	No
hvf	Yes	No	No	No
hcf	Yes	No	No	No
K-factor	Yes	No	No	No

Functions with parentheses will produce different values depending on which of the following is contained in their parentheses.

- Total: Total value (The total value of all harmonic components from the minimum order to N.* For information about how the value is determined, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.)
- 0(DC): DC value
- 1: Fundamental harmonic value
- k: The value of any order from 2 to N.*

* N is the maximum measurable order. The maximum measurable harmonic order is the smallest of the three orders listed below.

- The specified maximum measurable harmonic order
- The value determined automatically according to the PLL source frequency (see section 6.7 in the Getting Started Guide, IM WT5000-03EN)
- When the data update interval is 50 ms or Auto, the maximum measurable harmonic order is 100.

Wiring Unit Harmonic Measurement Functions (Σ functions)

Measurement Function	Characters or Numbers in Parentheses	
	Total Value	1
U Σ ()	Yes	Yes
I Σ ()	Yes	Yes
P Σ ()	Yes	Yes
S Σ ()	Yes	Yes
Q Σ ()	Yes	Yes
$\lambda\Sigma$ ()	Yes	Yes

Functions with parentheses will produce different values depending on which of the following is contained in their parentheses.

- Total: Total value
- 1: Fundamental harmonic value

Delta Computation Functions

Function	Description
$\Delta U1$	The values returned by the delta computation functions vary depending on the specified delta computation type.
$\Delta U2$	
$\Delta U3$	
$\Delta U\Sigma$	
ΔI	
$\Delta P1$	
$\Delta P2$	
$\Delta P3$	
$\Delta P\Sigma$	

For details about delta computation functions, see “Delta Computation (Δ Measure).”

► [Click here.](#)

Motor Evaluation Functions (Option)

Function	Description	Motor Number	Input Element
Speed	Motor rotating speed	Yes	No
Torque	Motor torque	Yes	No
SyncSp	Synchronous speed	Yes	No
Slip	Slip (%)	Yes	No
Pm	Mechanical output of the motor (mechanical power)	Yes	No
EaM1U, EaM1I	Electrical angles: Phase angles of the fundamental waves of U1 to I7 with the rising edge of the signal received through the Motor1 (MTR1) Z terminal of the motor evaluation function as the reference (specify an input element).	No	Yes
EaM3U, EaM3I	Electrical angles: Phase angles of the fundamental waves of U1 to I7 with the rising edge of the signal received through the Motor3 (MTR2) Z terminal of the motor evaluation function as the reference (specify an input element).	No	Yes

Auxiliary Input Measurement Functions (Option)

Function	Description
Aux1 to 8	Auxiliary inputs 1 to 8

IEC Harmonic Measurement Functions (Option)

The harmonic components included in U (k) and I (k) in IEC harmonic measurement vary depending on the [IEC 61000-4-7 Edition](#) number.

Edition	Description
1.0	Not required
2.0	Required
2.0 A1	Required
	Applies to the second and higher harmonics.

For the interharmonic grouping, see [Voltage/Current Grouping](#).

IEC Voltage Fluctuation and Flicker Measurement Functions (Option)

In IEC voltage fluctuation and flicker measurement mode, only the following measurement functions can be measured.

Function	Description
Un	Rated voltage
FreqU	Voltage frequency
dc	Relative steady-state voltage change
dmax	Maximum relative voltage change
Tmax	Period during which relative voltage change exceeds the threshold level
Pst	Short-term flicker value
Plt	Long-term flicker value
Pinst*	Instantaneous flicker sensation
CPF*	Cumulative probability function

* Data can only be acquired through communication output.

Measurement Range

Function	Description	Input Element	Motor Number
RngU	Voltage measurement range	Yes	No
RngI	Current measurement range	Yes	No
RngSpd	Speed measurement range	No	Yes
RngTrq	Torque measurement range	No	Yes
RngAux1 to 8	Aux measurement range	No	No

For measurement range functions, data can be acquired using the following methods.

- By setting a user-defined function
- By storing or by saving numeric data
- By outputting through communication

Timestamp

Function	Description
TS Date	Date of the update interval start time
TS Time	Time of the update the interval start time
TS Subsec	Fractions of seconds of the update interval start time

For timestamp functions, data can be acquired using the following method.

- By outputting through communication
- Store timestamps for storage times

What Is a Measurement Function?

Measurement Function

The physical values (such as rms voltage, average current, power, and phase difference) that this instrument measures and displays and measurement range and other measurement information are called measurement functions. Each measurement function is displayed using symbols that correspond to its physical value. For example, “Urms” corresponds to the true rms voltage.

Element

Element refers to a set of input terminals that can receive a single phase of voltage and current to be measured. This instrument can contain up to seven elements, numbered from 1 to 7. An element number is appended to the measurement function symbol for the measured data that this instrument displays, so that you can tell which data belongs to which element. For example, “Urms1” corresponds to the true rms voltage of element 1.

Wiring System

You can specify five wiring systems on this instrument to measure the power of various single-phase and three-phase power transmission systems: single-phase, two-wire; single-phase, three-wire; three-phase, three-wire; three-phase, four-wire; and three-phase, three-wire with three-voltage, three-current method.

Wiring Unit

The wiring unit is a set of two or three input elements of the same wiring system that are grouped to measure three-phase power. There can be up to three wiring units: ΣA , ΣB , and ΣC .

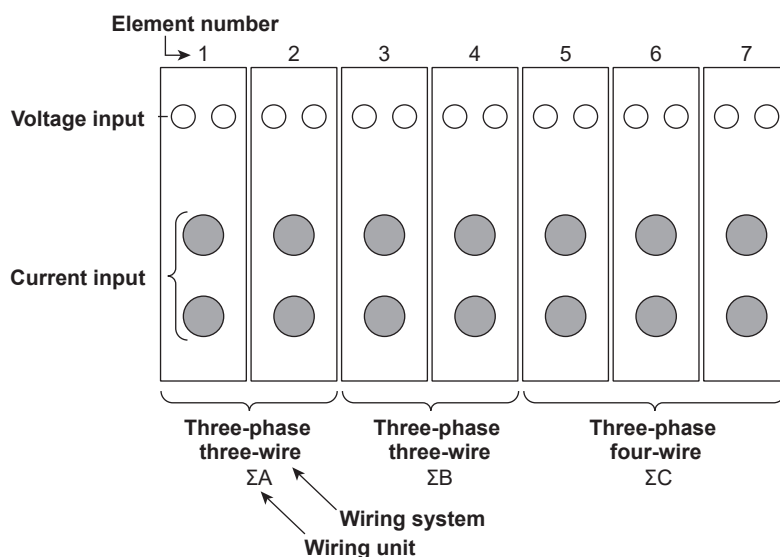
► [Click here.](#)

Σ Functions

The measurement function of a wiring unit is called a Σ function.

For example, “Urms ΣA ” corresponds to the average of the voltages of the input elements that are assigned to the wiring unit ΣA . The average value represents the true rms value.

► [Click here.](#)



Measurement Period

For information about the measurement period for computing measurement functions, see “Measurement Period (SYNC SOURCE).”

► [Click here.](#)

2 Setup Menu

This section explains the following settings:

- [Navigation](#)
- [Setup Menu \(Setup, SETUP\)](#)
- [Current Sensor Menu \(Current Sensor Settings\)](#)

Navigation

When you start the instrument, the navigation window appears. Select any of the following:

- Display the [setup menu](#), and configure the instrument.
- Display the [current sensor menu](#), and configure the current sensor.
- Tap the  button in the upper right to switch to the measurement screen.
- It is also possible to not display the navigation window at the next startup.

Setup Menu (Setup, MENU(SETUP))

Configure or execute the following items according to how the instrument is to be used.

- [Measurement Mode \(Measurement Mode\)](#)
- [Input Settings \(Basic Measurement Conditions, Input \(Basic\)\)](#)
- [Input Settings \(Advanced/Options, Input \(Advanced/Options\)\)](#)
- [Computation/Output \(Computation/Output\)](#)
- [Utility \(Utility\)](#)
- [Initialize Settings \(Initialize Settings\)](#)
- [Navigation window \(Navigation\)](#)
- [File List \(File List\)](#)
- [Save Setup \(Save Setup\)](#)
- [Load Setup \(Load Setup\)](#)

Measurement Mode (Measurement Mode)

Select the measurement mode from the following:

- Normal measurement (Normal)
- IEC harmonic measurement (IEC Harmonic)
- IEC voltage fluctuation and flicker measurement (IEC Flicker)

Initialize Settings (Initialize Settings)

You can reset the instrument settings to their factory default values. This feature is useful when you want to cancel all the settings that you have entered or when you want to redo measurement from scratch.

For information about how initialize the settings, see section 3.7 in the Getting Started Guide, IM WT5000-03EN.

Navigation Window (Navigation)

The navigation window appears.

File List (File List)

You can perform file operations such as creating folders on the storage device, deleting and copying files, and changing file names.

Storage Device Displayed in the File List

► [Click here.](#)



Up to 512 files and folders can be displayed in the file list. If there are more than a total of 512 files and folders in a given folder, the file list for that folder will display only 512 files and folders. There is no way to set which files and folders are displayed.

Display Format

Select whether to display the file list in a one-column list, two-column list, or using thumbnails.

Sorting the File List

You can sort the file list by file name, size, or date and time.

Selecting the File Type

Select the type of files to display in the file list.

Selecting Files (Select)

Select the files or folders you want to manipulate. Selecting multiple files is useful when you want to copy or delete multiple files at the same time.

Selecting Files Collectively

- **Selecting All Files**

When the cursor is on a device or folder in the file list, select ALL Set to select all of the files and folders within the device or folder that the cursor is on.

- **Deselecting All Files**

All of the selected files and folders are deselected.

Making Folders (New folder)

You can make folders. You can use the same characters in folder names that you can in file names.

Copying (Copy)

You can copy selected files and folders to other storage devices or folders. You can copy multiple files at the same time.

Moving (Move)

You can move selected files and folders to other storage devices or folders. You can move multiple files at the same time.

Renaming (Rename)

You can rename a selected file or folder.

Protecting (Protect)

You can set or release the protection of selected files.

Deleting (Delete)

You can delete selected files and folders.

Saving Setup Data (Save Setup, SAVE(SETUP))

You can save the setup data of this instrument to the specified storage device. The date, time, and communication setup parameters are not saved.

The extension is .SET.

File List (File List)

On the file list, specify the save destination. You can perform file operations such as creating folders on the storage device, deleting and copying files, and changing file names.

► [Click here.](#)

Auto Naming (Auto Naming)

OFF

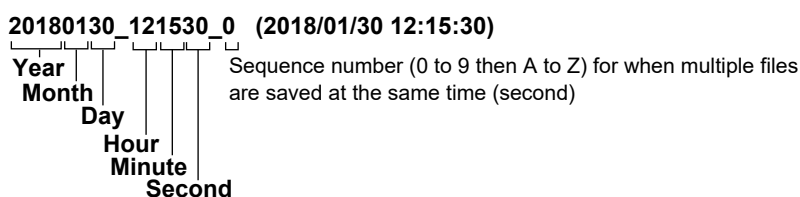
The auto naming feature is disabled. The name that you specify using the File Name setting is used. If there is a file with the same name in the save destination folder, you cannot save the data.

Auto Numbering (Numbering)

This instrument automatically adds a four-digit number from 0000 to 0999 after the common name specified using the File Name setting and saves files.

Date (Date)

The date and time when the file is saved are used as its name. The file name specified for the File Name setting is ignored.



A sequence number is appended to the date and time when multiple files are saved at the same time (second). The number starts at 0 and is incremented by one each time a file is added. The number 9 is followed by letters of the alphabet.

File Name (File Name)

You can set the common file name that is used when the auto naming feature is turned off or when the auto naming feature is set to Numbering. The maximum number of characters that you can use for file names and folder names is 32 characters. The following restrictions apply.

- Of those characters on the keyboard that appears on the screen, the characters that can be used are 0-9, A-Z, a-z, _, -, =, (,), {, }, [,], #, \$, %, &, ~, !, ` , and @. @ cannot be entered consecutively.
- The following exact strings cannot be used due to MS-DOS limitations:
AUX, CON, PRN, NUL, CLOCK, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9
- Keep the full path name (absolute path from the root folder) within 255 characters. If this is exceeded, an error will occur when you perform file operations (save, copy, rename, create folder, etc.). When an operation is being performed on a folder, the full path is up to the name of the folder. When an operation is being performed on a file, the full path is up to the name of the file.

The following additional restrictions apply when you use the file name auto naming feature.

- If you set auto naming to Numbering, a file name will consist of the characters that you entered for the file name and a four-character sequence number.
- If you set auto naming to Date, the characters that you entered for the file name will not be used. File names will only consist of the date information.

Comment (Comment)

You can add a comment that consists of up to 30 characters when you save a file. You do not have to enter a comment. You can use all characters and spaces that are displayed on the keyboard.

Settings That Are Shared with Those of Other Menus

The following settings are shared by the menus for saving setup data, storing data, saving data.

- File list display and save destination settings (File List)
- Automatic file naming settings (Auto Naming)
- File name (File Name)

The comment settings (Comment) are shared by the menus for saving setup data and storing data.

Saving (Save Exec)

Saves the data to the specified save destination with the specified file name.

Loading Setup Data (Load Setup, LOAD(SETUP))

On the file list, specify a file to load setup data from. The extension is .SET. For information about how to configure the file list display and how to operate files and folders, see “File List (File List).”

► [Click here.](#)

Loading (Execute Load)

Loads the data of the specified file.



- If you change the extension of the saved data file, by using a PC or some other device, the instrument will no longer be able to load it.
 - When setup data is loaded from a file, the setup data for each key is changed to match the loaded settings, and it cannot be changed back. We recommend that you save the current settings before loading different setup data.
 - The date, time, and communication setup parameters are not saved. So even if you load setup data from a file, the date, time, and communication settings will not change.
 - This instrument cannot load setup data that has been saved by a product with an incompatible firmware version.
 - This instrument cannot load setup data that was saved by an instrument with a different element configuration, different options, etc.
-

Current Sensor Menu (Current Sensor Settings)

Set the current sensor items. This is convenient when you want to configure only the current sensor settings. This menu displays the current sensor settings that are currently in use.

Starting the Current Sensor Setup (Start Setup)

A navigation starts for setting the following items in order.

- Current measurement terminal/CT sensor, input resistance (Terminal/CT Sensor, Input Resistance)
- Wiring system (Wiring)
- CT ratio, output voltage rate, external current sensor conversion ratio (CT Ratio, Output Voltage Rate, Sensor Ratio)
- Current amplitude correction, current phase correction (Current Amplitude Correction, Current Phase Correction)
- Current range (Current Range)

You can also set each item by tapping the setting item tab on the left side of the screen.

Current measurement terminal, CT sensor (Terminal, CT Sensor)

Set the following items.

- [Current measurement terminal \(Terminal\)](#)
- [CT preset \(CT Preset\)](#)
- [Input resistance \(Input Resistance\)](#)
- [Probe preset \(Probe Preset\)](#)
- [External current sensor on/off \(Ext Sensor\)](#)

Wiring system (Wiring)

Set the following items.

- [Range \$\Sigma\$ link \(Range \$\Sigma\$ Link\)](#)
- [Wiring system \(Wiring\)](#)

The wiring diagram of the selected wiring system is displayed in a figure.

CT ratio, output voltage rate, external current sensor conversion ratio (CT Ratio, Output Voltage Rate, Sensor Ratio)

Set the following items.

- [CT ratio preset \(CT Preset\)](#)
- [Scaling \(Scaling\)](#)
- [CT Ratio \(CT Ratio\)](#)
- [Output Voltage Rate \[V/A\] \(Output Voltage Rate\)](#)
- [External current sensor conversion ratio \(Sensor Ratio\)](#)

Current amplitude correction, current phase correction (Current Amplitude Correction, Current Phase Correction)

Set the following items.

- [Current amplitude correction on/off \(Current Amplitude Correction\)](#)
- [Correction ratio \(Correction Ratio\)](#)
- [Phase correction on/off \(Current Phase Correction\)](#)
- [Frequency \(Frequency\)](#)
- [Phase difference between I/O \(Phase Difference between I/O\)](#)

Calculates the [time difference between I/O \(Time Difference between I/O\)](#) from the specified frequency and the phase difference between the input and output and displays it.

Current range (Current Range)

Set the following items.

- [Current range display format \(Current Range Display Format\)](#)
- [Crest factor \(Crest Factor\)](#)
- [Range configuration \(Range Config\)](#)
- [Auto current range \(I Auto Range\)](#)
- [Current range \(Current Range\)](#)

Collective Setting

If you select a cell in the left most column of the list, all the input elements that can be configured for that item can be set collectively.

Current sensor status display (Sensor Status)

The status of power supply to the current sensor (CT series) is displayed in the sensor status indicator at the upper left of the screen. Tapping the sensor status indicator displays a detail window.

Current sensor status	Description
 (Non-CS Element)	An input element other than the 760903 is installed.
 (Non-Connection)	Terminal is set to Sensor, but a CT is not connected.
 (Connection Power Supply)	Terminal is set to Sensor, a current sensor (CT series) is connected, and power is supplied to it. You can also check the presence of a power supply with the current sensor's (CT series') NORMAL OPERATION indicator.
 (Over Current/Total Over Current)	Overcurrent is detected. For details, check the displayed error message.
 (Probe)	Terminal is set to Probe.

If an overcurrent is detected in any of the current sensor elements, the current sensor status is displayed as follows, and the power supply output to all the sensors and probes is stopped.



If the total output current becomes excessive and an overcurrent is detected, the current sensor status is displayed as follows, and the power supply to all the sensors and probes stops.



If a power supply error is detected, an error message is displayed. After you close the message, if the error persists for another 10 seconds, the error message is displayed again. Take appropriate measures quickly according to the message.

To resume the power supply, remove the cause of the overcurrent, and then restart the instrument. If the sensor status indicator still indicates Over Current/Total Over Current after the instrument is restarted, the instrument needs to be repaired.

Detecting the CT Series

If the instrument is restarted when a current sensor (CT series) is connected to the 760903 (current sensor element), the instrument detects the CT-ID (model) of the current sensor (CT series).

The detected CT-ID is displayed in the detail window of the sensor status indicator.

- In the case of a CT1000, CT200, or CT60, Unknown is displayed because they are not detectable.
- Do not connect a signal wire to the sensor ID pin because it can cause detection errors.

3 Input Settings (Basic Measurement Conditions)

Input Settings (Basic Measurement Conditions, Input (Basic))

You can specify the following items.

- [Wiring system \(Wiring\)](#)
- [Selecting the element for setting the measurement range \(Element1 to 7, 1 to 7 \(ELEMENTS\)\)](#)
- [Voltage range \(Voltage, VOLTAGE RANGE\)](#)
- [Auto voltage range \(Auto \(Voltage\), AUTO\)](#)
- [Current range \(Current, CURRENT RANGE\)](#)
- [Auto current range \(Auto \(Current\), AUTO\)](#)
- [External current sensor on/off \(Ext Sensor\)](#)
- [External current sensor conversion ratio \(Sensor Ratio\)](#)
- [Scaling \(Scaling\)](#)
- [Line filter \(Line Filter\)](#)
- [Frequency filter \(Freq Filter\)](#)
- [Measurement Period \(Sync Source\)](#)

Wiring System (Wiring)

The following five wiring systems are available on the instrument. The selectable wiring systems vary depending on the number of installed input elements.

- 1P2W: Single-phase two-wire system
- 1P3W: Single-phase three-wire system
- 3P3W: Three-phase three-wire system
- 3P4W: Three-phase four-wire system
- 3P3W(3V3A): Three-voltage three-current method

Wiring Unit

Wiring units are sets of two or three input elements of the same wiring system that are grouped together. You can define up to three wiring units: ΣA , ΣB , and ΣC .

- When there is one wiring unit, that unit is ΣA . You cannot make ΣB or ΣC the first wiring unit.
- When there are two wiring units, those units are ΣA and ΣB . You cannot make ΣC one of the first two wiring units.
- When there are three wiring units, those units are ΣA , ΣB , and ΣC .
- When there are multiple wiring units, element numbers are assigned to them in ascending order. The element numbers are assigned to ΣA , ΣB , and then ΣC .
- Wiring units are composed of input elements that are next to each other. Wiring units cannot consist of input elements that are not next to each other.
- Wiring units cannot consist of input elements that are different types.
- When Range Σ Link is enabled, a wiring unit cannot be configured with a 760903 (current sensor element) whose following settings are different.
 - CT preset
 - Input resistance

To configure a wiring unit, disable Range Σ Blank or make the above settings the same.

Σ Functions

The measurement function of a wiring unit is called a Σ function.

For example, "Urms ΣA " corresponds to the average of the voltages of the input elements that are assigned to the wiring unit ΣA . The average value represents the true rms value.

3 Input Settings (Basic Measurement Conditions)

Wiring System Combinations

You can configure any pattern that meets the conditions for wiring units described above.

For details about the relationship between wiring systems and how the values of the measurement functions are determined, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.



Select the wiring system to match the actual wiring of the circuit under measurement. The method in which the Σ functions (wiring unit measurement functions) are determined varies depending on the wiring system. If the selected wiring system does not match the wiring of the actual circuit, measurements and computation will not be correct.

Wiring System Display

The wiring system settings are displayed on the Elements tab in the input information area on the right side of the screen. The figure below shows wiring system display examples for a model with seven input elements installed.

When the wiring systems of elements 1 to 7 are set to single-phase two-wire

Elements	Options
1	U1 1000V I1 30A LF OFF FF OFF Sync Hrm [1]
2	U2 1000V I2 30A LF OFF FF OFF Sync Hrm [1]
3	U3 1000V I3 30A LF OFF FF OFF Sync Hrm [1]
4	U4 1000V I4 30A LF OFF FF OFF Sync Hrm [1]
5	U5 1000V I5 30A LF OFF FF OFF Sync Hrm [1]
6	U6 1000V I6 30A LF OFF FF OFF Sync Hrm [1]
7	U7 1000V I7 30A LF OFF FF OFF Sync Hrm [1]

When the wiring system of elements 1, 2, and 3 is set to three-phase four-wire and the wiring system of elements 5 and 6 is set to three-phase three-wire

Elements	Options
1	U1 1000V I1 30A LF OFF FF OFF Sync Hrm [1]
2	U2 1000V I2 30A LF OFF FF OFF Sync Hrm [1]
3	U3 1000V I3 30A LF OFF FF OFF Sync Hrm [1]
4	U4 1000V I4 30A LF OFF FF OFF Sync Hrm [1]
5	U5 1000V I5 30A LF OFF FF OFF Sync Hrm [1]
6	U6 1000V I6 30A LF OFF FF OFF Sync Hrm [1]
7	U7 1000V I7 30A LF OFF FF OFF Sync Hrm [1]

Wiring unit and system

The elements that compose the wiring unit are shown in the frame.

Wiring unit and system

The elements that compose the wiring unit are shown in the frame.

Settings of Elements Grouped in a Wiring Unit

If a wiring system other than 1P2W is selected when the measurement range, valid measurement range, or sync source settings of each input element are different, these settings are changed in the manner described below:

- When [range \$\Sigma\$ link](#) is set to on, the measurement range is set to the greatest of the measurement ranges of the input elements assigned to the same wiring unit. The external current sensor input range has precedence over the direct input current range.
- When range Σ link is set to on, The auto range on/off settings are changed to match the setting of the input element whose measurement range is highest. If multiple input elements are set to a common highest measurement range, the setting of the input element with the smallest input element number takes precedence.
- When range Σ link is set to on, in the valid measurement range settings, all measurement ranges are enabled (selected).
- The sync source, line filter, frequency filter, and the group of the harmonic measurement input element are set to the settings of the input element with the smallest input element number among the input elements assigned to the same wiring unit.

At the same time that you press 1 to 7 (ELEMENTS) to select the element that you want to set the voltage or current range of, the keys of the input elements that have been assigned to the same wiring unit illuminate.

Wiring Diagram (Figure)

The following information is displayed.

Wiring Diagram (Wiring)

The wiring diagram of the specified wiring system is displayed.

The input element type is shown as follows:

- 30A: 760901 (30A High Accuracy Element)
- 5A: 760902 (5A High Accuracy Element)
- CS: 760903 (Current Sensor Element)

Wiring System (Wiring)

▶ [Click here.](#)

External Current Sensor On/Off (Ext Sensor)

▶ [Click here.](#)

Selecting the Element for Setting the Measurement Range (Element1 to 7, 1 to 7 (ELEMENTS))

The following methods are available for selecting the element for setting the measurement range.

- 1 to 7 (ELEMENTS) keys
- Elements 1 to 7 of the Small menu (Range)

When range Σ link is set to on, the selected elements will switch for each wiring unit according to the wiring system.

Voltage Range (Voltage, VOLTAGE RANGE)

The voltage range can be fixed (when auto range is set to off) or determined automatically (when auto range is set to on).

Fixed Ranges

When the voltage range is fixed, you can select a range from the available options. The selected voltage range does not change even if the amplitude of the input signal changes. Set the range in reference to the rms value of the input signal. Select from the following.

760901 (30A High Accuracy Element), 760902 (5A High Accuracy Element), 760903 (Current Sensor Element)

- **When the Crest Factor Is Set to CF3**
1.5V, 3V, 6V, 10V, 15V, 30V, 60V, 100V, 150V, 300V, 600V, 1000V
- **When the Crest Factor Is Set to CF6 or CF6A**
0.75V, 1.5V, 3V, 5V, 7.5V, 15V, 30V, 50V, 75V, 150V, 300V, 500V

Auto range

► [Click here.](#)



- Set the range in reference to the rms value of the input signal. For example, if you are applying a 100-Vrms sinusoidal signal, set the range to 100 V.
 - When measuring a signal other than a sine wave (such as a distorted wave), you can obtain accurate measurements by selecting the smallest measurement range that does not produce any of the conditions below.
 - The input peak over-range indicator at the top of the screen illuminates or blinks in red.
 - The measured values of the voltage and current are indicated as being overload values ("-OL-").
 - The peak over-range indicator may not illuminate or blink in the following cases.
 - If the pulse width is narrow, and the peak value of the waveform cannot be acquired at the sampling rate of this instrument (approximately 10 MS/s).
 - If the high frequency components of the pulse waveform attenuate due to the bandwidth limitations of this instrument measurement circuit, causing the waveform peak value to be less than the peak overrange detection level.
 - When the secondary output of a VT (voltage transformer) is being applied to the voltage input terminal, set the voltage range according to the maximum value of the VT output. Then, use the scaling feature to set the VT ratio.
-

Auto Voltage Range (Auto (Voltage), AUTO (VOLTAGE RANGE))

When auto range is turned on, the range change automatically according to the amplitude of the input signal as described below. The different ranges used in the auto range are the same as those available for the fixed range.

760901 (30A High Accuracy Element), 760902 (5A High Accuracy Element), 760903 (Current Sensor Element)

Range increase

The measurement range is increased when any of the following conditions is met.

- The crest factor is set to CF3 or CF6 and the data of measurement function Urms or Irms exceeds 110% of the measurement range.
 - The crest factor is set to CF6A and the data of measurement function Urms or Irms exceeds 220% of the measurement range.
 - The crest factor is set to CF3 and the data of Upk* or Ipk* exceeds approximately 310% of the measurement range.
 - The crest factor is set to CF6 or CF6A and the data of Upk* or Ipk* exceeds approximately 620% of the measurement range.
- * Even if the null feature is on, the values are determined as if it were off.
- When a wiring unit is configured, the measurement range is increased on all input elements in the wiring unit when any of the elements in the unit meets the range-increase conditions described above.

Range decrease

The measurement range is decreased when all the following conditions are met.

- The data of Urms or Irms is less than or equal to 30% of the measurement range.
 - The data of Urms or Irms is less than or equal to 105% of the next lower range.
 - The crest factor is set to CF3 and the data of Upk* or Ipk* is less than or equal to 290% of the next lower range.
 - The crest factor is set to CF6 or CF6A and the data of Upk* or Ipk* is less than or equal to 580% of the next lower range.
- * Even if the null feature is on, the values are determined as if it were off.
- When a wiring unit is configured, the measurement range is decreased on all input elements in the wiring unit when all the elements in the unit meets the range-decrease conditions described above.



-
- If you disable a measurement range in the [valid measurement range](#) settings, that measurement range is skipped, and the auto range feature operates using only the valid measurement ranges.
 - When non-periodic pulse waveforms are applied, the range may not remain constant. If this happens, use the fixed range setting.
-

Current Range Settings

Current range settings vary depending on the input element type as follows:

760901(30A High Accuracy Element), 760902 (5A High Accuracy Element)

- [Current Range \(Current Range\)](#)
- [Auto Current Range \(Auto\)](#)
- [External Current Sensor On/Off \(Ext Sensor\)](#)
- [External Current Sensor Conversion Ratio \(Sensor Ratio\)](#)

760903 (Current Sensor Element)

- [Current Range \(Current Range\)](#)
- [Auto Current Range \(Auto\)](#)
- [Current Measurement Terminal \(Terminal\)](#)
- [CT preset \(CT Preset\)](#)
- [Input Resistance \(Input Resistance\)](#)
- [Output Voltage Rate \[V/A\] \(Output Voltage Rate\)](#)

Current Range (Current, CURRENT RANGE)

The current range can be fixed (when auto range is set to off) or determined automatically (when auto range is set to on).

Fixed Ranges

When the current range is fixed, you can select a range from the available options. The selected current range does not change even if the amplitude of the input signal changes. Set the range in reference to the rms value of the input signal. Select from the following.

760901(30A High Accuracy Element)

- **When the Crest Factor Is Set to CF3**
500mA, 1A, 2A, 5A, 10A, 20A, 30A
- **When the Crest Factor Is Set to CF6 or CF6A**
250mA, 500mA, 1A, 2.5A, 5A, 10A, 15A

760902 (5A High Accuracy Element)

- **When the Crest Factor Is Set to CF3**
5mA, 10mA, 20mA, 50mA, 100mA, 200mA, 500mA, 1A, 2A, 5A
- **When the Crest Factor Is Set to CF6 or CF6A**
2.5mA, 5mA, 10mA, 25mA, 50mA, 100mA, 250mA, 500mA, 1A, 2.5A

760903 (Current Sensor Element)

- **When the Current Measurement Terminal Is Set to Sensor (Current Sensor Input Range)**
 - **When the Crest Factor Is Set to CF3**
 - Input Resistance: 1 Ω
10mA, 25mA, 50mA, 100mA, 250mA, 500mA, 1A
 - Input Resistance: 1.5 Ω
6.67mA, 16.7mA, 33.3mA, 66.7mA, 167mA, 333mA, 667mA
 - Input Resistance: 5 Ω
5mA, 10mA, 20mA, 50mA, 100mA, 200mA
 - Input Resistance: 10 Ω
5mA, 10mA, 25mA, 50mA, 100mA
 - **When the Crest Factor Is Set to CF6 or CF6A**
 - Input Resistance: 1 Ω
5mA, 12.5mA, 25mA, 50mA, 125mA, 250mA, 500mA
 - Input Resistance: 1.5 Ω
3.33mA, 8.33mA, 16.7mA, 33.3mA, 83.3mA, 167mA, 333mA
 - Input Resistance: 5 Ω
2.5mA, 5mA, 10mA, 25mA, 50mA, 100mA
 - Input Resistance: 10 Ω
2.5mA, 5mA, 12.5mA, 25mA, 50mA
- **When the Current Measurement Terminal Is Set to Probe (Probe Input Range)**
 - **When the Crest Factor Is Set to CF3**
50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V, 10V
 - **When the Crest Factor Is Set to CF6 or CF6A**
25mV, 50mV, 100mV, 250mV, 500mV, 1V, 2.5V, 5V

Auto range

This is the same as the auto range feature for voltage.

► [Click here.](#)

3 Input Settings (Basic Measurement Conditions)



- When the secondary output of a CT (current transformer) or a clamp-type current sensor that outputs current is being applied to the current input terminal, set the current range according to the maximum value of the CT or current sensor output. Then, use the scaling feature to set the CT ratio or the conversion ratio of the clamp-type current sensor that outputs current.
 - If you set the [display format of current range](#) to Measure, current ranges can be displayed according to the current sensor or CT or the probe input range.
-

Auto Current Range (Auto (Current), AUTO (CURRENT RANGE))

This is the same as the auto range feature for voltage.

▶ [Click here.](#)

External Current Sensor On/Off (Ext Sensor)

This setting is available when the input element is 760901 (30A High Accuracy Element) or 760902 (5A High Accuracy Element). To apply the output of current sensors that produce voltage, such as shunts and clamps, to an element's external current sensor input terminal (EXT) and perform measurements, set Ext Sensor to on.

External Current Sensor Range

Set the external current sensor range according to the output of the external current sensor.

The external current sensor range can be fixed (when auto range is set to off) or determined automatically (when auto range is set to on).

Fixed Ranges

When the current range is fixed, you can select a range from the available options. The selected current range does not change even if the amplitude of the input signal changes. Set the range in reference to the rms value of the input signal. Select from the following.

760901 (30A High Accuracy Element), 760902 (5A High Accuracy Element)

- **When the Crest Factor Is Set to CF3**

Select from 50mV, 100mV, 200mV, 500mV, 1V, 2V, 5V, and 10V.

- **When the Crest Factor Is Set to CF6 or CF6A**

Select from 25mV, 50mV, 100mV, 250mV, 500mV, 1V, 2.5V, and 5V.

Auto range

This is the same as the auto range feature for voltage.

► [Click here.](#)

External Current Sensor Conversion Ratio (Sensor Ratio)

Set the conversion ratio used to measure the signal received by the external current sensor input terminal (EXT) from a current sensor that produces voltage. Set how many millivolts the current sensor transmits when 1 A of current is applied (conversion ratio). Then, the input signal can be made to correspond to the numeric data or waveform display data that is obtained when the current is directly applied to the current input terminals.

When using a current sensor that produces current, set the conversion ratio as the CT ratio.

► [Click here.](#)

Measurement Function	Conversion Ratio	Data before Conversion	Conversion Result
Current I	E	I_s (current sensor output)	I_s/E
Active Power P	E	P_s	P_s/E
Apparent power S	E	S_s	S_s/E
Reactive power Q	E	Q_s	Q_s/E
Max./min. current Ipk	E	I_{pk_s} (current sensor output)	I_{pk_s}/E

Selectable range: 0.0001 to 99999.9999

External Current Sensor Range and Conversion Ratio Configuration Example

When you measure a current with a maximum value of 100 A using a current sensor that produces 10 mV when 1 A of current is flowing, the maximum voltage that the current sensor produces is $10 \text{ mV/A} \times 100 \text{ A} = 1 \text{ V}$. Therefore, configure the settings as indicated below.

- External current sensor range: 1 V
- External current sensor conversion ratio: 10 mV/A

3 Input Settings (Basic Measurement Conditions)



- When you want to divide the external current sensor output by the conversion ratio and read the current of the circuit under measurement directly, turn the external VT/CT scaling feature off. If the feature is turned on, the value will be further multiplied by the CT ratio.
 - When you are measuring a signal other than a sine wave (such as a distorted wave), you can obtain accurate measurements by selecting the smallest measurement range that does not produce any of the conditions below.
 - The input peak over-range indicator at the top of the screen illuminates or blinks in red.
 - The measured values of the voltage and current are indicated as being overload values ("-OL-").
-

Current Measurement Terminal (Terminal)

This setting is available when the input element is 760903 (current sensor element).

Select the current measurement terminal from the following:

- Current sensor (Sensor)
- Current probe (Probe)



When current measurement terminal (Terminal) is specified, the following settings are initialized as follows:

- When a current sensor is selected
 - The scaling feature is turned on.
 - The CT ratio is set according to the CT preset.
 - The current range is set to the maximum range.
- When a current probe is selected
 - The CT is set to 1.0000.
 - The output voltage rate [V/A] is set according to the probe preset.

CT Preset (CT Preset)

This setting is available when the current measurement terminal is set to Sensor.

Select the CT preset from the following:

CT2000A, CT1000A, CT1000, CT200, CT60, Custom

To use other sensors, select Custom.

The input resistance and CT ratio are set according to the selected CT preset.

CT Preset (CT Preset)	Input Resistance (Input Resistance)	CT Ratio (CT Ratio)
CT2000A	1Ω	2000.0000
CT1000A	1Ω	1500.0000
CT1000	1.5Ω	1500.0000
CT200	5Ω	1000.0000
CT60	10Ω	600.0000
Custom	Remains at the current value	Remains at the current value

If you set this item, the scaling ON/OFF (Scaling) is set to ON.

Input Resistance (Input Resistance)

This setting is available when the current measurement terminal is set to current sensor.

Select the input resistance from the following:

10Ω, 5Ω, 1.5Ω, 1Ω

When you change this item, the CT preset is set to Custom.

Probe preset (Probe Preset)

This setting is displayed when the current measurement terminal is set to Probe.

The probe preset is fixed to Custom.

Output Voltage Rate [V/A] (Output Voltage Rate)

This setting is available when the current measurement terminal is set to Probe.

Set the conversion ratio used to measure the output from a current probe that produces voltage by receiving the signal through the current probe input terminal. Set how many volts the current probe transmits when 1 A of current is applied (conversion ratio). Then, the input signal can be made to correspond to the numeric data or waveform display data that is obtained when the current is directly applied to the current input terminals.

Set the output voltage rate in the following range.

0.0001 to 99999.9999

When you change this item, the probe preset is set to Custom.

Turning Scaling On and Off (Scaling)

You can select whether to apply the VT ratio, CT ratio, and power coefficient to applicable measurement functions.

► [Click here.](#)

CT Ratio (CT Ratio)

Set the CT ratio (or the conversion ratio of the current sensor that produces current).

► [Click here.](#)

Power Range

The measurement ranges (power ranges) of active power (P), apparent power (S), and reactive power (Q) are as follows:

Wiring System	Power Range
1P2W (single-phase two-wire)	Current range × voltage range
1P3W (single-phase three-wire)	Voltage range × current range × 2
3P3W (three-phase three-wire)	(when the voltage and current ranges on the elements in the
3P3W (3V3A, three-voltage three-current method)	wiring unit are set to the same range)
3P4W (three-phase four-wire)	Voltage range × current range × 3
	(when the voltage and current ranges on the elements in the wiring unit are set to the same range)

- When the result of the equation voltage range × current range exceeds 1000 W (VA or var), the displayed unit changes to kW (kVA or kvar).
- Number of displayed digits (display resolution)

► [Click here.](#)

For a detailed list of the available voltage and current range combinations and power ranges when all the elements have the same voltage or current range, see appendix 4 in the Getting Started Guide, IM WT5000-03EN.



In auto range mode, because the voltage and current ranges switch independently according to range increase and decrease conditions, different power ranges may be set for the same power value.

Scaling (Scaling)

You can set coefficients for when you apply a voltage or current signal from an external VT (voltage transformer) or CT (current transformer).

Turning Scaling On and Off (Scaling)

You can select whether to apply the VT ratio, CT ratio, and power coefficient to applicable measurement functions.

When reading measured values directly by using a VT or CT (or current sensor), select ON. When you select ON, the "Sc" indicator turns on in the input information area on the right side of the screen.

Applicable Measurement Functions

Voltage (U), current (I), power (P, S, and Q), maximum and minimum voltages (U+pk and U-pk), and maximum and minimum currents (I+pk and I-pk)

- ON: The measurement functions above are multiplied by the VT ratio, CT ratio, or power coefficient.
- OFF: The measurement functions above are not multiplied by the VT ratio, CT ratio, or power coefficient. The output values of the VT and CT are displayed directly as numeric data.

VT Ratio (VT Ratio)

Set the VT ratio when applying the secondary output of a VT to the voltage input terminal. Then, set the voltage range according to the maximum VT output.

Selectable range: 0.0001 to 99999.9999

CT Ratio Preset (CT Preset)

This setting is available when the input element is 760901 (30A High Accuracy Element) or 760902 (5A High Accuracy Element).

- When using the CT sold separately

Select the CT ratio from the preset settings. Select a preset (CT name) from the following:

Preset	CT Ratio (CT Ratio)
Others	Set using the number setting box.
CT2000A	2000.0000
CT1000A	1500.0000
CT1000	1500.0000
CT200	1000.0000
CT60	600.0000

If you set this item, the scaling ON/OFF (Scaling) is set to ON.

- When using other sensors

Select Others. If you select Others, the scaling ON/OFF and CT ratio do not change.

CT Ratio (CT Ratio)

Set the CT ratio (or the conversion ratio of the current sensor that produces current) when applying the secondary output of a CT or clamp-type current sensor that produces current to the current input terminal. Then, set the current range according to the maximum CT or current sensor output.

Selectable range: 0.0001 to 99999.9999

3 Input Settings (Basic Measurement Conditions)

Power Coefficient (SF Ratio, Scaling Factor)

By setting the power coefficient (SF), you can display the measured active power, apparent power, and reactive power after they have been multiplied by a coefficient.

Measurement Function	Data before Conversion	Conversion Result	
Voltage U	U_2 (secondary output of the VT)	$U_2 \times V$	V: VT ratio
Current I	I_2 (secondary output of the CT)	$I_2 \times C$	C: CT ratio
Active power P	P_2	$P_2 \times V \times C \times SF$	SF: Power coefficient
Apparent power S	S_2	$S_2 \times V \times C \times SF$	
Reactive power Q	Q_2	$Q_2 \times V \times C \times SF$	
Max./min. voltage Upk	Upk_2 (secondary output of the VT)	$Upk_2 \times V$	
Max./min. current Ipk	Ipk_2 (secondary output of the CT)	$Ipk_2 \times C$	

Selectable range: 0.0001 to 99999.9999



- If the value of the result of multiplying the measured value by the VT ratio, CT ratio, or power coefficient (scaling factor) exceeds 9999.99 M, “-OF-” will appear in the numeric data display frame.
- To correctly compute the power and efficiency of Σ functions, set the power coefficients of all elements so that all power units used in the computation are the same. For example, the efficiency cannot be computed correctly if elements or wiring units used in the computation have different power units, such as W (watt) and J (joule). To compute the efficiency correctly, make all the power units the same (either all W or all J).

Copying the VT Ratio, CT Ratio, or Power Coefficient (Exec Copy Σ)

Copying the VT Ratio (VT Ratio Copy Exec)

Copy the VT ratio of the selected input element to the other input elements in the same wiring unit.

Copying the CT Ratio (CT Ratio Copy Exec)

Copy the CT ratio of the selected input element to the other input elements in the same wiring unit.

Copying the Power Coefficient (SF Ratio Copy Exec)

Copy the power coefficient of the selected input element to the other input elements in the same wiring unit.

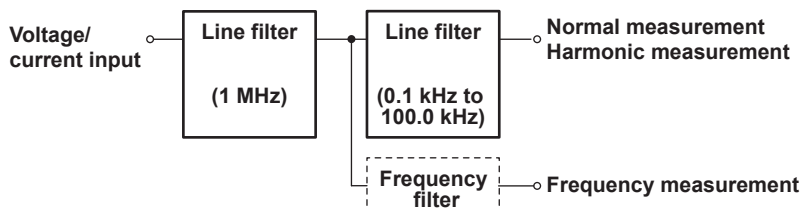


Because the scaling feature sets each input element independently, regardless of the range Σ link on /off setting, execute copying if necessary.

Line Filter (Line Filter)

There are two types of input filters, line filters and frequency filters.

Because the 1 MHz line filter is inserted as shown in the following figure, it affects normal measurement, harmonic measurement, and frequency measurement (for details, see the block diagram in appendix 12 of the Getting Started Guide, IM WT5000-03EN).



- You can set the line filter type by specifying Line Filter Type under line filter (Line Filter) in the input settings (advanced/options).
▶ [Click here.](#)
- When Line Filter Advanced Settings under line filter (Line Filter) in the input settings (advanced/options) is set to on, that filter function is enabled, and the settings explained in this section are disabled.
▶ [Click here.](#)

Turning the Line Filter On and Off (Line Filter)

When the line filter is turned on, measured values will not contain high frequency components. Thus, the voltage, current, and power of inverter waveforms, strain waveforms, etc., can be measured with their high frequency components eliminated.

Turning it off disables the line filter.

When the line filter is turned on, the accuracy and the upper limit of the measurement band change. For details, see sections 6.15 and 6.16 in the Getting Started Guide, IM WT5000-03EN.

Cutoff Frequency (CutOff)

Set the cutoff frequency in the following range.

0.1 kHz to 100.0 kHz (in 0.1 kHz steps), 1 MHz

The line filter functions as shown in the above figure according to the set frequency.

The line filter setting (off, or the cutoff frequency when set to on) is shown on the Elements tab of the input information area.

In IEC Harmonic Measurement Mode

In IEC harmonic measurement mode, the line filter is set as follows:

- The line filter settings of element 1 apply to all elements.
- Line filter type: Fixed to Butterworth

In IEC Voltage Fluctuation and Flicker Measurement Mode

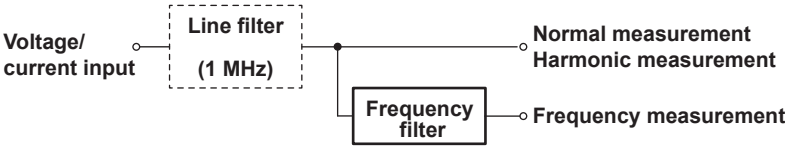
In IEC voltage fluctuation and flicker measurement mode, the line filter is set as follows:

- Common to all elements
- ON/OFF: Fixed to ON
- Cutoff frequency: Select 10kHz, 5kHz, 2kHz, or 1kHz.
- Line filter type: Fixed to Butterworth
- The line filter settings are not synchronized between the normal measurement mode and IEC voltage fluctuation and flicker measurement mode. They can be set separately for each mode.

Frequency Filter (Freq Filter)

Turning the Frequency Filter On and Off (Freq Filter)

Because the frequency filter is inserted as shown in the following figure, it affects frequency measurement (see the block diagram in appendix 12 of the Getting Started Guide, IM WT5000-03EN).



Moreover, if the computing method is sync source period average, it affects the detection of the measurement period for voltage, current, and power measurement. In this case, the frequency filter functions as a filter for detecting the [cross point](#) of the sync source signal more accurately. The frequency filter is not inserted in normal measurement or harmonic measurement. Therefore, the measured values include high frequency components even when the frequency filter is turned on.

- This instrument detects the cross point with a hysteresis of approximately 5% of the measurement range.
- The frequency filter setting (off, or the cutoff frequency when set to on) is shown on the Elements tab of the input information area.
- Even when the frequency filter is off, if the line filter (1 MHz) described earlier is on, the line filter (1 MHz) will affect frequency measurement.
- We recommend that the frequency filter be turned on and the cutoff frequency set as follows according to the input signal frequency.

Input Signal Frequency	Cutoff Frequency of the Frequency Filter
100 Hz or less	0.1 kHz
1 kHz or less	1 kHz
100 kHz or less	100 kHz

Cutoff Frequency (CutOff)

Set the cutoff frequency in the following range.
0.1 kHz to 100.0 kHz (in 0.1kHz steps)

In IEC Harmonic Measurement Mode

In IEC harmonic measurement mode, the line filter settings of element 1 apply to all elements.

In IEC Voltage Fluctuation and Flicker Measurement Mode

In IEC voltage fluctuation and flicker measurement mode, the line filter is set as follows:

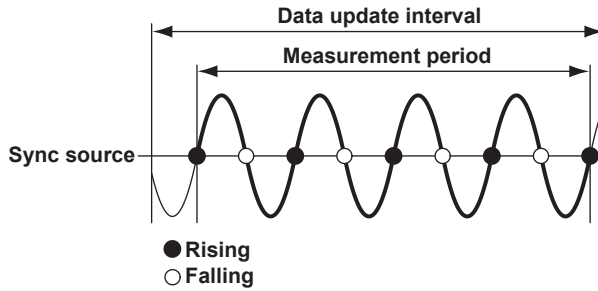
- Common to all elements
- ON/OFF: Fixed to ON
- Cutoff frequency: Select 10kHz, 5kHz, 2kHz, or 1kHz.
- The line filter settings are not synchronized between the normal measurement mode and IEC voltage fluctuation and flicker measurement mode. They can be set separately for each mode.

Measurement Period (Sync Source)

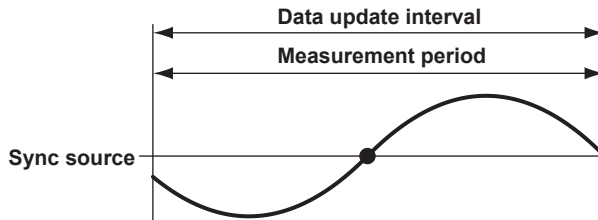
When the Computing Method Is Sync Source Period Average

Measurement Period of Normal Measurement Functions

The measurement period is determined by the input signal that is used as the reference (sync source). The measurement period is set within the data update interval between the first point where the sync source crosses the specified level (center of the amplitude by default) on a rising slope (or falling slope) and the last point where the sync source crosses the specified level on a rising slope (or falling slope).



If there is no more than one cross point within the data update interval, the measurement period is the entire data update interval.



3 Input Settings (Basic Measurement Conditions)

The measurement period for determining the numeric data of the peak voltage or peak current is always the entire span of the data update interval. Therefore, the measurement period for the measurement functions that are determined on the basis of the maximum voltage or current value (U+pk, U-pk, I+pk, I-pk, CfU, P+pk, P-pk, and CfI) is also the entire span of the data update interval.

For details, see appendix 5 in the Getting Started Guide, IM WT5000-03EN.

Measurement Period of Harmonic Measurement Functions

The measurement period is from the first sampled data in the data update interval to 1024 points or 8192 points (selected with the [number of FFT points](#) setting) counted at the sampling frequency for harmonics.

This instrument determines the harmonic sampling frequency automatically based on the period of the signal that is set as the PLL source. The sampling data and measurement period that are used to determine the values of harmonic measurement functions may be different from those used to determine the values of normal measurement functions.

Sync Source (Sync Source)

Select the signal to use as the sync source from the options listed below. The available options vary depending on the installed elements. When range Σ link is set to on, elements in the same wiring unit have the same sync source.

U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7, Ext Clk (external clock) 1, Z Phase 1 (Ch D) 2, Z Phase 3 (Ch H) 2, None

- 1 When you select Ext Clk, the external signal applied to the external clock input connector (EXT CLK) on the rear panel is used as the sync source. For the EXT CLK connector specifications, see section 4.3 in the Getting Started Guide, IM WT5000-03EN.
- 2 Models with the motor evaluation 1 or 2 option



-
- If sync source is set to None
All of the sampled data within the data update interval is used to determine the numeric data.
When you are measuring DC signals, this method can be used to prevent noise from causing errors in the detection of the measurement period.
 - When the computing method is sync source period average, if the sync source is not set correctly, the measured value may fluctuate or be incorrect. See appendix 5 in the Getting Started Guide, IM WT5000-03EN.
-

When the [Computing Method](#) Is Digital Filter Average

The measurement period is determined by the data update interval and response speed. You do not need to set the sync source (Sync Source). The setting appears dimmed.

4 Input Settings (Advanced/Options)

Input Settings (Advanced/Options, Input (Advanced/Options))

You can specify the following items.

- [Wiring System \(Wiring\)](#)
- [Measurement range \(Range\)](#)
- [Range Configuration \(Range Config\)](#)
- [Line filter \(Line Filter\)](#)
- [Frequency filter, rectifier, level \(Freq Filter/Rectifier/Level\)](#)
- [Null Feature \(Null\)](#)
- [Motor Evaluation/Auxiliary inputs \(Motor/Aux\)](#)
- [Sensor Correction \(Sensor Correction\)](#)

Wiring System (Wiring)

This is a feature similar to the wiring diagram.

► [Click here.](#)

Measurement Range (Range)

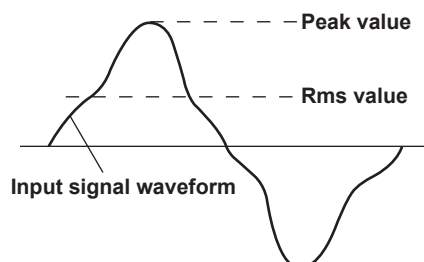
You can specify the following items.

- [Crest factor \(Crest Factor\)](#)
- [Range \$\Sigma\$ link \(Range \$\Sigma\$ Link\)](#)
- [Display Format of Current Range \(Current Range Display Format\)](#)

Crest Factor (Crest Factor)

The crest factor is defined as the ratio of the peak value of the waveform to the rms value.

$$\text{Crest factor (CF)} = \frac{\text{Peak value}}{\text{Rms value}}$$



On this instrument, the crest factor is the ratio of the maximum applicable peak value to the measurement range.

$$\text{Crest factor (CF)} = \frac{\text{Peak value that can be input}}{\text{Measurement range}}$$

You can set the crest factor to CF3, CF6, or CF6A.

- CF3: The crest factor is 3.
- CF6: The crest factor is 6.
- CF6A: The input range of the measurement range is expanded as follows as compared to when the crest factor is set to 6. This is used to suppress frequent range changes when measuring a distorted waveform in auto range mode.
 - Condition for increasing the range in auto range mode
The voltage or current exceeds 220% of the currently set measurement range.
 - Condition that cause an overload indication (" - O L - ") (for details, see section 1.3 in the Getting Started Guide, IM WT5000-03EN)
The measured voltage or current exceeds 280% of the currently set measurement range.

The measurable crest factor is as follows:

$$\text{Crest factor (CF)} = \frac{\{\text{measurement range} \times \text{CF setting (3 or 6)}\}}{\text{Measured value (rms value)}}$$

- * However, the peak value of the input signal must be less than or equal to the maximum allowable input.

If the crest factor of the input signal is greater than the specifications of this instrument (the crest factor defined at the rated input), you can measure the signal by setting a greater measurement range. For example, even if CF is set to 3, measurement is possible for signals with a crest factor greater than or equal to 5 when the measured value (rms value) is less than 60% of the measurement range. If the minimum effective input (1% of the measurement range) is being applied when CF is set to 3, measurement for CF = 300 is possible.

The voltage range, current range, effective input range, and measurement accuracy vary depending on the crest factor setting. For details, see chapter 6 in the Getting Started Guide, IM WT5000-03EN.



- When you change the crest factor, the following settings change for all elements.
 - All elements are automatically set to their maximum voltage and current ranges.
 - In the valid measurement range settings, all measurement ranges are enabled (selected).
 - If the crest factor is set to CF6 or CF6A, the measurement conditions of crest factor 5 and higher required by IEC 62018 are met.
 - When measuring waveforms whose crest factor is less than or equal to CF3, you can achieve more accurate measurements by setting the crest factor to 3.
-

Range Σ link (Range Σ Link)

You can select whether to collectively or independently set the measurement ranges of input elements assigned to the same wiring unit in the wiring system settings.

Turning Range Σ Link On and Off

For example, assume that the wiring system on a model with three input elements is set as follows:

Input elements 1 to 3: Three-phase, four-wire system (3P4W). Input elements 1 to 3 are assigned to a single wiring unit ΣA .

- OFF

The measurement range can be set independently for each input element included in a wiring unit.

- ON

The measurement range of input elements 1 to 3 are set to the same setting. This is convenient because when you are measuring a three-phase device, you can set the measurement range settings of all input elements included in a wiring unit simultaneously.

Settings That Are Shared between Input Elements When Range Σ Link Is Set to On

- Measurement range (including auto range on or off)
- Direct current input or external current sensor input
- Valid measurement range

How Settings Are Aligned When Range Σ Link Is Changed from Off to On

When range Σ link is changed from off to on, the measurement range, direct current input or external current sensor input, and valid measurement range settings of each input element in a wiring unit (ΣA , ΣB , or ΣC) are changed as follows:

- The measurement range is set to the greatest of the measurement ranges of the input elements assigned to the same wiring unit. The external current sensor input range has precedence over the direct input current range. The external current sensor input range has precedence over the direct input current range.
- The auto range on/off settings are changed to match the setting of the input element whose measurement range is highest. If multiple input elements are set to a common highest measurement range, the setting of the input element with the smallest input element number takes precedence.
- In the valid measurement range settings, all measurement ranges are enabled (selected).



If the following settings are different on a 760903 (current sensor element), Range Σ Link cannot be enabled.

- CT preset
- Input resistance

On the 760903 (current sensor element) that is to compose the wiring unit, make the above settings the same, and then enable Range Σ Link.

Display Format of Current Range (Current Range Display Format)

You can select the current range display format from the following options.

760901(30A High Accuracy Element), 760902 (5A High Accuracy Element)

Direct Input Range

- Direct input value display (Direct)
The current range is displayed as a value without multiplying the CT ratio to the current range. This setting is useful when you want to set the direct input range using the current sensor's (CT's) output current received by the current input terminal as a guide.
- Measurement range display (Measure)
When the scaling feature is set on, the current range is displayed as a value obtained by multiplying the CT ratio to the current range. This setting is useful when you want to set the direct input range using the current measured by the current sensor (CT) as a guide. For example, if you are using a CT that outputs 1 A when it receives 1000 A (CT ratio: 1000) and you set the direct input range to 1 A, the displayed current range is 1.00 kA.

External Current Sensor Range

- Direct input value display (Direct)
The external current sensor range (voltage) is displayed as the current range. This setting is useful when you want to set the external current sensor range using the external current sensor output voltage received by the external current sensor input terminal as a guide.
- Measurement range display (Measure)
The external current sensor range is divided by the external current sensor conversion ratio, and the resulting (current) range is displayed as the current range. This setting is useful when you want to set the external current sensor range using the current measured by the external current sensor as a guide. For example, if you are using a current sensor that produces 10 mV when it receives 1 A (external current sensor conversion ratio: 10 mV/A) and you set the external current sensor range to 1 V, the displayed current range is 100 A.

760903 (Current Sensor Element)

Current Sensor Input Range

- Direct input value display (Direct)
The current range is displayed as a value without multiplying the CT ratio to the current range. This setting is useful when you want to set the current sensor input range using the current sensor's (CT's) output current received by the current sensor connection terminal as a guide.
- Measurement range display (Measure)
When the scaling feature is set on, the current range is displayed as a value obtained by multiplying the CT ratio to the current range. This setting is useful when you want to set the current sensor input range using the current measured by the current sensor (CT) as a guide. For example, if you connect a CT2000A, set the CT preset to CT2000A, and the CT ratio is 2000.0000, when you set the current sensor input range to 1 A, the displayed current range is 2.00 kA.

Probe Input Range

- Direct input value display (Direct)
The probe input range (voltage) is displayed as the current range. This setting is useful when you want to set the probe input range using the current probe's output voltage received by the current probe input terminal as a guide.
- Measurement range display (Measure)
The probe input range is divided by the output voltage rate, and the resulting (current) range is displayed. This setting is useful when you want to set the probe input range using the current measured by the current probe as a guide. For example, if you are using a 720931 (2.5mV/A) and set the probe input range to 500 mV, the displayed current range is 200 A.

Range Configuration (Range Config)

You can specify the following items.

- Valid Measurement Range (Valid Measurement Range)
 - Measurement Range to Switch to When a Peak Over-Range Occurs (Peak Over Jump)
- [Click here.](#)

Item to Set the Range Configuration Of (Voltage/Current)

Select the item to set the range configuration of from the following:

- Voltage range (Voltage)
- Current range (Current)

Item to Set the Current Range Of (Setting Object)

Select the item to set the current range of from the following:

- **Terminal in Use**
The input terminal currently in use. The input terminal of each element currently in use is displayed highlighted at the top edge of the table.
- **Direct/Sensor**
 - Direct input range of the 760901 (30A High Accuracy Element) or 760902 (5A High Accuracy Element)
 - Current sensor range of the 760903 (current sensor element)
- **Ext Sensor/Probe**
 - External current sensor range of the 760901 (30A High Accuracy Element) or 760902 (5A High Accuracy Element)
 - Probe input range of the 760903 (current sensor element)

Valid Measurement Range (Valid Measurement Range)

This instrument switches between enabled measurement ranges. Disabled measurement ranges are skipped. For example, when using auto range to measure the current of a device that produces 2 A when operating and 100 mA when in standby, disable the 200 mA, 500 mA, and 1 A ranges. When the device is in standby, the range will be 200 mA. When the device begins operating, this instrument will skip the intermediate 200 mA, 500 mA, and 1 A ranges and switch directly to the 2 A range.

Element1 to Element7

For each input element or wiring unit, you can set all ranges as valid measurement ranges (All ON).

Measurement Range Box (Left column of the list)

For each range, you can set whether the range is a valid measurement range for all input elements (All ON) or not (All OFF).

Measurement Range to Switch to When a Peak Over-Range Occurs (Peak Over Jump)

You can specify which measurement range to switch to when the auto range feature is enabled and a peak over-range occurs. The background of the selected measurement range turns yellow. If a peak over-range occurs when this feature is disabled, this instrument increases the measurement range, switching between valid measurement ranges (measurement ranges whose check boxes have been selected).

When the [current range display format](#) is set to Measure, measurement ranges that reflect the CT conversion ratio of the current sensor are displayed for the valid measurement range and the measurement range when peak over-range occurs.

4 Input Settings (Advanced/Options)



- You cannot set all measurement ranges to off. There must be at least one valid range.
- The settings for the valid range and for the measurement range to switch to when peak over-range occurs are shared by all the input elements in a wiring unit.
- When range Σ link is on and you change the wiring system, all measurement ranges are enabled (set to their initial setting).
- When range Σ link is changed from off to on, all measurement ranges are enabled (set to their initial setting).
- If you set the valid range setting for the current measurement range to OFF, this instrument switches to the next highest measurement range. If there is no measurement range above the current one, this instrument switches to the next lowest measurement range.

Line Filter (Line Filter)

You can set the line filter in detail.

When the line filter is turned on, the accuracy and the upper limit of the measurement band change. For details, see sections 6.15 and 6.16 in the Getting Started Guide, IM WT5000-03EN.



In the following measurement modes, the line filter setting of Input (Advanced/Options) is dimmed and cannot be set.

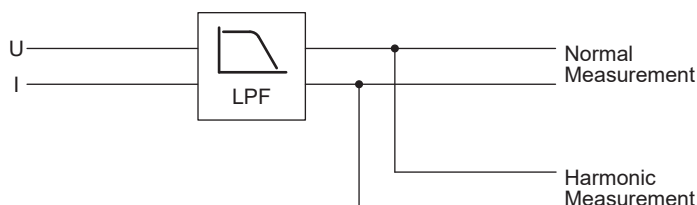
- IEC harmonic measurement mode
- IEC Voltage fluctuation and flicker measurement mode

Advanced Line Filter Setting (Line Filter Advanced Setting)

Turn the advanced line filter setting on or off.

When the Advanced Line Filter Setting Is Off

The line filter is configured as shown in the following figure. It is common low-pass filter for normal measurement and harmonic measurement.



Line Filter Type (Line Filter Type)

Set the line filter type to Butterworth or Bessel.

However, if the cutoff frequency is set to 1 MHz, the line filter type is fixed to Bessel.

Turning the Line Filter On and Off (Line Filter)

This is the same as turning the line filter on and off in the input settings (basic measurement conditions). The setting is shared.

► [Click here.](#)

Cutoff Frequency (CutOff)

This is the same as the line filter cutoff frequency in the input settings (basic measurement conditions). The setting is shared.

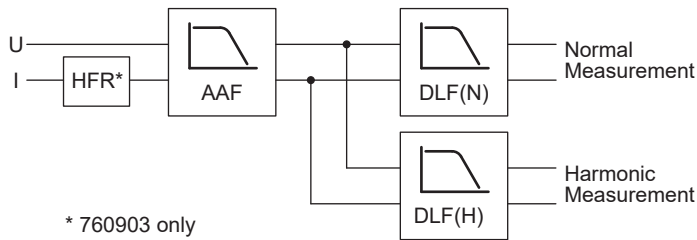
► [Click here.](#)

Setting All Input Elements Collectively

If you select the top cell of each item in the table, you can set the item collectively on all input elements.

When the Advanced Setting (Line Filter) Is On

The line filter consists of an HFR*, AAF, DLF(N), and DLF(H). You can set a different line filter for normal measurement and harmonic measurement.



Line Filter Type (DLF) (Line Filter Type (DLF))

Set the DLF(N) and DLF(H) types to Butterworth or Bessel.

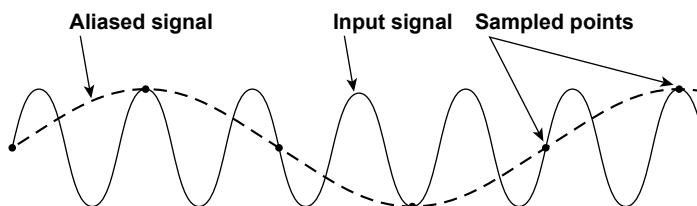
HF Rejection (HF Rejection: HFR)

This setting is available when the input element is 760903 (current sensor element). HFR (High Frequency Rejection) is a feature for turning on or off only the current signal side of the AAF. When applied, HFR eliminates the harmonic components in the current signal. It can be used to reject any harmonic noise that may be mixed in the current signal. If AAF is enabled when HFR is enabled, the filter characteristics of the AAF take precedence.

Anti-Aliasing Filter (Anti-Aliasing Filter: AAF)

Turn the anti-aliasing filter to off or on (1 MHz).

When an FFT is taken through the performance of A/D conversion on a repetitive waveform, a phenomenon occurs in which frequency components that exceed half the frequency of the sampling frequency are detected as low frequency components. This phenomenon is called aliasing.



If you use the 1 MHz anti-aliasing filter, harmonic components around 1 MHz and higher are removed to prevent aliasing.

Digital Line Filter (for normal measurement) (Digital Line Filter (Normal): DLF(N))

Set the digital line filter for normal measurement.

- **Turning DLF(N) On or Off (Digital Line Filter (Normal))**

Turn DLF(N) on or off.

- **Cutoff Frequency (Cutoff)**

Set the DLF(N) cutoff frequency in the following range.

0.1 kHz to 100.0 kHz (in 0.1 kHz steps)

Digital Line Filter (for harmonic measurement) (Digital Line Filter (Harmonics): DLF(H))

Set the digital line filter for harmonic measurement.

- **Turning DLF(H) On or Off (Digital Line Filter (Harmonics))**

Turn DLF(H) on or off.

- **Cutoff Frequency (Cutoff)**

Set the DLF(H) cutoff frequency in the following range.

0.1 kHz to 100.0 kHz (in 0.1 kHz steps)

Setting All Input Elements Collectively

If you select the top cell of each item in the table, you can set the item collectively on all input elements.

Frequency Filter, Rectifier, Level (Freq Filter/Rectifier/Level)

You can set the frequency filter in detail.

Sync Source and Frequency Measurement (Sync Source/Freq Measurement)

This instrument has a frequency filter for detecting the cross points of the sync source and measuring frequencies. You can set a high-pass filter (High Pass Filter: HPF), rectifier, low-pass filter (Low Pass Filter: LPF), and level to remove unneeded low and high frequencies and measure the frequency of the waveform component you want to measure.

► [Click here.](#)

Second frequency measurement (Freq2 Measurement)

This instrument can measure two frequencies for a single input signal. For example, if the voltage signal of element 1 is a 50 Hz signal with a 1 kHz signal superimposed, the instrument can simultaneously measure the 50 Hz as Freq and 1 kHz as Freq2. To measure the 50 Hz frequency, you would set the sync source and frequency measurement described above, and to measure the 1 kHz frequency, you would set the frequency filter of the second frequency measurement.

► [Click here.](#)

Sync Source and Frequency Measurement (Sync Source/Freq Measurement)



In the following measurement modes, the frequency filter setting of Input (Advanced/Options) is dimmed and cannot be set.

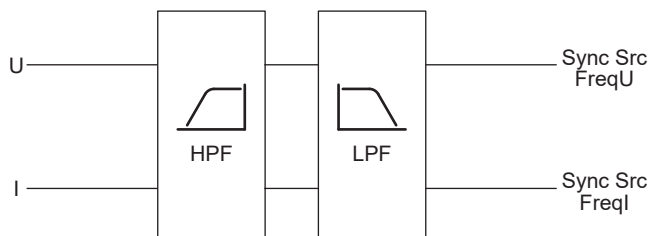
- IEC harmonic measurement mode
- IEC Voltage fluctuation and flicker measurement mode

Advanced Frequency Filter Setting (Freq Filter Advanced Setting)

Turn the advanced frequency filter setting on or off.

When the Advanced Frequency Filter Setting Is Off

The frequency filter consists of a high-pass filter and a low-pass filter.



- **Frequency Filter (HPF)**

The high-pass filter is fixed to on. The cutoff frequency is 0.1 Hz.

- **Turning the Frequency Filter (LPF) On and Off (Freq Filter)**

This is the same as turning the frequency filter on and off in the input settings (basic measurement conditions). The setting is shared.

► [Click here.](#)

- **Cutoff Frequency (Cutoff)**

This is the same as the frequency filter cutoff frequency in the input settings (basic measurement conditions). The setting is shared.

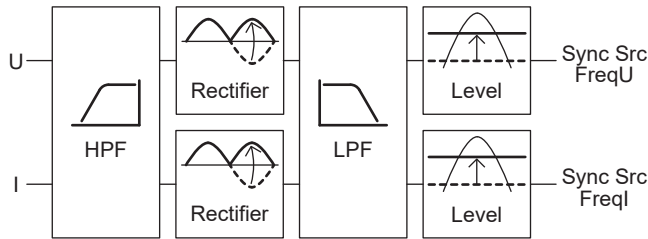
► [Click here.](#)

- **Setting All Input Elements Collectively**

If you select the top cell of each item in the table, you can set the item collectively on all input elements.

When the Advanced Frequency Filter Setting Is On

The frequency filter consists of a high-pass filter, a rectifier, a low-pass filter, and a cross level.



- **Turning the Frequency Filter (HPF) On and Off (Freq Filter)**

Turn the frequency filter (HPF) on or off.

- **HPF Cutoff Frequency (CutOff)**

Set the HPF cutoff frequency in the following range.

0.1 Hz, 1 Hz, 10 Hz, 0.1 kHz to 100.0 kHz (in 0.1 kHz steps)

- **Voltage Rectifier and Current Rectifier (Voltage Rectifier/Current Rectifier)**

Select whether to rectify the voltage and current (on/off).

* If rectifier is set to ON, reactive power Q, phase difference Φ , and QΣ measurements may change. See appendix 1 in the Getting Started Guide, IM WT5000-03EN.

- **Turning the Frequency Filter (LPF) On and Off (Freq Filter)**

This is the same as turning the frequency filter on and off in the input settings (basic measurement conditions). The setting is shared.

► [Click here.](#)

- **LPF Cutoff Frequency (CutOff)**

This is the same as the frequency filter cutoff frequency in the input settings (basic measurement conditions). The setting is shared.

► [Click here.](#)

- **Voltage Cross Level and Current Cross Level (Voltage Level/Current Level)**

You can set the voltage [cross level](#) and current cross level in the following ranges.

- When the rectifier is off: -100.0% to 100.0%
- When the rectifier is on: 0.0% to 100.0% (absolute value)

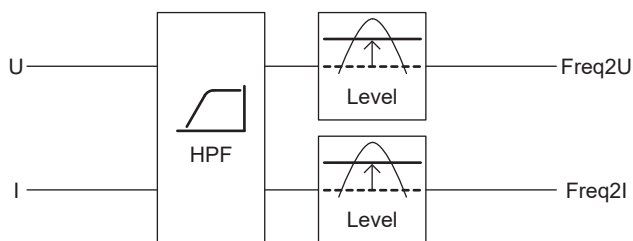
- **Setting All Input Elements Collectively**

If you select the top cell of each item in the table, you can set the item collectively on all input elements.

Second frequency measurement (Freq2 Measurement)

Set the frequency filter of the second frequency measurement (Freq2 Measurement).

The frequency filter consists of a high-pass filter and a cross level.



In the following measurement modes, the second frequency measurement settings are dimmed and cannot be set.

- IEC harmonic measurement mode
 - IEC Voltage fluctuation and flicker measurement mode
-

- **Turning the Frequency Filter (Freq2) On and Off (Freq Filter (Freq2))**

Turn the frequency filter (Freq2) on or off.

- **HPF Cutoff Frequency (CutOff)**

Set the HPF cutoff frequency in the following range.

0.1 Hz, 1 Hz, 10 Hz, 0.1 kHz to 100.0 kHz (in 0.1 kHz steps)

- **Voltage Cross Level (Freq2) and Current Cross Level (Freq2) (Voltage Level (Freq2)/Current Level (Freq2))**

You can set the voltage cross level and current cross level in the following ranges.

- When the rectifier is off: -100.0% to 100.0%
- When the rectifier is on: 0.0% to 100.0% (absolute value)

- **Setting All Input Elements Collectively**

If you select the top cell of each item in the table, you can set the item collectively on all input elements.

Null Feature (Null)

You can use the null feature to subtract the DC offset while a measurement cable or external sensor is connected.

Items to Configure Null Settings for (Control Target)

Tap Null or press NULL to select the input signals that you want to enable or disable the null feature for.

Voltage (Voltage)

- All (All): You can enable or disable the null feature for the voltage signals of all elements at the same time.
- U1 to 7: You can enable or disable the null feature for the voltage signals of each element separately.

Current (Current)

- All (All): You can enable or disable the null feature for the current signals of all elements at the same time.
- I1 to 7: You can enable or disable the null feature for the current signals of each element separately.

Motor/Aux (Options)

- All (All): You can enable or disable the null feature for the Speed, Torque, and Aux signals at the same time.
- Speed1 to 4, Torque1 to 4, Aux1 to 8: You can enable or disable the null feature for the Speed, Torque, and Aux signals separately.

Updating the Null Value (Null Value Update)

Select the updating of the null value for each input signal.

- New: When you tap Null or press NULL, this Instrument sets or updates the null value. Afterwards, the null value is used to correct the measurement function values.
- Hold (Hold): The function of this key varies depending on whether the null value has yet to be set or has already been set.
 - When the null value has yet to be set
When you enable the null feature, this Instrument sets the null value. Afterwards, the null value is used to correct the measurement function values. Even if you disable the null feature in this condition, the null value is stored in the instrument.
 - When the null value has already been set
Even if you enable the null feature, the null value is not updated. The saved null value discussed above is used to correct the measurement function values.

For example, if you turn on the power and then immediately enable the null feature, the null value has not yet been set, so the value measured then is used as the null value. If you disable the null feature in this condition, the specified null value is stored in the instrument. If you enable the null feature again, the null value is not updated. The saved null value discussed above is used to correct the measurement function values.

The held null value is cleared under the following circumstances.

- Operations that cause the null values of all inputs to be cleared
 - Turning on the power (the null values are not backed up when you turn off the power)
 - Initializing the settings
 - Loading a setup data file
- Operations that cause the null value of the input whose settings were changed to be cleared
 - Switching between direct current input and external current sensor input
 - Changing the Sense Type setting for the Speed or Torque motor evaluation input signal

4 Input Settings (Advanced/Options)

Null Values

When you enable the null feature, the following measurement values are used as the null values.

- Udc and Idc (simple voltage and current averages)
- Speed, Torque, and Aux signals (on models with the motor evaluation option)

Measurement Functions Affected by the Null Feature

All measurement functions are affected by the null values.



- If there are no previously measured values for Udc, Idc, Speed, Torque, or Aux, because for example the null feature has been turned on before any measurements have been made, the null values are set to zero.
 - For measurement functions that are computed based on an element's voltage and current values, the null values are subtracted from the sampled voltage and current values.
 - For motor evaluation measurement functions and auxiliary input measurement functions, the null values are subtracted from the computed numeric data.
-

Null Notification Information (Null Notification Information)

Null Notification (Null Notification)

Select whether to display the notification "Null setting is OFF. When using the current sensor, please enable the null settings" after warm-up (30 minutes after power-on), if the null feature is set to off.

- ON: The notification is displayed. If you are using a current sensor, current probe, CT, or the like and do not want to forget using the null feature, we recommend that you set this setting to on.
- OFF: The notification is not displayed.



A null notification is displayed when all the following conditions are met.

- When one or more 760903s (current sensor elements) are installed.
 - The measurement mode is normal measurement.
Null notification is not displayed in IEC harmonic measurement mode or IEC voltage fluctuation and flicker measurement mode.
-

Power-On Time (Power-On Time)

The time when the instrument was turned on is displayed.

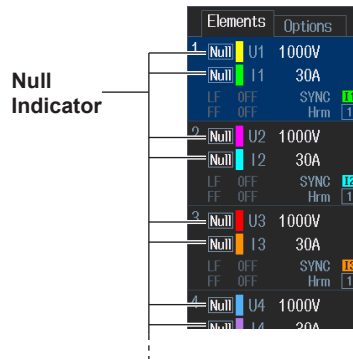
Notification Time (Notification Time)

The time when null notification will be displayed (the time 30 minutes after power-on) is displayed.

Enabling and Disabling the Null Feature (Null, NULL)

- When you tap Null or press NULL, the null feature is enabled. The NULL key illuminates.

For items that null states are set (Control Target), Null indicators illuminate to the left of the elements, motors, AUX inputs that are set to ON.



- If you tap Null or press NULL while the null feature is enabled, the NULL key light and Null indicators turn off, and the null feature is disabled.



- To make accurate measurements, we recommend that you execute zero-level compensation before enabling the null feature.
- The null feature is disabled when:
 - The power is turned on.
 - The settings are initialized.
 - A setup data file is loaded.
 - You switch between direct current input and external current sensor input.
 - You change the Sense Type setting for the Speed or Torque motor evaluation input signal.
- If the null feature is enabled or disabled while the display is held, the Null indicator will illuminate or turn off, but the held data will not be affected. Also, the Null indicator will be highlighted.
- The DC values that the null value is based on when the null feature is ON are held, but the upper limit of the null value is $\pm 10\%$ of the range when the crest factor is set to CF3. The upper limit of the null value is $\pm 20\%$ of the range when the crest factor is set to CF6 or CF6A.
- When the range is changed, the null value upper limit will be determined by the new range. The null value upper limit will also be adjusted when the range is decreased by the auto range feature.

Sensor Correction (Sensor Correction)

You can set the following current sensor correction settings.

- Current gain correction
- Current phase adjustment

Current Amplitude Correction

Current gain correction on/off (Current Amplitude Correction)

Select whether to correct the current amplitude (ON/OFF).

Correction Ratio (Correction Ratio)

Set the correction ratio.

Selectable range: 0.800000 to 1.200000

Current Phase Correction

To correctly measure power, impedance, power factor, watt hours, ampere hours, and so on, you must apply the voltage and current signals to the instrument's signal input terminals with no transfer time difference between the signals.

However, transfer time difference may occur between the two signals depending on the sensor or cable that you are using.

This instrument can measure by correcting the transfer time difference between the two signals.

Phase Correction On/Off (Current Phase Correction)

Select whether to correct the transfer time difference between the voltage and current (ON/OFF).

Frequency (Frequency)

Set the frequency for correcting the transfer time difference.

Selectable range: 50 Hz, 60 Hz, 0.1 kHz to 999.9 kHz (in 0.1 kHz steps), 1 MHz

Phase Difference between I/O (Phase Difference between I/O)

Set the phase difference between the input and output of the sensor or cable to be used.

Selectable range: -180.000° to +180.000°*

* The phase difference can be set within the range where the time difference between input and output is $\pm 10\mu\text{s}$.

When setting a phase difference that corresponds to the sensor's phase calibration value or propagation delay, set the sign as follows:

Lead: + or no sign

Lag: -

For example, to correct a lag of 1°, specify -1.000°.

Setting All Input Elements Collectively

If you select the left most cell of each item in the table, you can set the item collectively on all input elements.

Time Difference between I/O (Time Difference between I/O)

The correction value is calculated from the specified frequency and the phase difference between the input and output according to the following equation and displayed.

$$\text{Time Difference between I/O [s]} = \frac{\text{Phase difference [°]}}{360} \times \frac{1}{\text{Frequency [Hz]}}$$

5 Motor Evaluation and Auxiliary Input (Option)

Motor Evaluation/Auxiliary Inputs (Motor/Aux)

Motor Evaluation Function

This instrument can determine the motor rotating speed, torque, and output. It determines them using the revolution sensor signal, which is proportional to the motor rotating speed, and the torque meter signal, which is proportional to the motor torque. You can configure this instrument to receive analog (DC voltage) signals or pulse signals from the revolution sensor and torque meter. Also, you can set the number of motor poles and determine the motor's synchronous speed and slip. Furthermore, you can use the active power, frequency, and motor output measured by this instrument to compute the motor efficiency and total efficiency.

For a list of the measurement functions that can be measured with the motor evaluation feature and their descriptions, see “Motor Evaluation Functions” under “Items That This Instrument Can Measure.”

► [Click here.](#)

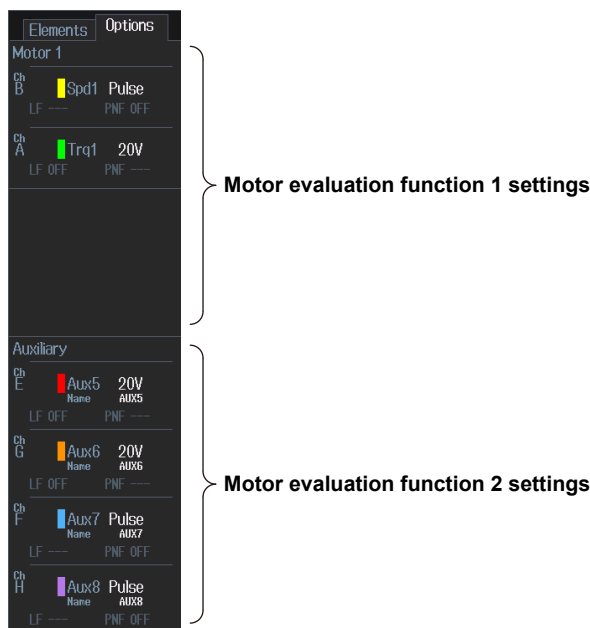
Auxiliary Input

You can apply signals from illuminance sensors, wind sensors, temperature sensors, and the like and display these physical quantities.

► [Click here.](#)

Motor/Auxiliary Input Displays

The motor/auxiliary input settings are displayed on the Options tab in the input information area on the right side of the screen. The following figure shows a display example when motor evaluation function 1 is set to single motor (revolution signal, pulse) and motor evaluation function 2 is set to auxiliary input (Aux).



MTR Configuration (MTR Configuration)

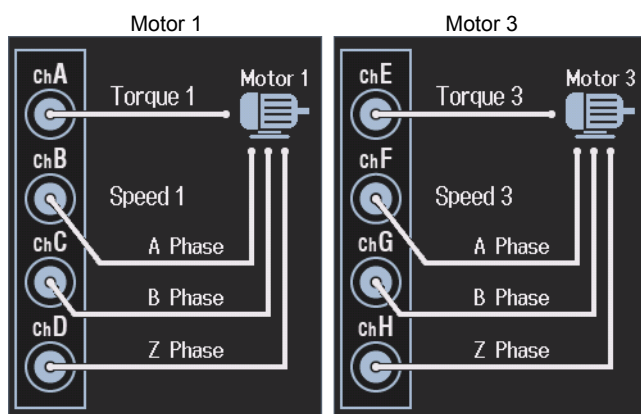
Select the functions of signal input Ch A to Ch H for motor evaluation function 1 and motor evaluation function 2.

- **Single Motor (revolution signal: pulse) (Single Motor (Speed:Pulse))**

The revolution signals are the pulses of phases A, B, and Z.

/MTR1	/MTR2	Function	Signal
Ch A	Ch E	Torque	Analog/pulse
Ch B	Ch F	Speed A	Pulse A phase (used for velocity measurement)
Ch C	Ch G	Speed B	Pulse B phase (used for rotation direction detection)
Ch D	Ch H	Speed Z	Pulse Z phase (used for electrical angle reference measurement)

Motor number assignments (Motor 1, Motor 3)

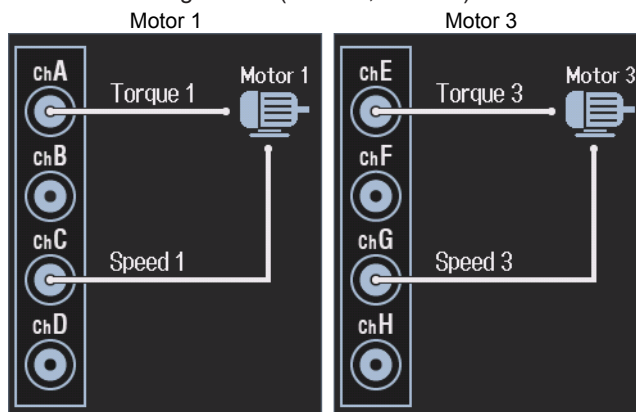


- **Single Motor (revolution signal: analog) (Single Motor (Speed:Analog))**

The revolution signals are analog.

/MTR1	/MTR2	Function	Signal
Ch A	Ch E	Torque	Analog/pulse
Ch B	Ch F	-	Not use
Ch C	Ch G	Speed	Analog
Ch D	Ch H	-	Not use

Motor number assignments (Motor 1, Motor 3)

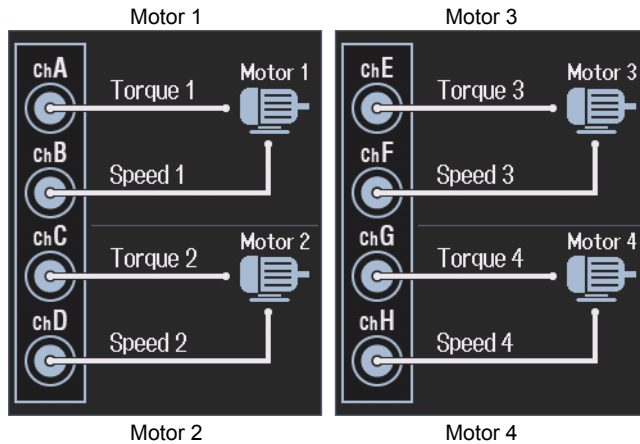


- **Double Motor (Double Motor)**

You can apply the torque and speed (pulse) signals from two circuits.

/MTR1	/MTR2	Function	Signal
Ch A	Ch E	Torque	Analog/pulse
Ch B	Ch F	Speed	Pulse
Ch C	Ch G	Torque	Analog/pulse
Ch D	Ch H	Speed	Pulse

Motor number assignments (Motor 1 to 4)

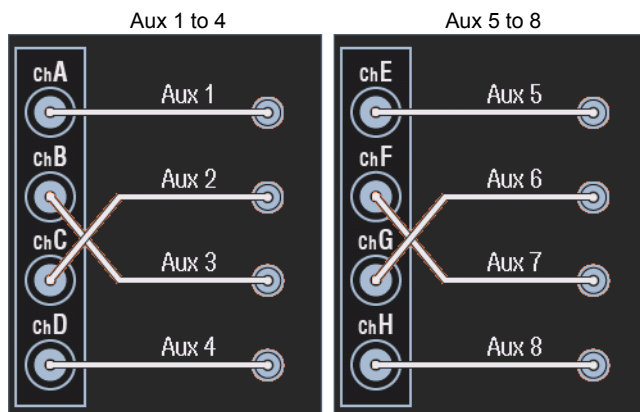


- **Auxiliary Input (Aux) (Auxiliary)**

You can apply analog voltage signals or pulse signals (e.g., frequency) from illuminance sensors, wind sensors, temperature sensors, and the like and display these physical quantities.

/MTR1	/MTR2	Function	Signal
Ch A	Ch E	Aux	Analog/pulse
Ch B	Ch F	Aux	Pulse
Ch C	Ch G	Aux	Analog/pulse
Ch D	Ch H	Aux	Pulse

Aux number assignments (Aux 1 to 8)



Motor/Aux Settings (Ch Settings)

Set the following items according to the MTR configuration.

When the MTR Configuration Is Set to Single Motor (revolution signal: pulse), Single Motor (revolution signal: analog), or Double Motor

- [Scaling factor \(Scaling\)](#)
- [Unit \(Unit\)](#)
- [Input signal type \(Sense Type\)](#)
- [Analog input auto range \(Analog Auto Range\)](#)
- [Analog input range \(fixed range\) \(Analog Range\)](#)
- [Setting the linear scaling of analog input manually \(Linear Scale A, B\)](#)
- [Computing the linear scaling of analog input from two points \(Calculation\)](#)
- [Line filter \(Line Filter\(Butterworth\)\)](#)
- [Pulse noise filter \(Pulse Noise Filter\)](#)
- [Sync source \(Sync Source\)](#)
- [Upper and lower limits of pulse input range \(Pulse Range Upper, Pulse Range Lower\)](#)
- [Torque signal pulse rating](#)
- [Revolution Signal Pulses per Revolution \(Pulse N\)](#)
- [Motor Poles \(Pole\)](#)
- [Frequency Measurement Source \(Source\)](#)

When the MTR Configuration Is Set to Auxiliary Input (Aux)

- [Input signal name \(Aux Name\)](#)
- [Scaling factor \(Scaling\)](#)
- [Unit \(Unit\)](#)
- [Input signal type \(Sense Type\)](#)
- [Analog input auto range \(Analog Auto Range\)](#)
- [Analog input range \(fixed range\) \(Analog Range\)](#)
- [Setting the linear scaling of analog input manually \(Linear Scale A, B\)](#)
- [Computing the linear scaling of analog input from two points \(Calculation\)](#)
- [Line filter \(Line Filter\(Butterworth\)\)](#)
- [Pulse noise filter \(Pulse Noise Filter\)](#)
- [Upper and lower limits of pulse input range \(Pulse Range Upper, Pulse Range Lower\)](#)

Input Signal Name (Aux Name)

When you set the MTR configuration auxiliary input (Aux), set the input signal name.

- Number of characters: Up to eight
- Usable characters: Spaces and all characters that are displayed on the keyboard

Scaling Factor (Scaling)

When the MTR Configuration Is Set to Single Motor (revolution signal: pulse), Single Motor (revolution signal: analog), or Double Motor

Setting the Scaling Factor for Scaling the Revolution Signal

You can set the factor for scaling the revolution signal. Set the factor to a value from 0.0001 to 99999.9999.

- **When the Revolution Signal Type is Analog**

This setting is used as the scaling factor in the equation for the [linear scaling of analog input](#).

- **When the Revolution Signal Type is Pulse**

This setting is used as the scaling factor in the equation for the number of [revolution signal pulses per revolution](#).

Setting the Scaling Factor for Scaling the Torque Signal

You can set the factor for scaling the torque signal to motor torque. Set the factor to a value from 0.0001 to 99999.9999.

- **When the Torque Signal Type is Analog**

This setting is used as the scaling factor in the equation for the [linear scaling of analog input](#).

- **When the Torque Signal Type is Pulse**

This setting is used as the scaling factor in the equation for the [torque signal pulse rating](#).

Setting the Scaling Factor for Computing the Motor Output

You can specify the scaling factor for computing the motor output (mechanical power) from the rotating speed and torque. Set the factor to a value from 0.0001 to 99999.9999.

The equation is indicated below. The scaling factors of the rotating speed and torque are set so that the unit of the rotating speed is min^{-1} (or rpm) and the unit of torque is $\text{N}\cdot\text{m}$. When the scaling factor of the motor output specified here is 1, the unit of the motor output P_m is W. Because the [efficiency computation](#) uses W as the unit of P_m , we recommend that you set the scaling factor of each item so that the unit of P_m is W.

$$\text{Motor output } P_m = \frac{2\pi}{60} \times \text{Speed} \times \text{Torque} \times S$$

Speed: The rotating speed, determined from the number of pulses per revolution

Torque: The torque, determined from the torque signal pulse rating

S: The scaling factor

When the MTR Configuration Is Set to Auxiliary Input (Aux)

You can set the factor for scaling the auxiliary signal. Set the factor to a value from 0.0001 to 99999.9999.

This setting is used as the scaling factor in the equation for the linear scaling of analog input.

Unit (Unit)

- Number of characters: Up to eight
- Usable characters: Spaces and all characters that are displayed on the keyboard

Input Signal Type (Sense Type)

Select the input signal from the following two types.

- Analog (Analog): Select this option when this instrument will receive DC voltage (analog) signals.
- Pulse (Pulse): Select this option when this instrument will receive pulse signals.

Settings for Different Input Signal Types

As indicated below, the settings that you need to configure vary depending on the input signal type.

Settings Related to the Signal Type

Setting	Signal Type	
	Analog	Pulse
Analog auto range	Yes	No
Analog range	Yes	No
Linear scale A, B	Yes	No
Line filter	Yes	No
Pulse noise filter	No	Yes
Sync source*	—	—
Pulse range	No	Yes
Number of pulses per revolution*	No	Yes

Yes: Must be set.

No: Does not need to be set.

—: Measurement can be performed when the sync source is set to None (the default setting), but you can increase synchronicity with power measurement by specifying a sync source.

Common Settings Unrelated to the Signal Type

- Scaling factor
- Unit
- Motor poles*
- Sync speed frequency measurement source*

* When the MTR configuration is set to auxiliary input (Aux), do not set this item.

Analog Input Range

Set the analog input range for input signals whose type has been set to analog. For input signals whose type has been set to pulse, there is no need to set the analog input range.

Analog Input Auto Range (Analog Auto Range)

Select whether to turn auto range on or off. When auto range is on, this instrument automatically switches between the following ranges according to the size of the input signal.

20 V, 10 V, 5 V, 2 V, 1 V

Range Increase

- The measurement range is increased when the input signal exceeds 110% of the measurement range.
- The measurement range is increased when the peak value of the input signal exceeds approximately 150% of the measurement range.

Range Decrease

The measurement range is decreased when the input signal falls below 30% of the measurement range and the peak value of the input signal is less than 125% of the lower range.



When non-periodic pulse waveforms are applied during auto range, the range may not remain constant. If this happens, use the fixed range setting.

Analog Input Range (Fixed Range) (Analog Range)

You can select one of the following input ranges.

20 V, 10 V, 5 V, 2 V, 1 V

Linear Scaling of Analog Input

Set the input signal slope and offset when the input signal type is set to analog.

Set the input signal slope and offset also when the MTR configuration is set to auxiliary input (AUX) and the input signal type is set to pulse.

The following two methods are available.

- Set the values manually.
- Specify two points, and use those points to compute the values.

Setting the Linear Scaling of Analog Input Manually (Linear Scale A, B)

You can set the slope (A) and offset (B) of the input signals to values within the following ranges.

Slope (A)

- When the MTR configuration is set to single motor (revolution signal: pulse), single motor (revolution signal: analog), or double motor
1.000 m to 1.000 M
- When the MTR configuration is set to auxiliary input (Aux)
–1.000 M to 1.000 M

However, A cannot be set to zero.

Offset (B)

–1.000 M to 1.000 M

The following equation is used to compute the measured values of an input signal.

Measured values of an input signal = $S(AX + B - \text{NULL})$

When the input signal type is set to analog

S: The scaling factor
A: The input signal slope
X: The input signal voltage
B: The offset
NULL: The [null value](#)

When the MTR configuration is set to auxiliary input (AUX) and the input signal type is set to pulse

S: The scaling factor
A: The pulse coefficient
X: The pulse frequency
B: The offset
NULL: The null value

When There Is No Offset in the Input Signal Voltage

If you set A to 1 and B to 0, the linear scaling settings do not affect computation, and the previous equation becomes:

Measured values of an input signal = $S(X - \text{NULL})$

The input signal is scaled when you set the scaling factor to the input signal per 1 V of input voltage.

When There Is Offset in the Input Signal Voltage

If you set S to 1, the scaling factor does not affect the computation, and the previous equation becomes

Measured values of an input signal = $AX + B - \text{NULL}$

The input signal is scaled when you set the input signal slope (A) to the input signal per 1 V of input voltage and offset (B) to the offset value.



If you enable the null feature and then change the input signal slope (A) or offset value (B), null correction will be offset. Reset the null value.

Computing the Linear Scaling of Analog Input from Two Points (Calculation)

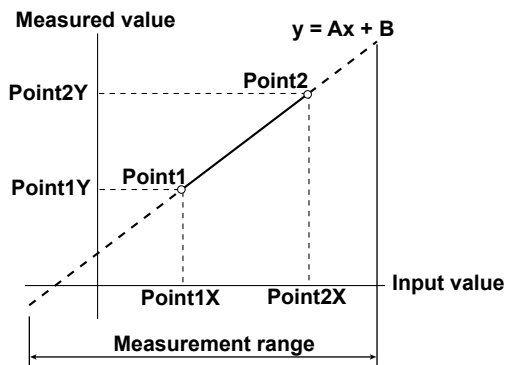
The input signal slope and offset are computed from two points.

On the input characteristic graphs of the input signal, you can specify two measured rpm or N•m values (Point1Y and Point2Y) in relation to two input voltage values (Point1X and Point2X).

Measured values (Point1X and Point2X): -1.000 T to 1.000 T

Computed values (Point1Y and Point2Y): -1.000 T to 1.000 T

Select Execute to use these four values to determine and set the input signal slope (A) and offset (B).



Line Filter (Line Filter(Butterworth))

You can remove high-frequency noise by inserting a line filter into the circuit used to measure the input signals. You can select the cutoff frequency from the following options. The filter type is Butterworth.

OFF, 100 Hz, 500 Hz, 1 kHz

Selecting OFF disables the filter.



The line filter setting applies to input signals whose type has been set to analog. For input signals whose type has been set to pulse, there is no need to configure this setting.

Pulse Noise Filter (Pulse Noise Filter)

You can remove high-frequency noise by inserting a pulse noise filter into the circuit used to measure the input signals.

You can select the cutoff frequency from the following options. The filter type is Butterworth.

OFF, 10kHz, 100kHz, 1MHz

Selecting OFF disables the filter.



The pulse noise filter setting applies to input signals whose type has been set to pulse. For input signals whose type has been set to analog, there is no need to configure this setting.

Sync Source (Sync Source)

When Measurement Method Is Set to Sync Source Period Average

When the MTR configuration is set to single motor (revolution signal: pulse), single motor (revolution signal: analog), or double motor, set the sync source.

- When you are measuring analog revolution and torque signals, you can select the element's input signal to use as the sync source from the following options. The available options vary depending on the installed elements.
U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7, Ext Clk (external clock)*, Z Phase 1 (Ch D), Z Phase 3 (Ch H), None
 - * For the EXT CLK connector specifications, see section 4.2 in the Getting Started Guide, IM WT5000-03EN.
- The measurement period is determined according to the cross point of the selected sync source. This instrument uses the measurement period to measure the analog revolution and torque signals.
- If sync source is set to None
All the sampled data within the data update interval is used to determine the rotating speed and torque.
- When the revolution or torque signal is a pulse signal, its value is the pulse signal period averaged over the measurement period. The measurement period is determined according to the sync source. If the pulse signal period does not fit within the measurement period, the previous period is used to determine the measured value.
- To achieve stable motor efficiency measurements, we recommend that you set the sync source for motor efficiency measurement to the same [sync source](#) that is set in the basic measurement conditions. This ensures that the measurement period is in sync with the measurement functions, such as those for voltage, current, and active power.

When Measurement Method Is Set to Digital Filter Average

The sync source setting is invalid.

Upper and Lower Limits of Pulse Input Range (Pulse Range Upper, Pulse Range Lower)

Set an appropriate range for the maximum and minimum input signal values. For example, when you are measuring signals for rotating speeds of 120 rpm to 180 rpm and torques of $-18 \text{ N}\cdot\text{m}$ to $+18 \text{ N}\cdot\text{m}$, set the rotating speed pulse input range to 100 rpm to 200 rpm, and set the torque pulse input range to $-20 \text{ N}\cdot\text{m}$ to $+20 \text{ N}\cdot\text{m}$.

You can set the pulse range for each input signal within the following limits.

- Torque signal: 10000.0000 to 10000.0000 [$\text{N}\cdot\text{m}$]
- Revolution signal: -99999.9999 to 99999.9999 [rpm]
- Aux signal: -10.00 M to 10.00 M

When the input signal type is pulse, the waveform display lower and upper limits are the values that you set here.

On models with the D/A output option, the rated D/A output values are as follows.

Input Signal	D/A Output
Setting for Pulse Range Upper	+5 V
Setting for Pulse Range Upper $\times (-1)$	-5 V

Torque Signal Pulse Rating

When the torque signal type is pulse, refer to the torque meter's specifications to set its rated positive and negative values.

Positive and Negative Rated Torque Signal Values (Rated Upper, Rated Lower)

Range: -10000.0000 to 10000.0000 ($\text{N}\cdot\text{m}$)

Positive and Negative Rated Torque Signal Pulse Frequencies (Rated Freq (Upper), Rated Freq (Lower))

Range: 1 to 100000000 (Hz)

The following equation is used to compute the torque.

$$\text{Torque} = S(\text{AX} + \text{B}) - \text{NULL}$$

S: The scaling factor¹

A: The torque pulse coefficient²

X: The pulse frequency

B: The torque pulse offset²

NULL: The [null value](#)

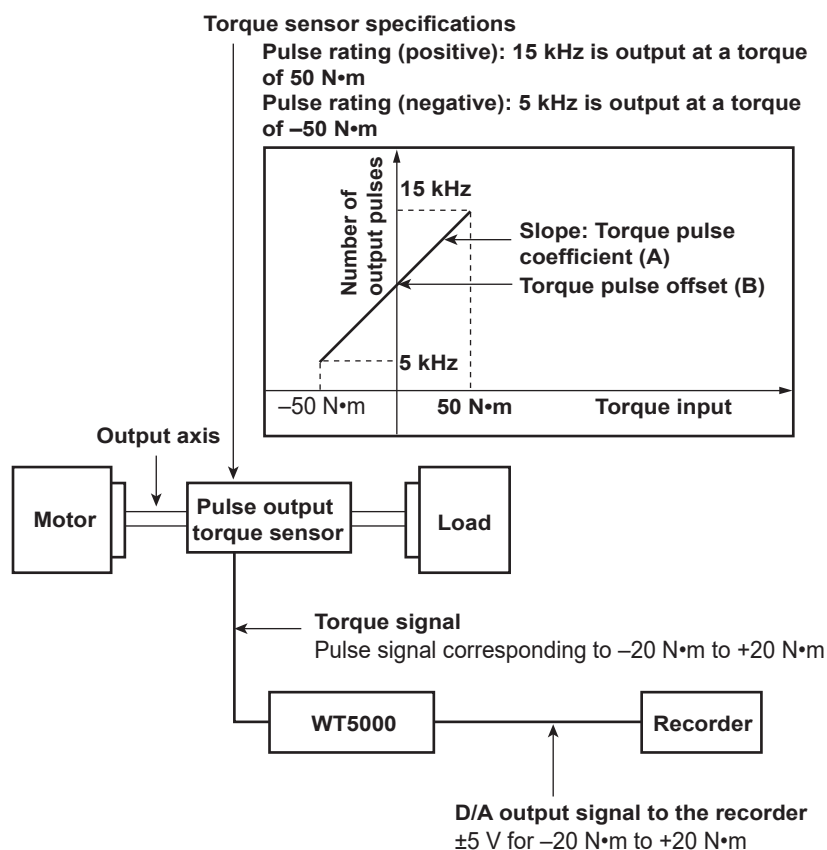
- 1 If the torque signal is a changed signal, you can set the [scaling factor](#) to determine the torque before the change.
- 2 The torque pulse coefficient and torque pulse offset are determined from the torque signal pulse rating as shown in the next figure.

5 Motor Evaluation and Auxiliary Input (Option)

Relationship between the Torque Signal Pulse Input Range and Pulse Rating

To measure a torque of $-20\text{ N}\cdot\text{m}$ to $+20\text{ N}\cdot\text{m}$ using a torque meter with specifications in the figure below, configure the pulse input range and pulse rating settings as indicated below.

- Upper limit of the pulse input range (Pulse Range Upper): 20.0000
- Lower limit of the pulse input range (Pulse Range Lower): -20.0000
- Positive rated torque signal value (Rated Upper): 50.0000
- Negative rated torque signal value (Rated Lower): -50.0000
- Positive rated torque signal pulse frequency (Rated Freq Upper): 15000
- Negative rated torque signal pulse frequency (Rated Freq Lower): 5000



The pulse input range setting applies to input signals whose type has been set to pulse. For input signals whose type has been set to analog, there is no need to configure this setting.

Revolution Signal Pulses per Revolution (Pulse N)

Set the number of pulses per revolution to a value from 1 to 9999.

The following equation is used to compute the rotating speed.

$$\text{Rotating speed} = S \left(\frac{X}{N} - \text{NULL} \right)$$

S: The scaling factor*

X: The number of input pulses from the revolution sensor per minute

N: The number of pulses per revolution

NULL: The [null value](#)

- * When the scaling factor is 1, the rotating speed is the number of revolutions per minute (min^{-1} or rpm). If the revolution signal is a changed signal, you can set the [scaling factor](#) to determine the rotating speed before the change.



The setting specifying the number of revolution signal pulses per revolution applies to input signals whose type has been set to pulse. For input signals whose type has been set to analog, there is no need to configure this setting.

Sync Speed(Sync Speed)

Motor Poles (Pole)

Set the number of motor poles to a value from 1 to 99. This number is used to compute the sync speed.

Frequency Measurement Source (Source)

- Select the frequency measurement source to use to compute the sync speed from the options below. This number is used to compute the sync speed. The available options vary depending on the installed elements. U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7
- Normally, you should select the voltage or current that is being applied to the motor. If you select the frequency of a voltage or current that is not being applied to the motor, the sync speed may not be determined properly.

Sync Speed Equation

The sync speed unit is fixed at min^{-1} or rpm.

$$\text{Sync speed (min}^{-1}\text{)} = \frac{120 \times F_s}{\text{Pole}}$$

F_s : The frequency of the frequency measurement source (Hz)

Pole: The number of motor poles

Slip Equation

The sync speed unit is fixed at min^{-1} or rpm. To determine the slip, configure the rotating speed [scaling factor](#) so that the unit of the rotating speed is also min^{-1} (or rpm).

$$\text{Slip (\%)} = \frac{\text{SyncSp} - \text{Speed}}{\text{SyncSp}} \times 100$$

SyncSp: The synchronous speed (min^{-1})

Speed: The rotating speed (min^{-1})



Set the frequency measurement source to a stable voltage or current signal that is being applied to the motor and that has low distortion and noise.

Electrical Angle Measurement (Electrical Angle Measurement)

Turning Electrical Angle Measurement On and Off

When the MTR configuration is set to single motor (revolution signal: pulse), select whether to measure electrical angles.



When the data update interval is 10 ms, electrical angle measurement is disabled.

Harmonic Analysis Trigger (Harmonics Trigger)

Each input element can be divided into two groups Hrm1 and Hrm2, and harmonics can be measured.

Select the Hrm1 and Hrm2 harmonic analysis triggers from the following options.

- Z Phase 1 (Ch D): Motor1's phase Z (channel D). This appears as an option when the electrical angle measurement of Motor1 is set to on.
- Z Phase 3 (Ch H): Motor3's phase Z (channel H). This appears as an option when the electrical angle measurement of Motor3 is set to on. (Models with the motor evaluation 2 option)
- None

Harmonic Element Group (Hrm Element Group)

This is the dividing of each input element into groups Hrm1 and Hrm2.

► [Click here.](#)

Valid Electrical Angle Measurement Items (Valid EA Items)

These are the electrical angle measurement items. They are set automatically according to the harmonic analysis trigger and harmonic element group settings.

Example: EaM1U1 is the electrical angle of M1 (motor 1) and U1 (voltage of element 1).

Electrical Angle Correction (Correction)

Set the electrical angle correction value.

Electrical Angle Correction (Electrical Angle Correction)

Set the correction value to a number from -180.00° to 180.00° .

Auto Correction Entry (Auto Enter Correction)

This instrument automatically sets the correction value to the difference between the phase of the voltage or current whose correction value is being automatically computed and the current electrical angle phase.

Auto Correction Entry Target(Target)

Select the voltage or current to automatically enter the calibration value. The available options vary depending on the installed elements.

U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7

Executing the auto correction entry (Execute)

An automatic electrical angle correction entry will be executed.

Computing the Motor Efficiency and Total Efficiency

This instrument can compute the motor efficiency (the ratio of power consumption to motor output) and total efficiency from the active power and motor output that it measures.* You can set the efficiency equation using the η Formula setting.

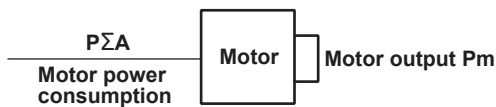
► [Click here.](#)

* The total efficiency is the ratio of total power consumption—not just the power consumption of the motor but also the power consumption of the converter that supplies the motor with power—to motor output.

The following is an example of how the values are computed.

When the Motor Input Is Wired to ΣA

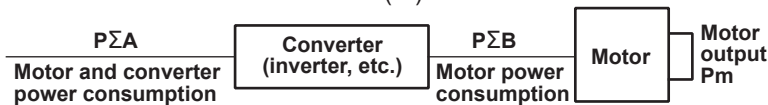
$$\text{Motor efficiency (\%)} = \frac{\text{Motor output } P_m \text{ (W)}}{P_{\Sigma A} \text{ (W)}} \times 100$$



When the Converter and Motor Inputs Are Wired to ΣA and ΣB , Respectively

$$\text{Motor efficiency (\%)} = \frac{\text{Motor output } P_m \text{ (W)}}{P_{\Sigma B} \text{ (W)}} \times 100$$

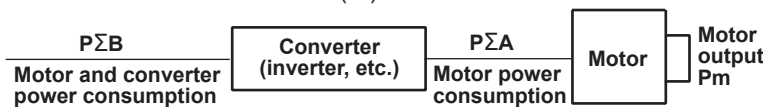
$$\text{Total efficiency (\%)} = \frac{\text{Motor output } P_m \text{ (W)}}{P_{\Sigma A} \text{ (W)}} \times 100$$



When the Converter and Motor Inputs Are Wired to ΣB and ΣA , Respectively

$$\text{Motor efficiency (\%)} = \frac{\text{Motor output } P_m \text{ (W)}}{P_{\Sigma A} \text{ (W)}} \times 100$$

$$\text{Total efficiency (\%)} = \frac{\text{Motor output } P_m \text{ (W)}}{P_{\Sigma B} \text{ (W)}} \times 100$$



If ΣA or ΣB is a three-phase, three-wire (3P3W) system, you can use [delta computation](#) to perform 3P3W>3V3A transformation on ΣA and ΣB . From the 3P3W>3V3A transformation, you can determine one unmeasured line voltage and one unmeasured common mode current.

6 Computation and Output Configuration

Computation and Output (Computation/Output)

You can specify the following items.

- [Efficiency equation \(Efficiency\)](#)
- [Delta computation \(\$\Delta\$ Measure\)](#)
- [Data update interval \(Update Rate\)](#)
- [Averaging \(Averaging\)](#)
- [Harmonic measurement conditions \(Harmonics\)](#)
- [Computation \(Measure\)](#)
- [Display \(Display\)](#)
- [Data storage \(Store\)](#)
- [Data saving \(Data Save\)](#)
- [Integrated power \(watt hours, Integration\)](#)
- [D/A output \(D/A Output, option\)](#)

Efficiency Equation (Efficiency)

You can create an efficiency equation by combining measurement function symbols. This instrument can determine the energy conversion efficiency of the device using the numeric values of the measurement functions.

η_1 to η_4

You can create four efficiency equations (η_1 to η_4), using the following measurement functions as operands.

- The active powers of each element (P1 to P7)
- The active powers of the Σ functions (P Σ A to P Σ C)
- The motor output (Pm1 to Pm4, on models with the motor evaluation 1 or 2 option)
- Udef1, Udef2

Udef1, Udef2

To add active powers and motor output and use them in η_1 to η_4 , use Udef1 and Udef2. You can add up to four operands consisting of the measurement functions listed above.

Equation Examples

- **Efficiency of a Single-Phase, Two-Wire Input/Single-Phase, Two-Wire Output Device**

Input: Power of element 1 (P1)

Output: Power of element 2 (P2)

Efficiency equation: $P2/P1 \times 100$ (%)



- **Efficiency of a Single-Phase, Two-Wire Input/Three-Phase, Three-Wire Output Device**

Input: Power of element 1 (P1)

Output: Σ power of elements 2 and 3 (P Σ A)

Efficiency equation: $P\Sigma A/P1 \times 100$ (%)

- **Efficiency of a Three-Phase, Three-Wire Input/Three-Phase, Three-Wire Output Device**

Input: Σ power of elements 1 and 2 (P Σ A)

Output: Σ power of elements 3 and 4 (P Σ B)

Efficiency equation: $P\Sigma B/P\Sigma A \times 100$ (%)

- **Efficiency of Motor 1 with a Single-Phase, Two-Wire Input**

Input: Power of element 1 (P1)

Output: Motor 1 output (Pm1)

Efficiency equation: $Pm1/P1 \times 100$ (%)

- **Efficiency of Motor 1 with a Three-Phase, Three-Wire Input**

Input: Σ power of elements 1 and 2 (P Σ A)

Output: Motor 1 output (Pm1)

Efficiency equation: $Pm1/P\Sigma A \times 100$ (%)



To correctly compute the efficiency, set the power coefficients of all elements so that all power units used in the computation are the same. For example, the efficiency cannot be computed correctly if elements or wiring units used in the computation have different power units, such as W (watt) and J (joule).

Delta Computation (Δ Measure)

The sum or difference of the instantaneous voltage or current values (sampled data) between the elements in a wiring unit can be used to determine various types of data such as the differential voltage and phase voltage. This calculation is called *delta math*.

Types of Delta Computation (Δ Measure Type)

The following types of delta computation are available:

- Differential voltage and differential current (Difference)
- Line voltage and phase current (3P3W > 3V3A)
- Star-delta transformation (Star>Delta)
- Delta-star transformation (Delta>Star)

The delta computation types that you can select vary as indicated below according to the wiring system.

Wiring System	Delta Computation Type
1P3W	Difference, 3P3W>3V3A
3P3W	Difference, 3P3W>3V3A
3P4W	Star>Delta
3P3W(3V3A)	Delta>Star

• Differential Voltage and Differential Current (Difference)

The differential voltage and differential current between two elements can be computed on a single-phase, three-wire system or on a three-phase, three-wire system.

When you perform delta computation on wiring unit ΣA , the available measurement functions are as follows.

$\Delta U1rms[UdiffA]$, $\Delta U1mn[UdiffA]$, $\Delta U1dc[UdiffA]$, $\Delta U1rmn[UdiffA]$, $\Delta U1ac[UdiffA]$

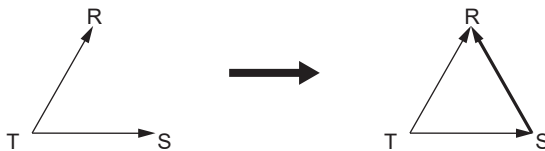
$\Delta Irms[lidiffA]$, $\Delta Imn[lidiffA]$, $\Delta Idc[lidiffA]$, $\Delta Irmn[lidiffA]$, $\Delta lac[lidiffA]$

* In the measurement functions, *rms*, *mn(mean)*, *dc*, *rmn(r-mean)*, and *ac* are the delta computation modes. A indicates the wiring unit.

► [Click here.](#)

• Line Voltage and Phase Current (3P3W > 3V3A)

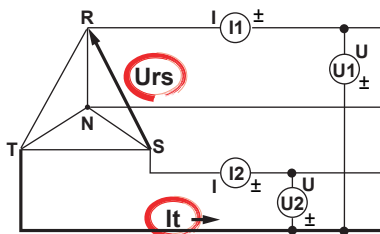
You can compute unmeasured line voltages and phase currents by converting the data of a three-phase three-wire system to the data of the three-voltage, three-current method (3V3A).



When you perform delta computation on wiring unit ΣA , the available measurement functions are as follows.

$\Delta U1rms[UrsA]$, $\Delta U1mn[UrsA]$, $\Delta U1dc[UrsA]$, $\Delta U1rmn[UrsA]$, $\Delta U1ac[UrsA]$

$\Delta Irms[ItA]$, $\Delta Imn[ItA]$, $\Delta Idc[ItA]$, $\Delta Irmn[ItA]$, $\Delta lac[ItA]$



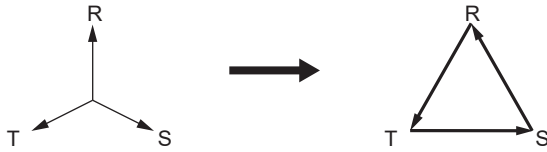
* In the measurement functions, *rms*, *mn(mean)*, *dc*, *rmn(r-mean)*, and *ac* are the delta computation modes. A indicates the wiring unit.

► [Click here.](#)

6 Computation and Output

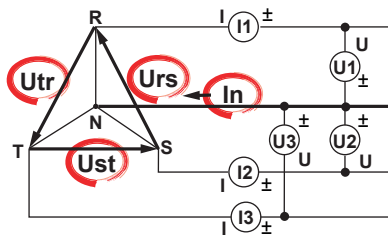
• Star-Delta Transformation (Star>Delta)

You can use the data from a three-phase, four-wire system to compute the data of a delta connection from the data of a star connection.



When you perform delta computation on wiring unit ΣA , the available measurement functions are as follows.

$\Delta U1_{rms}[UrsA]$, $\Delta U1_{mn}[UrsA]$, $\Delta U1_{dc}[UrsA]$, $\Delta U1_{rmn}[UrsA]$, $\Delta U1_{ac}[UrsA]$
 $\Delta U2_{rms}[UstA]$, $\Delta U2_{mn}[UstA]$, $\Delta U2_{dc}[UstA]$, $\Delta U2_{rmn}[UstA]$, $\Delta U2_{ac}[UstA]$
 $\Delta U3_{rms}[UtrA]$, $\Delta U3_{mn}[UtrA]$, $\Delta U3_{dc}[UtrA]$, $\Delta U3_{rmn}[UtrA]$, $\Delta U3_{ac}[UtrA]$
 $\Delta U\Sigma_{rms}[U\Sigma A]$, $\Delta U\Sigma_{mn}[U\Sigma A]$, $\Delta U\Sigma_{dc}[U\Sigma A]$, $\Delta U\Sigma_{rmn}[U\Sigma A]$, $\Delta U\Sigma_{ac}[U\Sigma A]$
 $\Delta I_{rms}[InA]$, $\Delta I_{mn}[InA]$, $\Delta I_{dc}[InA]$, $\Delta I_{rmn}[InA]$, $\Delta I_{ac}[InA]$



* In the measurement functions, *rms*, *mn(mean)*, *dc*, *rmn(r-mean)*, and *ac* are the delta computation modes. A indicates the wiring unit.

► [Click here.](#)

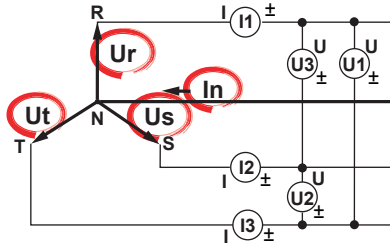
• Delta-Star Transformation (Delta>Star)

Using the data from a three-phase three-wire system that uses a three-voltage, three-current method, you can compute the data of a star connection from the data of a delta connection. This function is useful when you wish to observe the phase voltage of an object that has no neutral line, such as a motor. The center N of the star connection is computed as the center of the delta connection. If the actual center of the star connection does not match the center of the delta connection, an error results.



When you perform delta computation on wiring unit ΣA , the available measurement functions are as follows.

$\Delta U1_{rms}[UrA]$, $\Delta U1_{mn}[UrA]$, $\Delta U1_{dc}[UrA]$, $\Delta U1_{rmn}[UrA]$, $\Delta U1_{ac}[UrA]$
 $\Delta U2_{rms}[UsA]$, $\Delta U2_{mn}[UsA]$, $\Delta U2_{dc}[UsA]$, $\Delta U2_{rmn}[UsA]$, $\Delta U2_{ac}[UsA]$
 $\Delta U3_{rms}[UtA]$, $\Delta U3_{mn}[UtA]$, $\Delta U3_{dc}[UtA]$, $\Delta U3_{rmn}[UtA]$, $\Delta U3_{ac}[UtA]$
 $\Delta U\Sigma_{rms}[U\Sigma A]$, $\Delta U\Sigma_{mn}[U\Sigma A]$, $\Delta U\Sigma_{dc}[U\Sigma A]$, $\Delta U\Sigma_{rmn}[U\Sigma A]$, $\Delta U\Sigma_{ac}[U\Sigma A]$
 $\Delta I_{rms}[InA]$, $\Delta I_{mn}[InA]$, $\Delta I_{dc}[InA]$, $\Delta I_{rmn}[InA]$, $\Delta I_{ac}[InA]$
 $\Delta P1[PrA]$
 $\Delta P2[PsA]$
 $\Delta P3[PtA]$
 $\Delta P\Sigma[P\Sigma A]$



* In the measurement functions, *rms*, *mn(mean)*, *dc*, *rmn(r-mean)*, and *ac* are the delta computation modes. A indicates the wiring unit.

► [Click here.](#)

For information about equations, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.

For information about the measurement period, see “Measurement Period.”

► [Click here.](#)

Delta Computation Modes (Δ Measure Mode)

You can select the voltage or current mode to be displayed as delta computation values from the following:
rms, mean, dc, r-mean, ac



- We recommend that you set the measurement range and scaling (VT/CT ratio and coefficients) of the elements that are undergoing delta computation as closely as possible. Using different measurement ranges or scaling causes the measurement resolutions of the sampled data to be different. This results in errors.
- The numbers (1, 2, and 3) that are attached to delta computation measurement function symbols have no relation to the element numbers. The computation of all delta measurement functions, from $\Delta U1$ to $\Delta P\Sigma$, varies depending on the wiring system and the delta computation type. For details, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.
- When only one element is installed in this instrument, this feature cannot be used, and its settings do not appear.
- Delta computation cannot be performed on a single-phase, two-wire (1P2W) wiring system.
- Delta computation is not possible when the computing method is digital filter average.

Data Update Interval (Update rate)

The data update interval is the interval at which the data that is used in measurement functions is sampled.

Update Mode (Update Mode)

Select the trigger for updating data from the following options.

- Constant interval (Constant)
- Trigger (Trigger)

Constant Interval (Constant)

At each data update interval, the numeric data is updated, stored, transmitted through a communication interface, and converted and output as analog signals.

The measurement mode display at the upper right of the screen shows Normal Mode.

To capture relatively fast load fluctuations in the power system, select a fast data update rate. To capture low frequency signals, select a slow data update rate.

Trigger (Trigger)

Numeric data is updated once according to the waveform display trigger operation.

The measurement mode display at the upper right of the screen shows Normal Mode (Trg).

If the update mode is set to trigger, measurement takes place from when a trigger is detected over the data update interval. The following amount of time 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 update mode is set to constant interval, storage, communication output, and D/A output operate in sync with the data update interval.



- If you do not set the trigger level properly, the waveform display start point (the signal level on the left edge of the screen) may be unstable, or waveforms may not appear.
 - Even when the update mode is set to trigger, the mode is set to constant interval in the following situations.
 - During integration
-

Data Update Interval (Update Rate)

Select from the following.

10ms, 50ms, 100ms, 200ms, 500ms, 1s, 2s, 5s, 10s, 20s

The data update interval setting is displayed at the top of the screen.

- **Display Update Interval**

Numeric Data Display

Data Update Interval	Display Update Interval
10 ms	1 s
50 ms to 200 ms	200 ms
500 ms to 20 s	Same as the data update interval

Displays Other Than Numeric Data Display

The display update interval is 1 second.

Computing Method (Measurement Method)

Set the how to compute measurement values to one of the options below.

- **Sync Source Period Average (Sync Source Period Average)**

The sampled data in the data update interval is computed using the sync source period average method to derive the measured values. (However, this excludes integrated power WP and integrated current q in DC mode.)

This method requires the period of the specified [sync source](#) signal to be detected accurately. Check whether the sync source signal frequency is being measured correctly by following the procedures in sections 3.1 and 3.4 in the User's Manual, IM WT5000-02EN.

- **Digital Filter Average (Digital Filter Average)**

The sampled data is averaged by applying a digital filter to derive the measured values.

This method does not require the input signal period to be detected.

The computing method setting is displayed as SP or DF at the top of the screen.

Response Speed (Response)

If the computing method is set to digital filter average, set the response speed to one of the options below.

The lower measurement frequency limit is set as follows according to the response speed.

- Fast (≥ 100 Hz): 100 Hz
- Mid (≥ 10 Hz): 10 Hz
- Slow (≥ 1 Hz): 1 Hz
- VSlow (≥ 0.1 Hz): 0.1 Hz

The response speed setting is displayed as F, M, S, or V at the top of the screen.

Trigger (Trigger Settings)

If you set the update mode to trigger, set the trigger.

The trigger determines when a waveform is displayed. A trigger is said to “occur” when the trigger condition is met and a waveform is displayed.

Trigger mode (Trigger Mode)

The trigger mode determines the conditions for updating the display. Select from the following options.

- **Auto (Auto)**

If the trigger conditions are met before an approximately 100 ms timeout, this instrument updates the displayed waveforms on each trigger occurrence. If not, this instrument automatically updates the displayed waveforms. If the period of the trigger signal is greater than 100 ms, the display is updated as the two conditions described above alternate. If this occurs, set the trigger mode to normal.

- **Normal (Normal)**

The instrument updates the waveform display only when the trigger conditions are met. If no triggers occur, the display is not updated. If you want to view waveforms that this instrument cannot trigger on, or if you want to check the ground level, set the trigger mode to auto.

Trigger Source (Trigger Source)

The signal that this instrument checks for the trigger condition is referred to as the trigger source. Select from the following options. The available options vary depending on the installed elements.

U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7, Ext Clk (external clock)*

* When you select Ext Clk, the external signal applied to the external clock input connector (EXT CLK) on the rear panel is used as the trigger source. For the EXT CLK connector specifications, see section 4.3 in the Getting Started Guide, IM WT5000-03EN. When Ext Clk is set as the trigger source, the trigger slope and trigger level are set as follows:

- Trigger slope: Falling. Trigger slope setting will be invalid.
- Trigger level: 0.0% Trigger level setting will be invalid.

Trigger Slope (Slope)

Slope refers to the movement of the signal from a low level to a high level (rising edge) or from a high level to a low level (falling edge). When the slope is used as one of the trigger conditions, it is called a trigger slope.

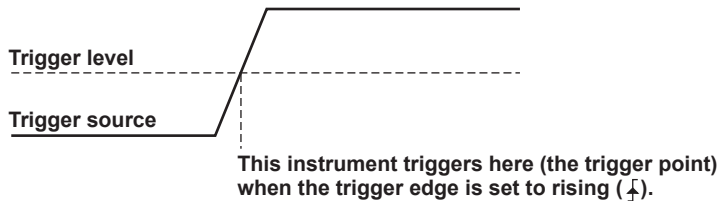
The following trigger slope settings are available for triggering the instrument.

- : Rising: An edge is detected when the trigger source changes from a level below the trigger level to a level above the trigger level.
- : Falling: An edge is detected when the trigger source changes from a level above the trigger level to a level below the trigger level.
- : The instrument triggers on both rising and falling edges.

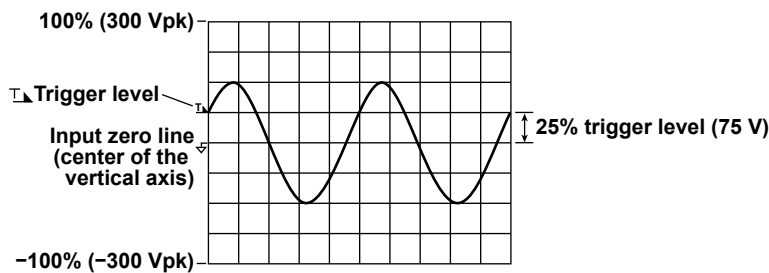
Trigger Level (Trigger Level)

The trigger level is the level at which the trigger slope is determined. When the trigger source passes through the trigger level on a rising or falling edge, a trigger occurs.

- You can select a value between 0.0 and $\pm 100.0\%$.
- A value of 100% corresponds to half the height of the waveform display. If the zero level of the input signal is set to the center of the vertical axis, 100% corresponds to the top of the waveform display, and -100% corresponds to the bottom of the waveform display. The upper and lower limits of the waveform display correspond to three times the voltage or current measurement range of each element when the crest factor is set to CF3. Likewise, the limits are six times when the crest factor is set to CF6 or CF6A.
- When Ext Clk is set as the trigger source, the trigger level setting is invalid.



- **Measurement range:** 100 Vrms when the crest factor is set to CF3.
50 Vrms when the crest factor is set to CF6 or CF6A.
- **Trigger level:** 25%



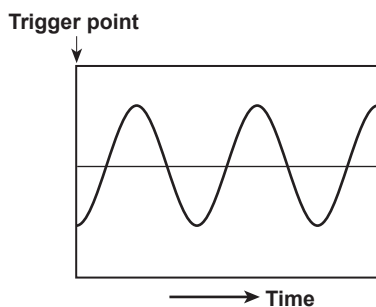
If you do not set the trigger level properly, the waveform display start point (the signal level on the left edge of the screen) may be unstable, or waveforms may not appear.

Trigger Point

The trigger point is the point at which a trigger occurs. The trigger point is always displayed at the left end of the screen.

After the trigger is activated, the waveform display continues from the left of the screen to the right of the screen with the passage of time.

(The arrow below the word “Trigger point” in the figure below is just for illustration. The arrow does not appear on the actual display.)





- To prevent noise-related errors, the trigger feature has a hysteresis of approximately 1% when the crest factor is set to CF3. For example, when the trigger slope is set to $\underline{F}$, a trigger will occur if the input signal level falls approximately 1% below the trigger level and then passes through the trigger level on a rising edge. The trigger feature has a hysteresis of approximately 2% when the crest factor is set to CF6 or CF6A.
- The trigger feature for displaying waveforms does not work in the following circumstances.
 - When the update mode is set to constant interval
 - During integration

Therefore, the waveform display start point (the signal level at the left edge of the screen) may not be stable. Also, the numeric data measurement period may not be synchronized with the waveform data measurement period.

Averaging (Averaging)

You can take exponential or moving averages of the numeric data. The averaging function is effective when reading of the numeric display is difficult due to fluctuations. This occurs when the fluctuation of the power supply or the load is large or when the input signal frequency is low.

Turning Averaging On and Off (Averaging)

Measurement Functions Used in Normal Measurement

You can select whether to average values. When you enable averaging (ON), the AVG indicator at the top of the screen illuminates.

Harmonic Measurement Functions

- If averaging is turned on, and the averaging type is exponential averaging, averaging is performed on harmonic measurement functions.*
- Even if averaging is turned on, if the averaging type is moving average, averaging is not performed on harmonic measurement functions.*

* In addition to the harmonic measurement functions, averaging is also applied to U_{fnd}, I_{fnd}, P_{fnd}, S_{fnd}, Q_{fnd}, λ_{fnd}, and Φ_{fnd}.

Averaging Type (Averaging Type)

You can use exponential (Exp) or moving averages (Lin).

Exponential Averaging (Exp)

With the specified attenuation constant, the numeric data is exponentially averaged according to the equation below.

$$D_n = D_{n-1} + \frac{(M_n - D_{n-1})}{K}$$

D_n: Displayed value that has been exponentially averaged n times. (The first displayed value, D₁, is equal to M₁.)

D_{n-1}: Displayed value that has been exponentially averaged n – 1 times.

M_n: Measured data at the nth time.

K: Attenuation constant (select from 2 to 64)

Moving Average (Lin)

The specified average count is used to compute moving averages according to the equation below.

$$D_n = \frac{M_{n-(m-1)} + \dots + M_{n-2} + M_{n-1} + M_n}{m}$$

D_n: Simple average of m numeric data values from n–(m–1)th to nth time

M_{n-(m-1)}: Numeric data at the n–(m–1)th time

.....

.....

M_{n-2}: Measured data at the n – 2th time.

M_{n-1}: Measured data at the n – 1th time.

M_n: Measured data at the nth time.

m: Average count (select a number from 8 to 64)

Attenuation Constant or Average Count (Averaging Count)

- If the averaging type is exponential averaging, set the attenuation constant to a value within the following range.
2 to 64
- If the averaging type is moving average, set the average count to a value within the following range.
8 to 64

Measurement Functions That Are Averaged

The measurement functions that are directly averaged are indicated below. Other functions that use these functions in their computation are also affected by averaging. For details about how the values of the measurement functions are determined, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.

Measurement Functions Used in Normal Measurement

- Urms, Umn, Udc, Urmn, Uac, Irms, Imn, Idc, Irmn, Iac, P, S, Q, Ufnd, Ifnd, Pfnd, Sfnd, Qfnd, fU, fI, f2U, f2I
- $\Delta U1$ to $\Delta P\Sigma$ (delta computation)
- Torque, Speed, Pm, Aux (models with the motor evaluation 1 or 2 option)
- λ , Φ , λfnd , Φfnd , CfU, CfI, Pc, q, q+, q–, and $\eta 1$ to $\eta 4$ are computed using the averaged values of Urms, Irms, P, S, and Q.
- SyncSp is computed using the averaged value of fU or fI (models with the motor evaluation 1 or 2 option).
- Slip is computed using the averaged value of Speed (models with the motor evaluation 1 or 2 option).

Harmonic Measurement Functions

- U(k), I(k), P(k), S(k), Q(k)
 - $\lambda(k)$, and $\Phi(k)$ are computed using the averaged values of P(k) and Q(k).
 - Z, Rs, Xs, Rp, Xp, Uhdf, Ihdf, Phdf, Uthd, Ithd, Pthd, Uthf, Ithf, Utif, Itif, hvf, hcf, and K-factor are computed using the averaged values of U(k), I(k), and P(k).
- k: The harmonic order

Measurement Functions That Do Not Perform Averaging

The following measurement functions do not perform averaging.

Measurement Functions Used in Normal Measurement

U+pk, U–pk, I+pk, I–pk, P+pk, P–pk, ITime, WP, WP+, WP–, WP Σ , WP+ Σ , WP– Σ , WS, WQ

Harmonic Measurement Functions

$\Phi U(k)$, $\Phi I(k)$, ΦU_i-U_j , ΦU_i-U_k , ΦU_i-I_i , ΦU_j-I_j , ΦU_k-I_k , fPLL1, fPLL2, EaM1U, EaM1I, EaM3U, EaM3I

* k: The harmonic order

Measurement Functions Used in Normal and Harmonic Measurement

F1 to F20, Event1 to Event8



- When averaging is turned on, the average value of multiple measurements is determined and displayed. If the input signal changes drastically, it will take longer for the change to be reflected in the measured values when averaging is used.
- A larger attenuation constant (for exponential averaging) or average count (for moving averages) will result in more stable (and less responsive) measured values.

D/A Output (D/A Output, option)

You can generate numeric data as ± 5 V FS DC voltage signals from the rear panel D/A output terminal. You can set up to 20 items (channels).

Output Items (Item)

The measurement functions that you select under Function and Element/ Σ appear here.

Function (Function)

- You can select any of the measurement functions listed under "Items That This Instrument Can Measure."
▶ [Click here.](#)
- To output integrated values through D/A conversion, set the rated time for integrated D/A output.
▶ [Click here.](#)
- You can also choose not to output a measurement function (None). The output for channels that have been set to none is 0 V, because they have no corresponding numeric data.
- When the [D/A output range mode](#) is set to Fixed, the D/A output of channels whose measurement function has been set to Z, Rs, Xs, Rp, Xp, Utif, Itif, or F1 to F20 is Fixed at 0 V. When the range mode is manual, the channels produce voltages.

Element (Element/ Σ)

- When the function (Function) is set to something other than Speed, Torque, Pm, Slip, or SyncSp
 - Depending on the function, select the element/wiring unit from the following options, or you may not need to select it. The available options vary depending on the installed elements.
Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC
 - If an element in the selected wiring unit does not exist, because there is no data, the output is 0 V. For example, if elements are assigned to ΣA but not to ΣB , the output for the measurement function for ΣB is 0 V.
- If you set the function (Function) to Speed, Torque, Pm, Slip, or SyncSp, you can select the motor number (Motor 1, Motor 2, Motor 3, or Motor 4).

Harmonic Order (Order (k))

When you select a function that has harmonic data, you can set the displayed harmonic order within the following range.

Total (Total value) or 0 (DC) to 500

The harmonic orders that can be specified vary depending on the measurement function. For details, see "Harmonic Measurement Function Orders."

▶ [Click here.](#)

The outputs of orders that exceed the maximum measurable order are 0 V. For information about the maximum measurable harmonic order, see "Maximum Harmonic Order to Be Measured (Max Order)."

▶ [Click here.](#)

D/A Output Range Mode (Range Mode)

You can select the D/A output range mode from the following options.

Fixed (Fixed)

When a measurement function's rated value is received, +5 V is output. For details, see "Relationship between Output Items and the D/A Output Voltage."

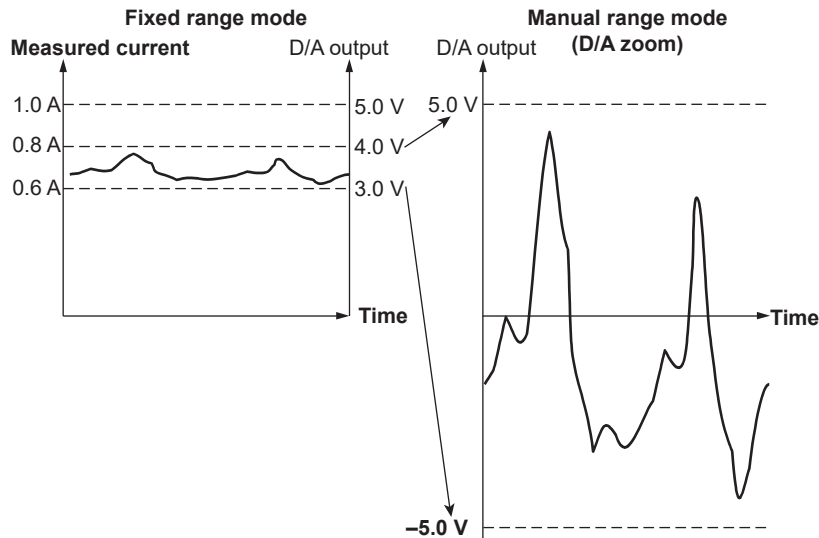
▶ [Click here.](#)

6 Computation and Output

Manual (Manual)

You can set which measurement function values result in a D/A output of -5 V, and which result in a D/A output of +5 V.

This enables the D/A output to be expanded or reduced for each channel (D/A zoom). For example, if you are measuring a current that fluctuates between 0.6 A and 0.8 A with a measurement range of 1 A, when the D/A output range mode is Fixed, the D/A output voltage will fluctuate between 3.0 V and 4.0 V. When you want to observe the fluctuations more closely, you can use the D/A zoom feature. If you set the D/A output range mode to Manual and set the minimum value to 0.6 and the maximum value to 0.8, this Instrument will produce -5 V when the measured current value is 0.6 A and +5 V when the measured current value is 0.8 A.



Maximum (Max) and Minimum (Min) Range Values

When the D/A output range mode is Manual, you can set the maximum (Max) and minimum (Min) values within the following range.

-9.999T to 9.999T



- The output is 0 V if a measurement function is not selected or if there is no numeric data.
- If a scaling factor such as a VT ratio, CT ratio, or power coefficient is applied to a voltage, current, or power value and scaling is enabled, this Instrument produces 100% output (5 V) when the scaled measured value is the same as the scaled rated value (measurement range × scaling factor).
- For Σ functions, this Instrument produces 100% output (5 V) when the measured value is equivalent to the value that is measured when all of the elements in the group are at their rated values. When the elements have different scaling factors, this Instrument produces 100% output (5 V) when the scaled measured values are the same as the scaled rated values (measurement range × scaling factor).

Rated Time for Integrated D/A Output (Integration Rated Time)

When integrated values are output through D/A output, a rating value (the same value as the measurement range) is continuously applied, the integrated value after the specified amount of time has elapsed is taken to be 100%, and the D/A output at that point is 5 V. It is assumed that the change in the D/A output from 0% of the integrated value (0 V) to 100% of the integrated value (5 V) will occur linearly over time, and the D/A output value is determined by the ratio of the actual input level to this assumed straight line.

For the relationship between measured integrated D/A output and voltage, see "Relationship between Output Items and D/A Output Voltage."

Setting the Rated Time for Integrated D/A Output

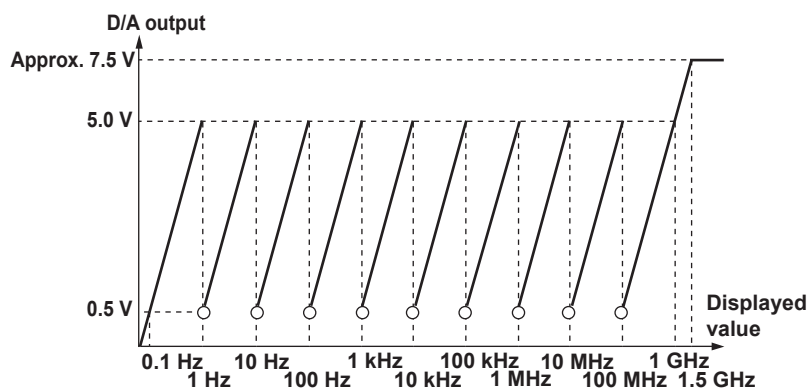
- You can set the hour, minute, and second within the following range.
00000:00:00 to 10000:00:00
- This setting is valid in the following integration modes.
 - Manual integration mode
 - Real-time normal integration mode when the integration timer is set to 00000:00:00
- In the following integration modes, the rated time for integrated D/A output is set to the same time that the timer is set to.
 - Standard integration mode
 - Continuous integration mode
 - Real-time normal integration mode when the integration timer is not set to 00000:00:00
 - Real-time continuous integration mode



When the rated time for integrated D/A output is set to 00000:00:00, the D/A output for the integrated value is fixed at 0 V.

Relationship between Output Items and D/A Output Voltage

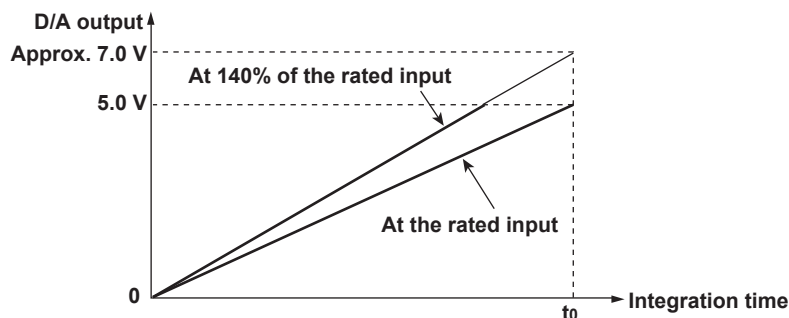
Frequency (the figure is simplified)



User-Defined Events

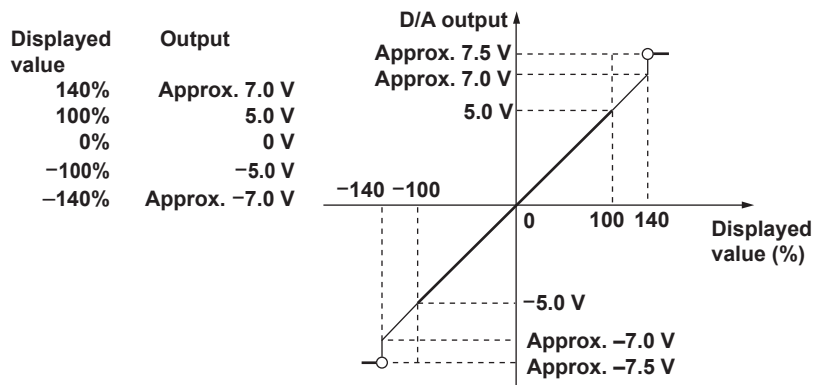
- When the event is occurring (True): +5 V
- When the event is not occurring (False): 0 V

Integrated Values



t_0 : The rated time of integrated D/A output in manual integration mode.
The timer time in normal or continuous integration mode.

Other Items



- The outputs for λ , Φ , EaM1U, EaM1I, EaM3U, and EaM3I do not exceed ± 5 V. When the display format of Φ is set to 360° , the output for Φ ranges from 0 V to +5 V. When the display format of Φ is set to 180° (lagging 180° to leading 180°), the output for Φ ranges from -5 V to +5 V. The sign for lead/lag follows the phase polarity (Phase Polarity) setting. However, when an error occurs, the output is approximately 7.5 V. Only the outputs for U-pk and I-pk are approximately -7.5 V when an error occurs.
- The outputs for η_1 to η_4 , Uhd, Ihd, Phd, Uthd, Ithd, Pthd, Uthf, Ithf, hvf, hcf, and Slip* are +5 V at 100%.

- The output for an analog torque signal is +5 V when the torque reaches the value of the input range $\times$ the torque scaling factor $\times$ the input signal slope (this is the rated value).^{*} For example, when the input range is 10 V, if the scaling factor is set to 1 N•m of torque per 1 V of input voltage, the output is +5 V when the torque is 10 N•m.
 - The output for a pulse torque signal is –5 V when the torque reaches the value specified for Pulse Range Upper $\times$ –1, and the output is +5 V when the torque reaches the value specified for Pulse Range Upper.^{*}
 - The output for an analog rotating speed signal is +5 V when the rotating speed reaches the value of the input range $\times$ the revolution scaling factor $\times$ the input signal slope (this is the rated value).^{*} For example, when the input range is 10 V, if the scaling factor is set to 100 rpm per 1 V of input voltage, the output is + 5 V when the rotating speed is 1000 rpm.
 - The output for a pulse rotating speed signal is –5 V when the rotating speed reaches the value specified for Pulse Range Upper $\times$ –1, and the output is +5 V when the rotating speed reaches the value specified for Pulse Range Upper.^{*}
 - The output for SyncSp is +5 V when SyncSp is at the rated value for Speed.^{*}
 - The output for Pm is +5 V when Pm reaches the motor output value obtained from the rated values for the torque and rotating speed.¹
 - When the auxiliary signal is analog, the output for Aux is +5 V when Aux reaches the value of the analog signal's input range $\times$ the scaling factor for Aux $\times$ the auxiliary signal slope (this is the rated value).^{*}
 - When the auxiliary signal is pulse, the output for Aux is –5 V when the auxiliary signal reaches the value specified for Pulse Range Upper $\times$ –1, and the output is +5 V when the auxiliary signal reaches the value specified for Pulse Range Upper.^{*}
- ^{*} Applies to models with the motor evaluation 1 or 2 option.

7 Harmonic Measurement Conditions

Harmonic Measurement Conditions (Harmonics)

Using harmonic measurement, you can measure functions that are based on the voltage, current, and power harmonics and their distortion factors; on the phase angle of each harmonic relative to the fundamental; etc. You can also compute the harmonic distortion factors for voltage and current.

For a list of the measurement functions that can be measured with harmonic measurement and their descriptions, see “Harmonic Measurement Functions” under “Items That This Instrument Can Measure.”

► [Click here.](#)



When the data update interval is 10 ms, harmonic measurement is disabled.

The following menu items appear.

- [Input element group \(Elements\)](#)
- [PLL source \(PLL Source\)](#)
- [Measured harmonic orders \(Min Order/Max Order\)](#)
- [Distortion factor equation \(Thd Formula\)](#)
- [Number of FFT points \(FFT Points\)](#)

Input Element Group (Elements)

You can divide all the input elements into two groups: Hrm1 and Hrm2, and measure harmonics using two PLL sources with different frequencies. You can measure the input and output harmonics of an AC–AC converter whose input and output frequencies are different.

Element1 to Element7

Set the group of each element to Hrm1 or Hrm2. Input elements that are assigned to the same wiring unit are set to the same group.

PLL Source (PLL Source)

For harmonics to be measured, the fundamental period (the period of the fundamental signal) that will be used to analyze the harmonics must be determined. The signal for determining the fundamental period is the PLL (phase locked loop) source.

Select the PLL source of groups Hrm1 and Hrm2 from the following options. The available options vary depending on the installed elements.

U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7, Ext Clk

- * If you select Ext Clk, the frequency of the signal applied to the rear panel's external clock input connector (EXT CLK) is used as the fundamental frequency for harmonic measurement. For the EXT CLK connector specifications, see section 4.3 in the Getting Started Guide, IM WT5000-03EN.



- Select a signal that has the same period as the signal that you want to measure the harmonics of. For stable harmonic measurement, choose an input signal for the PLL source that has as little distortion and fluctuation as possible. If the fundamental frequency of the PLL source fluctuates or if the fundamental frequency cannot be measured due to waveform distortion, correct measurements will not be obtained. When the measured item is a switching power supply and in other cases where the distortion of the voltage signal is smaller than that of the current signal, we recommend that the PLL source be set to the voltage.
- If all of the input signals are distorted or the amplitude is small compared to the measurement range, the specifications may not be met. To achieve stable, accurate measurements on high harmonics, set the PLL source to an external clock signal and apply a signal with the same period as the input signal to the external clock input terminal.
- If the fundamental frequency of the input signal is less than the following frequencies and the input signal contains high frequency components, we recommend that you turn on the frequency filter and set the cutoff frequency as follows.

Fundamental Frequency of the Input Signal	Cutoff Frequency of the Frequency Filter
100 Hz or less	0.1 kHz
1 kHz or less	1 kHz
10 kHz or less	10 kHz
100 kHz or less	100 kHz

- If the amplitude level of the signal applied to the element that is specified as the PLL source is small compared to the measurement range, PLL synchronization may not be achieved. If the **crest factor** is set to CF3, set the measurement range so that the amplitude level of the PLL source is at least 50%. If the crest factor is set to CF6 or CF6A, set the measurement range so that the amplitude level of the PLL source is at least 100%.
- If the frequency of the PLL source changes, correct measured values are displayed four data updates after the change. Correct measured values may not be obtained immediately after the PLL source or its frequency changes, because the PLL circuit inside this instrument redetects the frequency.

Measured Harmonic Orders (Min Order/Max Order)

The harmonic measurement range can be specified for groups Hrm1 and Hrm2. The harmonic orders specified here are used to determine the numeric data of the distortion factor.

► [Click here.](#)

Minimum Harmonic Order to Be Measured (Min Order)

Select from the following.

- 0: The 0th order (DC) component is included when numeric harmonic waveform data is determined.
- 1: The 0th order (DC) component is not included when numeric harmonic waveform data is determined. The harmonic measurement data (the harmonic waveform data) is determined from the 1st order (the fundamental wave).

Maximum Harmonic Order to Be Measured (Max Order)

You can select a value between 1 and 500.

However, the maximum measurable harmonic order is the smallest of the three orders listed below.

- The specified maximum harmonic order to be measured
- The value determined automatically according to the PLL source frequency (see section 6.7 in the Getting Started Guide, IM WT5000-03EN)
- When the data update interval is 50 ms or Auto, the maximum measurable harmonic order is 100.

The numeric data corresponding to harmonic orders above the maximum measurable harmonic order is displayed as "-----" (no data).



- If the minimum harmonic order to be measured is set to 1, the data of the DC component is not included when the distortion factor is determined.
- There is no overload value indication ("-OL-") or zero indication (rounding to zero) for the numeric data of harmonic orders 0 (DC) to 500. For information about the overload value indication ("-OL-") and zero indication (rounding to zero) in normal measurement, see sections 6.15 and 6.16 in the Getting Started Guide, IM WT5000-03EN.
- When the data update interval is set to 10 ms, harmonic measurement is not performed.

Distortion Factor Equation (Thd Formula)

When determining the harmonic measurement functions U_{hdf}, I_{hdf}, P_{hdf}, U_{thd}, I_{thd}, and P_{thd}, you can select to use one of the denominators described below as the denominator for the equation. For information about equations, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.

1/Total (1/Total)

The denominator is the measured data of all orders from the minimum measured order (0 or 1st) to the maximum measured order (within the upper limit of harmonic analysis).

1/Fundamental (1/Fundamental)

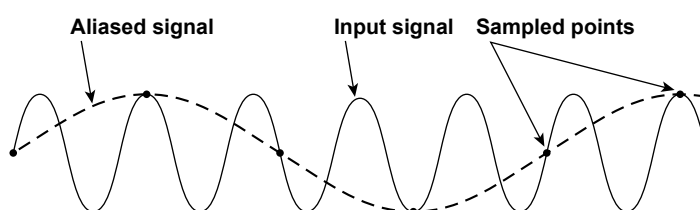
The denominator is the data of the fundamental signal component (1st order).

Number of FFT Points (FFT Points)

Set the number of FFT points to 1024 or 8192.

Anti-Aliasing Filter

When an FFT is taken through the performance of A/D conversion on a repetitive waveform, a phenomenon occurs in which frequency components that exceed half the frequency of the sampling frequency are detected as low frequency components. This phenomenon is called aliasing.



Aliasing causes problems such as increased errors in measured values and incorrect measurements of the phase angles on each harmonic. An anti-aliasing filter is used to prevent aliasing and eliminate high frequency components that are irrelevant to the harmonic measurement.

For example, when an input signal with a fundamental frequency of 50 Hz is measured up to the 50th order, the frequency of the 50th order is 2.5 kHz. Thus, a 5-kHz anti-aliasing filter is used to eliminate high frequency components that are greater than or equal to approximately 5 kHz, which are irrelevant to harmonic measurement.

This instrument uses the line filter as an anti-aliasing filter for harmonic measurements. For information about how to configure the filter, see “Line Filter (Line Filter).”

► [Click here.](#)

The accuracy and the upper limit of the measurement bandwidth change when the anti-aliasing filter (line filter) is turned ON. For details, see sections 6.15 and 6.16 in the Getting Started Guide, IM WT5000-03EN.

8 Computation

Computation (Measure)

You can specify the following items.

- [User-defined functions \(User Defined Functions\)](#)
- [Measuring the average active power](#)
- [MAX hold \(Max Hold\)](#)
- [User-defined events \(User Defined Events\)](#)
- [Equation for apparent power \(S Formula\)](#)
- [Apparent power and reactive power computation types \(S,Q Formula\)](#)
- [Equation for corrected power \(Pc Formula\)](#)
- [Phase difference display format \(Phase\)](#)
- [Master/slave synchronous measurement \(Sync Measure\)](#)

User-Defined Functions (User Defined Functions)

You can combine function symbols to create equations and use the numeric data of the combined functions to determine the value of the equation.



User-defined functions allow you to determine physical values other than those of the measurement functions by combining operands. The measurement functions that you can specify for the [efficiency equation](#) are fixed at power and motor output. However, by using user-defined functions, you can create equations consisting of measurement functions other than power and motor output measurement functions to determine ratios other than efficiency.

Selecting Which User-Defined Function to Configure

Select the number of the user-defined function that you want to configure from the options below.

- F1–F5: User-defined functions F1 to F5
- F6–F10: User-defined functions F6 to F10
- F11–F15: User-defined functions F11 to F15
- F16–F20: User-defined functions F16 to F20

Turning the Computation of User-Defined Functions On or Off

Turn the computation of user-defined functions on or off.

User-Defined Function Name (Name)

- Number of characters: Up to 8
- Usable characters: Spaces and all characters that are displayed on the keyboard

Expression (Expression)

Operation Type

You can use combinations of measurement functions and element numbers (e.g., Urms1) as operands to configure up to 20 equations (F1 to F20). There can be up to 16 operands in 1 equation.

The different types of operands are listed below (measurement function: operand).

• Normal Measurement

Voltage, current, and power

Urms: URMS()	Irms: IRMS()	P: P()	Pfnd: PFND()
Umn: UMN()	Imn: IMN()	S: S()	Sfnd: SFND()
Udc: UDC()	Idc: IDC()	Q: Q()	Qfnd: QFND()
Urmn: URMN()	Irmn: IRMN()	λ : LAMBDA()	λ fnd: LAMBDADFND()
Uac: UAC()	Iac: IAC()	Φ : PHI()	Φ fnd: PHIFND()
Ufnd: UFND()	Ifnd: IFND()	Pc: PC()	---
U+pk: UPPK()	I+pk: IPPK()	P+pk: PPPK()	---
U-pk: UMPK()	I-pk: IMPK()	P-pk: PMPK()	---
CfU: CFU()	CfI: CFI()	---	---
fU: FU()	fI: FI()	---	---
f2U: F2U()	f2I: F2I()	---	---

Integrated power

Wp: WH()	q: AH()	ITime: ITIME()
Wp+: WHP()	q+: AHP()	WS: SH()
Wp-: WHM()	q-: AHM()	WQ: QH()

Efficiency

η 1: ETA1() to η 4: ETA4()

User-defined functions

F1: F1() to F20: F20()

• Harmonic measurement

U(k):UK(,)	I(k):IK(,)	P(k):PK(,)
S(k):SK(,)	Q(k):QK(,)	λ (k):LAMBDK(,)
Φ U(k):UPHI(,)	Φ I(k):IPHI(,)	Φ (k):PHIK(,)
Z(k):ZK(,)	Rs(k):RSK(,)	Xs(k):XSK(,)
---	Rp(k):RPK(,)	Xp(k):XPK(,)
Uhdf(k):UHDF(,)	Ihdf(k):IHDF(,)	Phdf(k):PHDF(,)
Uthd: UTHD()	Ithd: ITHD()	Pthd: PTHD()
Uthf: UTHF()	Ithf: ITHF()	---
Utif: UTIF()	Itif: ITIF()	---
hvf: HVF()	hcf: HCF()	---
fPLL1:PLLFRQ1()	fPLL2:PLLFRQ2()	Kfactor:KFACT()
Φ U1-U2: PHIU1U2()	Φ U1-U3: PHIU1U3()	Φ U1-I1: PHIU1I1()
Φ U2-I2: PHIU2I2()	Φ U3-I3: PHIU3I3()	---

- **Delta computation**

$\Delta U1()$: DELTAU1()	$\Delta I()$: DELTAI()	$\Delta P1()$: DELTAP1()
$\Delta U2()$: DELTAU2()	---	$\Delta P2()$: DELTAP2()
$\Delta U3()$: DELTAU3()	---	$\Delta P3()$: DELTAP3()
$\Delta U\Sigma()$: DELTAUSIG()	---	$\Delta P\Sigma()$: DELTAPSIG()
$\Delta U1rms()$: DELTAU1RMS()	$\Delta U1mean()$: DELTAU1MN()	$\Delta U1rmean()$: DELTAU1RMN()
$\Delta U2rms()$: DELTAU2RMS()	$\Delta U2mean()$: DELTAU2MN()	$\Delta U2rmean()$: DELTAU2RMN()
$\Delta U3rms()$: DELTAU3RMS()	$\Delta U3mean()$: DELTAU3MN()	$\Delta U3rmean()$: DELTAU3RMN()
$\Delta U\Sigma rms()$: DELTAUSIGRMS()	$\Delta U\Sigma mean()$: DELTAUSIGMN()	$\Delta U\Sigma rmean()$: DELTAUSIGRMN()
$\Delta U1dc()$: DELTAU1DC()	$\Delta U1ac()$: DELTAU1AC()	$\Delta Irms()$: DELTAIRMS()
$\Delta U2dc()$: DELTAU2DC()	$\Delta U2ac()$: DELTAU2AC()	$\Delta Imean()$: DELTAIMN()
$\Delta U3dc()$: DELTAU3DC()	$\Delta U3ac()$: DELTAU3AC()	$\Delta Irmean()$: DELTAIRMN()
$\Delta U\Sigma dc()$: DELTAUSIGDC()	$\Delta U\Sigma ac()$: DELTAUSIGAC()	$\Delta Idc()$: DELTAIDC()
---	---	$\Delta Iac()$: DELTAIAC()

- **Motor evaluation (option)**

Speed: SPEED()	Torque: TORQUE()	Pm: PM()
Slip: SLIP()	SyncSp: SYNC()	---
EaM1U: EAM1U()	EaM1I: EAM1I()	---
EaM3U: EAM3U()	EaM3I: EAM3I()	---

- **Auxiliary input (option)**

Aux1:AUX1()	Aux2:AUX2()	Aux3:AUX3()
Aux4:AUX4()	Aux5:AUX5()	Aux6:AUX6()
Aux7:AUX7()	Aux8:AUX8()	---

- **Measurement range**

RngU:RNGU()	RngI:RNGI()
RngSpd:RNGSPD() ¹	RngTrq:RNGTRQ() [*]
RngAux: RNGAUX1() to RNGAUX8() [*]	

^{*} Models with the motor evaluation 1 or 2 option

Setting the Operand Parameters

The parameters that you need to enter depend on whether the function is followed by “(,)” or “()”.

- **(,) Notation**

Specify the element to the left of the comma, and specify the harmonic order to the right of the comma. For example: (E1,OR2).

- Symbols representing elements
 - E1 to E7: Elements 1 to 7
 - SA to SC: Wiring units ΣA to ΣC
- Symbols representing harmonic orders (Order)
 - ORT: Total value
 - OR0: dc
 - OR1: Fundamental wave
 - OR2 to OR500: Harmonic orders 2 to 500

- **Setting Parameters for Functions Followed by “()”**

- For measurement functions other than Speed, Torque, Pm, Slip, or SyncSp, depending on the function, set the symbol representing the element, or you may not need to set it. For example, set it as (E1). For information about the symbols that can be used for the parameters of each operand, see appendix 6 in the Getting Started Guide, IM WT5000-03EN.
- For the Speed, Torque, Pm, Slip, and SyncSp measurement functions, set M1 to M4, which are symbols representing the motor numbers. For example, set it as (M1).

8 Computation Function

Values Substituted in Operands

- The unit of ITIME() is seconds.
- $\eta 1$ to $\eta 4$ are displayed as percentages (see in appendix 1 in the Getting Started Guide, IM WT5000-03EN). However, in this section ETA1 to ETA4 are described as ratios.

Example: When $\eta 1$ is 80%, ETA1 is 0.8

- The U1 in PHIU1U2 represents the voltage signal of the element whose element number is the smallest in the wiring unit (ΣA , ΣB , or ΣC). For example, if input elements 2, 3, and 4 are assigned to wiring unit ΣA , PHIU1U2 is the phase difference between the voltage signals of input elements 2 and 3.
- User-defined equations can use other user-defined equations with smaller numbers as operands. For example, the equation for user-defined function F3 can be set to F1() + F2(). This allows equations that would otherwise exceed 50 characters in length to be computed. This can be accomplished by for example setting equations in F1 and F2, and then adding or dividing those equations in F3. This feature is also convenient when defining multiple equations that include common operands. For example, you can set common operands in F1, and then set F4 as F3() divided by F1() and set F5 as F4() divided by F1(). However, if you enter a user-defined equation with a number that is greater than or equal to its own number, correct results will not be obtained. For example, if you set user-defined function F3 to F1()+F3() or to F1()+F4(), the computed result will be displayed as "-----" (no data) or "-OF-" (overflow).

Operators

The following operators can be used in equations.

Operators	Example	Description
+, -, *, /	U(E1,OR1)-U(E2,OR1)	Basic arithmetic
ABS	ABS(P(E1,ORT)+P(E2,ORT))	Absolute value
SQR	SQR(I(E1,OR0))	Square
SQRT	SQRT(ABS(I(E1,OR3)))	Square root
LOG	LOG(U(E1,OR25))	Natural logarithm
LOG10	LOG10(U(E1,OR25))	Common logarithm
EXP	EXP(U(E1,OR12))	Exponent
NEG	NEG(U(E1,OR12))	Negation
SIN	SIN(URMS(E1))	Sine
COS	COS(URMS(E1))	Cosine
TAN	TAN(URMS(E1))	Tangent
ASIN	ASIN(URMS(E1))	Arcsine
ACOS	ACOS(URMS(E1))	Arccosine
ATAN	ATAN(URMS(E1))	Arctangent

Number and Type of Characters That Can Be Used in Equations

- Number of characters: Up to 60
- Usable characters: Spaces and all characters that are displayed on the keyboard

On the keyboard, press  to enter operand and equation characters. The characters that you can select are indicated below.

ABS(	NEG(	CF	HCF(	MN(
SQR(	SIN(	ITIME(	KFACT(	RMN(
SQRT(	COS(	THD(	EAM1U(	DC(
LOG(	TAN(	THF(	EAM1I(	AC(
LOG10(	PPK(	TIF(	PLLFRQ1(	PC(
EXP(	MPK(	HVF(	RMS(	

Equation Examples

An equation to determine the rms value of the harmonic components of the voltage signal of input element 2.

$$\sqrt{(\text{Total rms voltage value})^2 - (\text{Rms value of the fundamental voltage signal})^2}$$
$$\text{SQRT}(\text{SQR}(\text{U}(\text{E2}, \text{ORT})) - \text{SQR}(\text{U}(\text{E2}, \text{OR1})))$$



If an operand in an equation is undetermined, the computed result is displayed as “-----” (no data). This occurs when a delta computation measurement function is in the equation, but delta computation is turned OFF, or when a measurement function of an element that is not installed is in the equation.

Unit (Unit)

- Number of characters: Up to 8
- Usable characters: Spaces and all characters that are displayed on the keyboard

Loading Presets (Preset)

This instrument contains preset equations for rotational-coordinate voltages, currents (id, iq, vd, vq), and so on used in the vector control of three-phase motors. When calculating these parameters, load the presets, and adjust the equations as necessary for use.

There are several types of presets. For example, the presets for three-phase three-wire system (three-voltage three-current method) are as follows:

No.	ON/OFF	Name	Expression	Unit
F1	ON	id	$\text{SQRT}(3) \cdot \text{NEG}(\text{IK}(\text{E1}, \text{OR1}) \cdot \text{SIN}(\text{EAM1I}(\text{E1})))$	
F2	ON	iq	$\text{SQRT}(3) \cdot \text{IK}(\text{E1}, \text{OR1}) \cdot \text{COS}(\text{EAM1I}(\text{E1}))$	
F3	ON	vd	$\text{NEG}(\text{UK}(\text{E1}, \text{OR1}) \cdot \text{SIN}(\text{EAM1U}(\text{E1}) + 30))$	
F4	ON	vq	$\text{UK}(\text{E1}, \text{OR1}) \cdot \text{COS}(\text{EAM1U}(\text{E1}) + 30)$	
F5	ON	omega	$2 \cdot 3.1415 \cdot \text{FU}(\text{E1})$	
F6	ON	Ld	$(\text{F4}() - 111 \cdot \text{F2}() - \text{F5}() \cdot 222) / (\text{F5}() \cdot \text{F1}())$	
F7	ON	Lq	$(111 \cdot \text{F1}() - \text{F3}()) / (\text{F5}() \cdot \text{F2}())$	

Saving User-Defined Functions (Save UserDef)

File List (File List)

On the file list, specify the save destination. You can perform file operations such as creating folders on the storage device, deleting and copying files, and changing file names.

▶ [Click here.](#)

Auto Naming (Auto Naming)

This is the same as the auto naming feature for saving setup data.

▶ [Click here.](#)

File name (File Name)

This is the same as the file name setting for saving setup data.

▶ [Click here.](#)

Saving (Save)

Saves the user-defined functions to the specified save destination with the specified file name.

Measurement stops while this instrument is saving data. After this instrument finishes saving or saving is cancelled, measurement resumes.

Loading User-Defined Functions (Load UserDef)

The user-defined function of the file specified in the file list is loaded. The extension is .TXT. For information about how to configure the file list display and how to operate files and folders, see "File List (File List)."

▶ [Click here.](#)

Loading (Execute Load)

Loads the data of the specified file.

- If you change the extension of the saved data file, by using a PC or some other device, the instrument will no longer be able to load it.
- When a user-defined function is loaded from a file, the user-defined function is changed to the loaded function and cannot be changed back. We recommend that you save the current user-defined function before loading a user-defined function from a file.

Measuring the Average Active Power

The average active power can be computed for devices, such as intermittent control devices, whose power fluctuates. Use a user-defined function to specify the equation for computing the average active power.

$$\text{Average active power} = \frac{\text{Integrated power}}{\text{Elapsed integration time}}$$

For example, to determine the average active power of element 1, set the equation of a user-defined function as follows:

$$\text{WH(E1)}/(\text{ITIME(E1)}/3600)$$

The unit of ITIME() is seconds.

MAX Hold (Max Hold)

Select whether to hold the maximum numeric value (MAX value) (on or off). You can determine the measurement functions whose maximum values will be held using a user-defined function. The different types of operands are listed below (measurement function: operand).

Urms: MAXURMS()	Irms: MAXIRMS()	P: MAXP()
Umn: MAXUMN()	Imn: MAXIMN()	S: MAXS()
Udc: MAXUDC()	Idc: MAXIDC()	Q: MAXQ()
Urmn: MAXURMN()	Irmn: MAXIRMN()	---
Uac: MAXUAC()	Iac: MAXIAC()	---
U+pk: MAXUPPK()	I+pk: MAXIPPK()	P+pk: MAXPPPK()
U-pk: MINUMPK()	I-pk: MINIMPK()	P-pk: MINPMPK()

To hold the maximum value of the Urms for element 1, enter MAXURMS(E1) in the equation for a user-defined function, and enable MAX hold.

- For information about the symbols that can be used for the parameters of each operand, see appendix 6 in the Getting Started Guide, IM WT5000-03EN.
- The maximum values of the data above are held while the MAX hold function is enabled.
- Numeric data list output through the D/A output and the communication values all reflect the held maximum values.



- When MAX hold is applied to measurement functions that have positive and negative values, this instrument compares the absolute values to determine the maximum value.
- To reset held maximum values, turn MAX hold off, and then turn it on again.

User-Defined Events (User Defined Event)

User-defined events can be used to trigger data storage. You can define up to eight user-defined events.

Turning User-Defined Events On and Off

Select whether to enable user-defined events.

User-Defined Event Name (Name)

- Number of characters: Up to 8
- Usable characters: Spaces and all characters that are displayed on the keyboard

Judgment Conditions (Expression)

Set the judgment conditions.

Judgment Method (Expression Type)

Select the judgment method from the following options.

- Range (Range): Specify judgment conditions using ranges of measurement function values or differences from a reference value.
- Condition (Condition): Specify judgment conditions using user-defined events.

Indication of User-Defined Event Occurrence (Indications)

Set the character strings to show when a user-defined event occurs (True) and when it does not occur (False).

- Number of characters: Up to 6
- Usable characters: Spaces and all characters that are displayed on the keyboard

Range (Range)

Specify the judgment condition here when you have set the judgment condition specification method to Range.

- **Function (Function)**

You can select any of the measurement function types listed under “Items That This Instrument Can Measure.”

► [Click here.](#)

- **Element (Element/ Σ)**

- If you select a function other than Speed, Torque, Pm, Slip, or SyncSp, depending on the function, select the element/wiring unit from the following options, or you may not need to select it. The available options vary depending on the installed elements.
Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC
- If you select Speed, Torque, Pm, Slip, or SyncSp for the function (Function), select the motor number from the following options. The options vary depending on the installed motor evaluation function option.
Motor 1, Motor 2, Motor 3, Motor 4

- **Harmonic Order (Order (k))**

This is the same as setting the harmonic order in all items display of the numeric data display.

► [Click here.](#)

- **Judgment Condition**

Select the method for comparing the measured value and the reference value from the following options.

OFF, <, <=, =, >, >=, !=(not equal)

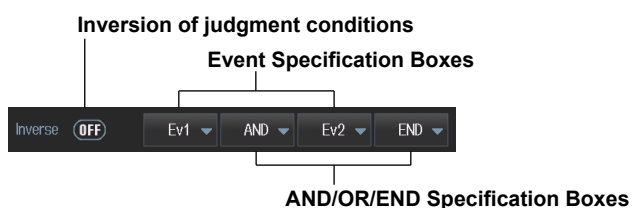
- **Reference Value**

Select a number from -9.9999 T to 9.9999 T.

For example, a condition that is true when $150 < \text{the measured power value of element 1} < 160 \text{ W}$ and false otherwise would be configured as shown below.

Condition (Condition)

Specify the judgment condition here when you have set the judgment condition specification method to Condition.



Turning the Judgment Condition Inversion On and Off (Inverse)

You can invert the judgment of the condition (true or false) indicated to the right of the check box.

Event Specification Boxes

You can select the number of a user-defined event that is smaller than the number of the user-defined event that you are currently configuring. For example, when you are configuring the conditions of user-defined event Ev3, you can select Ev1 or Ev2.

AND/OR/END Specification Boxes

• AND, OR

To use multiple user-defined events to configure a condition, set the method of combining the events to logical AND or logical OR. When you select AND or OR, an event specification box appears to the right of the AND/OR/END specification box. The number of user-defined events that you can combine is indicated below. When you reach the maximum number of combinable user-defined events, no AND/OR/END specification box appears to the right of the last event.

- Ev1: 0. You cannot use other user-defined events as conditions. Set the judgment condition using a range.
- Ev2: 1 (Ev1)
- Ev3: 2 (Ev1 and Ev2)
- Ev4: 3 (Ev1 to Ev3)
- Ev5: 4 (Ev1 to Ev4)
- Ev6: 5 (Ev1 to Ev5)
- Ev7: 6 (Ev1 to Ev6)
- Ev8: 7 (Ev1 to Ev7)

• END

Select END to end the definition of the condition. No event specification box appears to the right of an AND/OR/END specification box that has been set to END.



If you set the event judgment condition to a range and the function of the judgment condition returns a value of "-----" (no data), because judgment cannot be performed, the judgment result is FALSE. For example, when integration is not being performed, if the function of event Ev1 is set to integrated power (WP) and the judgment condition is $WH(E1) > 0$, the measured data is displayed as "-----" (no data), so the judgment for Ev1 is FALSE. Also, if you set the judgment condition specification method to Condition and events that cannot be judged are included in the judgment conditions, the judgment result is FALSE. For example, if you set the judgment condition of event Ev2 to $NOT(EV1())$, if the judgment for Ev1 is FALSE because of the reason given in the example above, the result for Ev2 is not TRUE but FALSE.

Equation for Apparent Power (S Formula)

You can select the voltage and current to use to compute the apparent power (voltage × current) from the following options.

- $U_{rms} \cdot I_{rms}$
The product of the true rms values of the voltage and current
- $U_{mean} \cdot I_{mean}$
The product of the voltage's and current's rectified mean values calibrated to the rms values
- $U_{dc} \cdot I_{dc}$
The product of the simple averages of the voltage and current
- $U_{mean} \cdot I_{rms}$
The product of the voltage's rectified mean value calibrated to the rms value and the current's true rms value
- $U_{rmean} \cdot I_{rmean}$
The product of the voltage's and current's rectified mean values

Apparent Power and Reactive Power Computation Types (S,Q Formula)

There are three types of power: active power, reactive power, and apparent power. In general, they are defined by the following equations.

$$\text{Active power } P = UI \cos \Phi \quad (1)$$

$$\text{Reactive power } Q = UI \sin \Phi \quad (2)$$

$$\text{Apparent power } S = UI \quad (3)$$

U = rms voltage; I = rms current; Φ = Phase difference between voltage and current

The power values are related as follows:

$$(\text{Apparent power } S)^2 = (\text{Active power } P)^2 + (\text{Reactive power } S)^2 \quad (4)$$

The three-phase power is the sum of the power of each phase.

These definitions only apply for sine waves. The measured values for apparent power and reactive power vary for distorted waveform measurement depending on which of the above definitions are combined for the computation. Because the equations for deriving the apparent and reactive power for distorted waveforms are not defined, none of the equations can be said to be more correct than the other. Therefore, this instrument allows you to select the apparent power and reactive power equations.

Unlike apparent power and reactive power, active power is derived directly from the sampled data, so errors resulting from different definitions do not occur.

Type 1 (Type 1) (The method used in the normal mode of conventional WT series power meters)

This instrument calculates the apparent power of each phase using equation 3, calculates the reactive power of each phase using equation 2, and sums the results to derive the power.

$$\text{Active power for a three-phase four-wire system} \quad P\Sigma = P1 + P2 + P3$$

$$\text{Apparent power for a three-phase four-wire system} \quad S\Sigma = S1 + S2 + S3 (= U1 \times I1 + U2 \times I2 + U3 \times I3)$$

$$\text{Reactive power for a three-phase four-wire system} \quad Q\Sigma = Q1 + Q2 + Q3$$

$$(= s1 \times \sqrt{(U1 \times I1)^2 - P1^2} + s2 \times \sqrt{(U2 \times I2)^2 - P2^2} + s3 \times \sqrt{(U3 \times I3)^2 - P3^2})$$

The signs for s1, s2, and s3 are negative when the current leads the voltage and positive when the current lags the voltage.

Type 2 (Type 2)

This instrument calculates the apparent power of each phase using equation 3 and sums the results to derive the three-phase apparent power. This instrument calculates the three-phase reactive power from the three-phase apparent power and the three-phase active power using equation 4.

$$\text{Active power for a three-phase four-wire system} \quad P\Sigma = P1 + P2 + P3$$

$$\text{Apparent power for a three-phase four-wire system} \quad S\Sigma = S1 + S2 + S3 (= U1 \times I1 + U2 \times I2 + U3 \times I3)$$

$$\text{Reactive power for a three-phase four-wire system} \quad Q\Sigma = \sqrt{S\Sigma^2 - P\Sigma^2}$$

Type 3 (Type 3) (The method used in the harmonic measurement modes of the WT1600, WT3000 and PZ4000)

This instrument calculates the reactive power of each phase using equation 2 and calculates the three-phase apparent power using equation 4.

$$\text{Active power for a three-phase four-wire system} \quad P\Sigma = P1 + P2 + P3$$

$$\text{Apparent power for a three-phase four-wire system} \quad S\Sigma = \sqrt{P\Sigma^2 + Q\Sigma^2}$$

$$\text{Reactive power for a three-phase four-wire system} \quad Q\Sigma = Q1 + Q2 + Q3$$

Equation for Corrected Power (Pc Formula)

Some standards require that a voltage transformer's active power be corrected when the load connected to the voltage transformer is very small. You can select an equation to use for this correction and specify the coefficient.

Applicable Standard (Pc Formula)

Select from the following.

- Type 1 (Type 1): IEC76-1 (1976)
- Type 1 (Type 2): IEC76-1(2011)

Equations for each applicable standard

Type 1: IEC76-1(1976)

$$P_c = \frac{P}{P_1 + P_2 \left(\frac{U_{rms}}{U_{mn}} \right)^2}$$

Type 2: IEC76-1(2011)

$$P_c = P \left(1 + \frac{U_{mn} - U_{rms}}{U_{mn}} \right)$$

Pc: Corrected Power

P: Active power

U_{rms}: True rms voltage

U_{mn}: Voltage's rectified mean calibrated to the rms value

P₁, P₂: Coefficients specified by the applicable standard

Coefficients (P1 and P2)

You can set coefficients P₁ and P₂ to values within the range of 0.0001 to 9.9999.



The IEEE C57.12.90-2010 equation is the same as IEC761 (1976).

Phase Difference Polarity (Phase Polarity)

The phase difference Φ between the voltage and current indicates the current phase relative to the voltage of each element.

- Lead(-)/Lag(+)
Lead: -
Lag: + or no sign
- Lead(+)/Lag(-)
Lead: + or no sign
Lag: -

Phase Difference Display Format (Phase Angle)

- 180° (180°)

If the current phase is in the counterclockwise direction with respect to voltage, the current is leading (D) the voltage. If the current phase is in the clockwise direction with respect to the voltage, the current is lagging (G) the voltage. The phase difference is expressed by an angle between 0 and 180° (see appendix 2 in the Getting Started Guide, IM WT5000-03EN).

- 360° (360°)

The phase difference is expressed as an angle between 0 and 360° in the clockwise direction.



- If the measured voltage or current value is zero, "Error" is displayed.
- Phase difference Φ for lead (Lead) and lag (Lag) is displayed correctly only when both the voltage and current are sine waves and the ratio of the input to the measurement range is not greatly different between the voltage and current.
- If the computation result of power factor λ exceeds 1, Φ is displayed as follows:
 - If the power factor λ is greater than 1 and less than or equal to 2, Φ returns 0.
 - If λ is greater than 2, Φ returns an error ("Error" is displayed).
- For harmonic measurement, the phase differences Φ_U and Φ_I of harmonic orders 1 to 500 of the voltage and current are always displayed using an angle between 0 and 180° (no sign for lead and negative sign for lag).

Master/Slave Synchronous Measurement (Sync Measure)

Connect the external start signal input/output terminals (MEAS. START) of the master and slave instruments using a BNC cable (sold separately). You can synchronize the measurement of two instruments making one the master and the other the slave. The master outputs a measurement start signal, and the slave receives the signal.

For the specifications of the external start signal input/output terminals, see section 4.3 in the Getting Started Guide, IM WT5000-03EN.



The measurement of the master and slave units cannot be synchronized under the following conditions:

- When the data update interval differs between the master and slave.
- During real-time integration mode or real-time storage mode.

Follow the procedure below to hold values during synchronized measurement.

- To hold the display: Hold the display of the master first.
 - To unhold the display: Unhold the display of the slave first.
-



-
- To use the IEEE 1588 time synchronization feature, see Utility > System Configuration > IEEE 1588 Time Synchronization Feature.

▶ [Click here.](#)

- Even when using the IEEE 1588 time synchronization feature, if you want to perform synchronous measurement between two units, connect the two units with a BNC cable, and perform master/slave synchronous measurement.
-

9 Display

Display (Display)

[Single Screen Display \(Full Screen Display\)](#)

[Split Display](#)

[Display Settings](#)

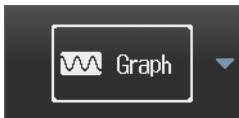
Single Screen Display (Full Screen Display)

You can display the following screens.

[Numeric: Numeric display](#)



[Graph: Graph display](#)

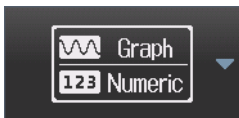
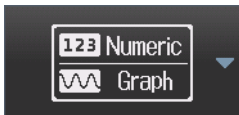


Split Display

You can split the screen into top and bottom halves, and select a display to show in each half.

[Numeric: Numeric display](#)

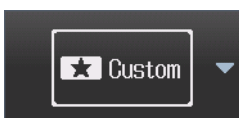
[Graph: Graph display](#)



Custom Display

You can register your favorite screen configurations.

[Custom: Custom display](#)



Custom Screen Registration (Custom)

▶ [Click here.](#)

Display Settings

Numeric Display

Each time you press NUMERIC, the display format switches, in order, between All Items, 4 Items, 8 Items, 16 Items, Matrix, Hrm List Single, Hrm List Dual, and User.

Graph Display

Each time you press GRAPH, the screen switches, in order, between waveform display, trend display, bar graph display, and vector display.

Custom Display

Each time you press CUSTOM, the screen changes between the screen configurations registered in registration tabs 1, 2, 3, 4, and 5 in order.

10 Numeric Data Display

Numeric Data Display (NUMERIC)

You can press NUMERIC to make the numeric data display appear.

Each time you press NUMERIC, the display format switches, in order, between All, 4 Items, 8 Items, 16 Items, Matrix, Hrm List Single, Hrm List Dual, and User.

Numeric Data Display Format

You can select the number of numeric data items that are displayed simultaneously from the choices below or choose to display a list of items.

All Display (All Items)

A table of numeric data is displayed with measurement functions listed vertically and symbols indicating elements and wiring units listed horizontally. You cannot change the order of the displayed items. The number of displayed items varies depending on the number of elements that are installed in this instrument.

▶ [Click here.](#)

4-Value Display (4 Items)

Four numeric data values are displayed in two columns.

▶ [Click here.](#)

8-Value Display (8 Items)

- When the display format is single screen display (full screen display), eight numeric data values are displayed in two columns.
- When the display format is split display, eight numeric data values are displayed in four columns.

▶ [Click here.](#)

16-Value Display (16 Items)

Sixteen numeric data values are displayed in four columns.

▶ [Click here.](#)

Matrix Display

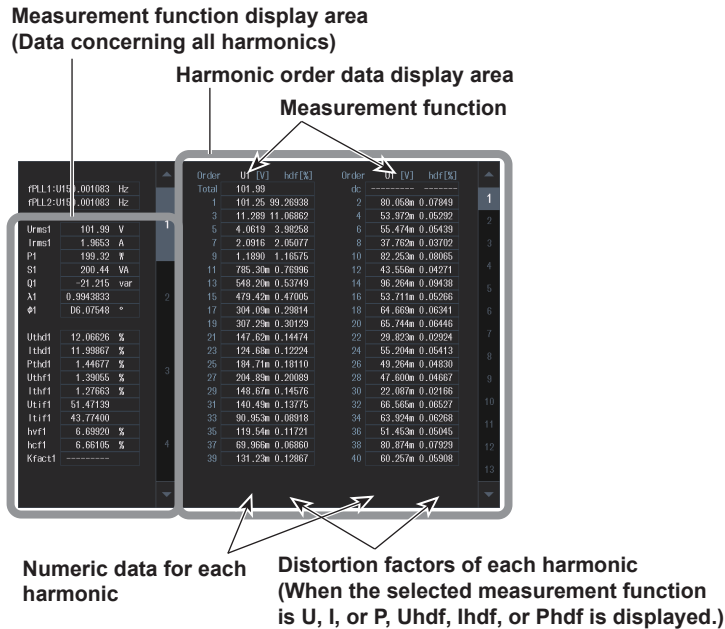
A table of numeric data is displayed with measurement functions listed vertically and symbols indicating elements and wiring units listed horizontally. You can change the order of the displayed items and the number of columns.

▶ [Click here.](#)

10 Numeric Data Display

Harmonics List Single Screen (Hrm List Single)

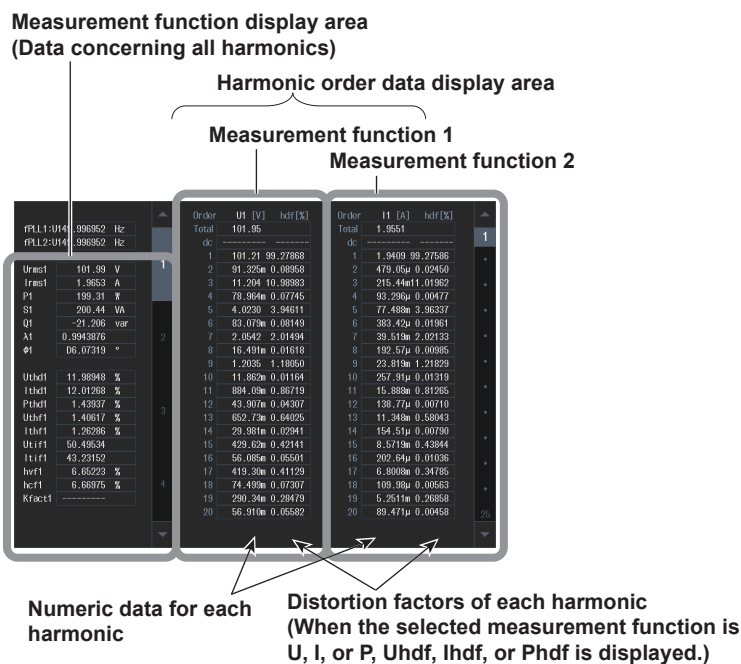
- When the display format is single screen display, 42 harmonic order data items of a single measurement function are displayed in two columns.
- When the display mode is split display, 22 harmonic order data items of a single measurement function are displayed in two columns.



► [Click here.](#)

Harmonics List Dual Screen (Hrm List Dual)

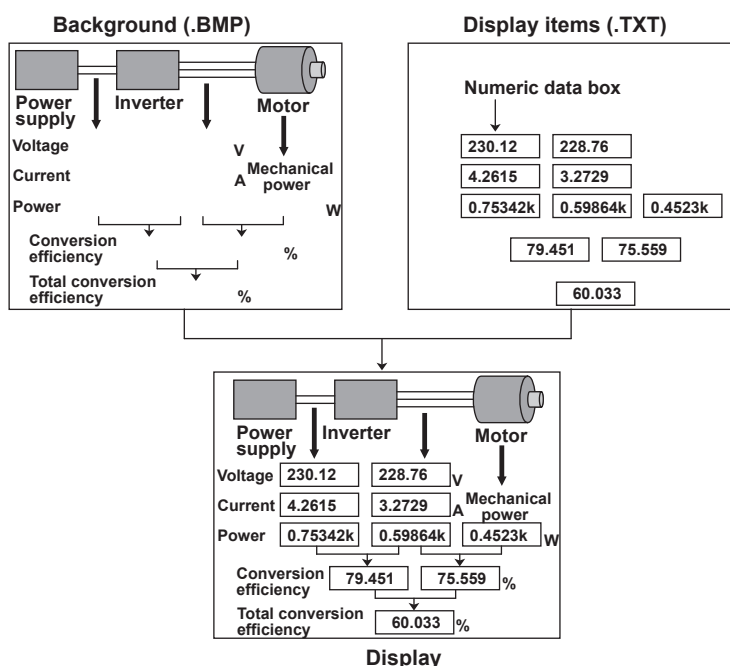
- When the display format is single screen display, the harmonic order data items of two measurement functions are displayed in two separate columns, each containing up to 22 values.
- When the display format is split display, the harmonic order data items of two measurement functions are displayed in two separate columns, each containing up to 12 values.



► [Click here.](#)

User Display (User)

You can use an illustration (.BMP) or picture (.BMP) from a PC or other device as the background of the display. You can arrange numeric data boxes on top of this background to create a custom display. Numeric data appears in this custom display.



Switching the Displayed Page (Page Scroll)

You can switch the displayed page and display a new set of items.

- ▼ on the screen or + on the Display menu: The next page is displayed.
- ▲ on the screen or – on the Display menu: The previous page is displayed.
- If you tap between ▲ and ▼, a page is displayed according to the tapped position.

In the All Items Display

The first page is always displayed in the top half of the screen. You can switch between pages 2 and later pages in the bottom half of the screen. When the display is split and the All Items display is shown, you can switch between all pages, including page 1, in order.

In the 4-, 8-, and 16-Value Displays

You can switch between and display pages 1 to 12.

In the Matrix Display

You can switch between and display pages 1 to 9.

In the Harmonics List Single Screen or Harmonics List Dual Screen

You can switch separately between the pages of the measurement function display (on the left side of the screen) and the harmonic order data display (on the right side of the screen). When scrolling with the + and – buttons on the Display menu, use the Header/List button on the same menu to select the display whose pages you want to switch between.

Number of Displayed Digits (Display Resolution)

The number of displayed digits (display resolution) for voltage, current, active power, apparent power, reactive power, and so on is as follows:

- If the value is less than or equal to 600000: Six digits.
- If the value is greater than 600000: Five digits.

For details, see appendix 4 in the Getting Started Guide, IM WT5000-03EN. When the range rating (rated value of the specified measurement range) is specified, the Σ functions of the voltage, current, active power, apparent power, reactive power, and so on, are set to the decimal place and unit of the element with the lowest number of displayed digits (display resolution) in the wiring unit. For details about the display resolution during integration, see “Number of Displayed Digits (Display Resolution)” under “Integrated Power (Watt hours).”

► [Click here.](#)

Display Items (Items, Numeric)

The display item options vary depending on the current display.

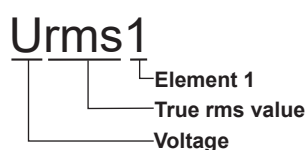
- [All display \(All Items\)](#)
- [4-, 8-, and 16-value displays \(4 Items/8 Items/16Items\)](#)
- [Matrix display \(Matrix\)](#)
- [Harmonics list single/dual \(Hrm List Single/Dual\)](#)

For a list of the measurement functions and their descriptions, see “Items That This Instrument Can Measure.”

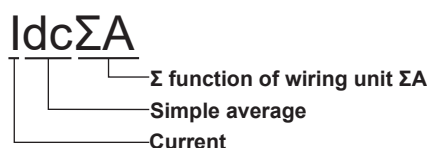
► [Click here.](#)

Example of How Measurement Functions Are Displayed in the Numeric Data Display

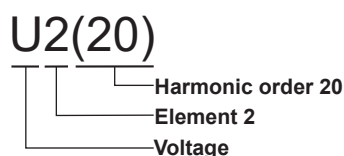
True rms voltage of element 1



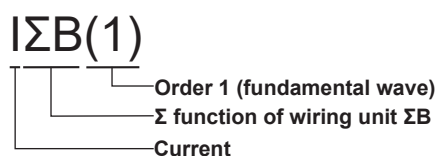
Simple average of the currents of the elements in wiring unit ΣA



Voltage of the 20th order of element 2



Simple average of the fundamental currents of the elements in wiring unit ΣB



Notes about the Numeric Data Display

- “-----” is displayed if a measurement function is not selected or if there is no numeric data.
- If Urms, Umn, Udc, Urmn, Uac, Irms, Imn, Idc, Irmn, or Iac exceeds 140% of the measurement range, “-OL-” is displayed to indicate an overload value.
- If the voltage or current exceeds 140% of the measurement range, “-OL-” is displayed to indicate an overload value for P.
- If the measured or computed result cannot be displayed using the specified decimal place or unit, “-OF-” (for overflow) is displayed.
- If rounding to zero is on, when the voltage or current measurement meets the following conditions relative to the measurement range, Urms, Umn, Urmn, Irms, Imn, Irmn, and other measurement functions based on these measurement functions are displayed as zero. The λ and Φ functions will return errors (“Error” is displayed).
 - When the Crest Factor Is Set to CF3
When Urms, Uac, Irms, or Iac is 0.3% or less. When Umn, Urmn, Imn, or Irmn is 2% or less.
 - When the Crest Factor Is Set to CF6 or CF6A
When Urms, Uac, Irms, or Iac is 0.6% or less. When Umn, Urmn, Imn, or Irmn is 4% or less.
- If the analysis window width (number of cycles of the fundamental signal) that is determined by the fundamental frequency is shorter than the data update interval, harmonic data is not measured, and “-----” (no data) is displayed. If this happens, increase the data update interval. For example, if the number of FFT points is 1024, the data update interval is 50 ms and the fundamental frequency is 10 Hz (the period is 100 ms), the analysis window will be 1 wave wide (see section 6.7 in the Getting Started Guide, IM WT5000- 03EN), and the data measurement period will be 100 ms. In this case, the time required for harmonic measurement is approximately 150 ms or greater (data measurement period + data processing time). To measure and display harmonic data, set the data update interval to a value greater than or equal to 200 ms.
- There is no overload value indication (“-OL-”) or zero indication (rounding to zero) for the numeric data of harmonic orders 0 (DC) to 500.
- If the measured frequency is outside the measurement range, the fU, fI, f2U, f2I, fPLL1, or fPLL2 function returns an error (“Error” is displayed).
- If λ is greater than 1 or less than -1, λ and Φ are displayed as follows.

	λ	Φ
$1 < \lambda \leq 2$	1	0.0
$-2 \leq \lambda < -1$	-1	180.0
$\lambda < -2$ or $2 < \lambda$	Error	Error

All display (All Items)

You cannot change individual measurement functions. Change the display by scrolling the page.
The number of displayed pages is 12.

Harmonic Order (Order (k))

On the All display, this setting is valid on pages 9 and 10. On pages 9 and 10, the order setting appears in the upper left of the screen.

When you select a function that has harmonic data, you can set the displayed harmonic order within the following range.

Total (Total value) or 0 (dc) to 500

The harmonic orders that can be specified vary depending on the measurement function. For details, see "Harmonic Measurement Function Orders."

▶ [Click here.](#)

The numeric data corresponding to harmonic orders above the maximum measurable harmonic order is displayed as "-----" (no data). For information about the maximum measurable harmonic order, see "Maximum Harmonic Order to Be Measured (Max Order)."

▶ [Click here.](#)

Turning the Display of the Numeric Data for All Elements and Wiring Units On and Off (Display All Elements)

- OFF

The numeric data is displayed in seven columns. When the total number of elements and wiring units is 8 or more, you can them by using the ◀ and ▶ buttons on the Display menu to scroll the screen horizontally.

- ON

When the total number of elements and wiring units is 8 or more, all the numeric data for the elements and wiring units is displayed in 10 columns using small fonts. If you select ON when the total number of elements and wiring units is seven or less, the display is the same as when OFF is selected.

4-, 8-, and 16-Value Displays (4 Items/8 Items/16 Items)

Item Number to Set (Item No.)

Select the number of the item that you want to configure.

Function (Function)

You can select any of the measurement function types listed under “Items That This Instrument Can Measure.”

► [Click here.](#)

If you select None, no measurement function is displayed for the selected item.

Element (Element/ Σ)

- When the function (Function) is set to something other than Speed, Torque, Pm, Slip, or SyncSp
 - Depending on the function, select the element/wiring unit from the following options, or you may not need to select it. The available options vary depending on the installed elements.
Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC
 - If the selected wiring unit does not have any elements assigned to it, because there is no data, “-----” (no data) is displayed. For example, if elements are assigned to ΣA but not to ΣB , the measurement function for ΣB is displayed as “-----” (no data).
- If you select Speed, Torque, Pm, Slip, or SyncSp for the function (Function), select the motor number from the following options. The options vary depending on the installed motor evaluation function option.
Motor 1, Motor 2, Motor 3, Motor 4

Harmonic Order (Order (k))

This is the same feature as the harmonic orders on the All display.

► [Click here.](#)

Resetting the Display Items (Reset Items)

Reset Patterns (Reset Pattern)

You can select the reset method from the following options.

- Element Origin (Element Origin)
The numeric data for each element is displayed on each page. The pattern that the data is arranged in varies depending on the number of installed elements.
- Function Origin (Function Origin)
The numeric data for each function is displayed on each page. The pattern that the data is arranged in varies depending on the number of installed elements.
- Clear Current Page (Clear Current Page)
All the display items on the current page are set to None.
- Clear All Pages (Clear All Pages)
All the display items on every page are set to None.

Resetting the Items (Reset Items Exec)

Reset the items.

Matrix display (Matrix)

Item Number to Set (Item No.)

This is the same as setting the item number in the 4-, 8-, and 16-value displays.

▶ [Click here.](#)

Function (Function)

This is the same as setting the function in the 4-, 8-, and 16-value displays.

▶ [Click here.](#)



- In the matrix display, if you choose a measurement function that does not require an element or wiring unit (such as $\eta 1$ to $\eta 4$, F1 to F20, Ev1 to Ev8, etc.), data is displayed in the first column.
 - If the function (Function) is set to Speed, Torque, Pm, Slip, or SyncSp, the data is displayed as follows:
Column 1: Motor1 data
Column 2: Motor2 data
Column 3: Motor3 data
Column 4: Motor4 data
-

Harmonic Order (Order (k))

This is the same feature as the harmonic orders on the All display.

▶ [Click here.](#)

Resetting the Display Items (Reset Items)

This is the same as resetting the display items in the 4-, 8-, and 16-value displays.

▶ [Click here.](#)

Column Settings (Column Settings)

Number of Columns (Column Num)

Set the number of columns to 4 or 7.

Column Number (Column No.)

Select the number of the column that you want to configure.

Element (Element/ Σ)

- You can select the element/wiring unit from the options below. The available options vary depending on the installed elements.
None, Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC
- If you select None, no measurement data is displayed in the selected column.
- If the selected wiring unit does not have any elements assigned to it, because there is no data, "-----" (no data) is displayed. For example, if elements are assigned to ΣA but not to ΣB , the measurement function for ΣB is displayed as "-----" (no data).

Resetting the Settings (Reset Items Exec)

Reset the column settings.

Harmonics List Single/Dual (Hrm List Single/Dual)

For each measurement function, you can display the numeric data for a harmonic order from 0 (DC) to 500 or for all harmonic orders in two columns.

Item Number to Set (List Item No.)

- You can specify two lists to show in the harmonic order data display area (the right side of the screen). Select the number of the list you want to configure: 1 or 2.
 - When harmonics list single screen is selected, the data of List Item No1 is listed in two columns.
 - When harmonics list dual screen is selected, the data of List Item No1 is listed in one column, and the data of List ItemNo2 is listed in another column.
- You cannot change individual items in the measurement function display area (the left side of the screen). Use the following method to change the displayed page.
 - ▼ on the screen: The next page is displayed.
 - ▲ on the screen: The previous page is displayed.
 - If you tap between ▲ and ▼, a page is displayed according to the tapped position.

Function (Function)

Select the measurement function to show in the harmonic order data display area from the following options.

U, I, P, S, Q, λ, Φ, ΦU, ΦI, Z, Rs, Xs, Rp, Xp

Element (Element/Σ)

You can select the element or wiring unit to display in the harmonic order data display area. This is the same as setting the element in the 4-, 8-, and 16-value displays.

► [Click here.](#)

Harmonics

The Total value and 0 (DC) order numeric data is always displayed at the top of the harmonic order data display area. To switch between the displays of the numeric data for harmonic orders 1 to 500, use ▼/▲ or +/- on the screen.

The number of harmonic orders that switch when you change the page is indicated below.

	Single Screen Display	Split Display
Harmonics list single screen	40th	20th
Harmonics list dual screen	20th	10th

User Display (User)

Display Configuration (Items)

Item Number to Set (Item No.)

Select the number of the item that you want to configure. When the numeric data display format is User, you can set the item number between 1 and 224.

Function (Function)

This is the same as setting the function in the 4-, 8-, and 16-value displays.

▶ [Click here.](#)

If you select None, you can display a character string in the numeric data box. Select the [String](#) menu item to enter the string.

Element (Element/ Σ)

This setting is valid when Function is not set to None. This is the same as setting the element in the 4-, 8-, and 16-value displays.

▶ [Click here.](#)

Order (Order; option)

This is the same as setting the order in the 4-, 8-, and 16-value displays.

▶ [Click here.](#)

If you set Function to None, a menu item for entering a string (String) appears.

String (String)

This menu item appears when you set Function to None. Enter the character string to display in the numeric data box. You can enter a string of up to 15 characters in length.

X Display Position (X Position)

Set the position where the left edge of the numeric data box will appear on the screen to a value from 0 (the left edge of the screen) to 999 (the right edge of the screen).

Y Display Position (Y Position)

Set the position where the top edge of the numeric data box will appear on the screen to a value from 0 (the top of the screen) to 719 (the bottom of the screen).

Font Size (Font Size)

Select the font size from the options below.

14, 16, 20, 24, 32, 48, 64, 96, and 128

Font Color (Color)

Select the font color from the options below.

Yellow, Green, Magenta, Cyan, Red, Orange, Light Blue, Purple, Blue, Pink, Light Green, Dark Blue, Blue Green, Salmon Pink, Mid Green, Gray, White, Dark Gray, Blue Gray, and Black

General (General)

Total Number of Items (Total Items)

You can set the total number of numeric data boxes to display to a number from 1 to 224.*

Number of Items per Page (Items Per Page)

You can set the total number of numeric data boxes to display per page to a number from 1 to 224.*

The total number of pages is Total Items/Items Per Page.

* The ranges of Total Items and Items Per Page are related as indicated below.

- Total Items: Items Per Page to Items Per Page × 12
- Items Per Page: Total Items/12 to Total Items

Saving the Display Configuration (Save Items)

You can save the display configuration that you have created to the specified storage medium. The extension is .TXT.

Displaying a File List and Specifying the Save Destination (File List)

On the file list, specify the save destination. For information about how to configure the file list display and how to operate files and folders, see “File List (File List).”

▶ [Click here.](#)

Automatic File Naming (Auto Naming)

This is the same as the auto naming feature for saving setup data.

▶ [Click here.](#)

File Name (File Name)

This is the same as the auto naming feature for saving setup data.

▶ [Click here.](#)

Saving (Save)

Saves the display configuration.



-
- Note that if there is a file with the same name in the save destination, it will be overwritten without warning.
 - File names are not case sensitive.
-

Simultaneous Saving of the Background File (Image)

Select whether to save the background file at the same time when the display configuration is saved.

Loading Files (Load)

Loading a Display Configuration File (Load Items)

On the file list, specify a file to load display configuration data from. The extension is .TXT.

For information about how to configure the file list display and how to operate files and folders, see “File List (File List).”

▶ [Click here.](#)

Loading a Background File (Load Bmp)

On the file list, specify a background file to load. The extension is .BMP.

If you use a commercial graphics program to create an image that meets the following specifications, you can load the image to this instrument.

- File format: BMP
- Resolution: 1000 × 720 pixels
- Color scale: 16-bit high color (R: 5 bits, G: 6 bits, B: 5 bits) or 24-bit true color (R: 8 bits, G: 8 bits, B: 8 bits)
- Size: Approx. 1.4 MB (16 bit) or approx. 2 MB (24 bit)

▶ [Click here.](#)



- If you attempt to load an image that does not meet the above specifications, the image will not be displayed properly, or an error message will appear and you will not be able to load the image.
- After you properly load a display configuration file and a background file, if you restart this instrument and the same background file is not in the same location, the background will return to its default.

Simultaneously Loading a Display Configuration File and a Background File (Load Items & Bmp)

When you select a display configuration file (.TXT) from the file list and load it, if there is a background file with a .BMP extension and the same name as the display configuration file, that file is also loaded.

▶ [Click here.](#)



If there is no background file with the same name as the display configuration file in the same directory as the display configuration file, an error occurs.

11 Graph Display

Graph Display (GRAPH)

Press GRAPH to display the waveforms of the following input signals.

- [Waveform display \(Wave\)](#)
- [Trend display \(Trend\)](#)
- [Bar graph display \(Bar\)](#)
- [Vector display \(Vector\)](#)

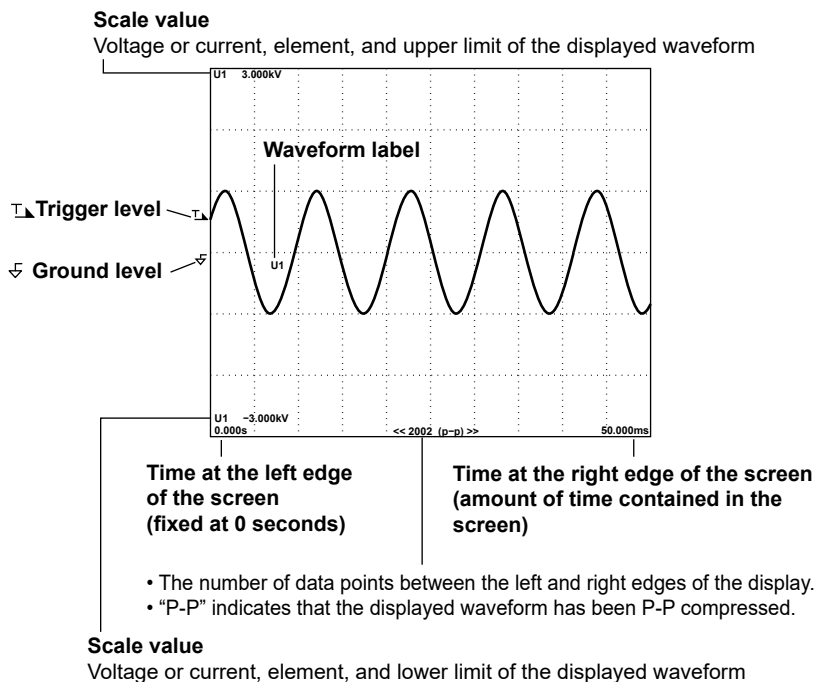
Each time you press GRAPH, the screen switches, in order, between waveform display, trend display, bar graph display, and vector display.

Waveform display (Wave)

The waveforms of the following input signals can be displayed.

- Input element's voltage and current
- Motor evaluation function's (option) speed, torque, Aux

Waveform Display Example



If you do not set the trigger level properly, the waveform display start point (the signal level on the left edge of the screen) may be unstable, or waveforms may not appear.

Display Group (Group)

Select the group you want to display from 1 to 4.

For each group, set the waveform you want to display using [display item \(Wave\)](#). For example, you can set group 1 to display the inverter's input waveform, group 2 to display the inverter's output waveform, and group 3 to display the motor's speed and torque.

If you change the display to split display in this condition, you can easily switch between observing the input and output waveforms of the inverter and motor by changing the groups (1 to 3) displayed in the top and bottom screens.

Display Items (Items, Wave)

You can specify the following items.

- Display, waveform mapping (Display/Mapping)
- Zoom, position (Zoom/Position)

Displayed Item Preset (Displayed Item Preset)

All (All)

Switches the waveform display on/off state of all input signals.

Voltage (U)

Switches the waveform display on/off state of all voltage signals.

Current (I)

Switches the waveform display on/off state of all current signals.

$\Sigma A/\Sigma B/\Sigma C$ ($\Sigma A/\Sigma B/\Sigma C$)

Switches the waveform display on/off state of the voltage or current signal of ΣA , ΣB , or ΣC .

Display ON/OFF (Display)

Switches the waveform display on/off state of each input signal on the display setting table.

- You can turn on and off waveform display of the voltage or current signal of each element.
- On models with the motor evaluation 1 or 2 option, you can turn the displays of the waveforms of the speed, torque, and Aux input signals on and off.

Waveform Mapping Mode (Wave Mapping Mode)

You can assign waveforms to windows on the screen. Choose one of the following methods for assigning the waveforms to the windows.

- Auto

Waveforms whose displays are turned on are assigned to the split screens in the following order.

- U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7
- Speed1, Speed2, Torque1, Torque2, Aux1 to 4 (models with the motor evaluation 1 option)
- Speed3, Speed4, Torque3, Torque4, Aux5 to 8 (models with the motor evaluation 2 option)

- Fixed

Regardless of whether their displays are on or off, waveforms are assigned in order according to their element numbers, with an element's voltage waveform (U) coming before its current waveform (I). The speed and Aux1 waveforms appear in the top window. 1, 2 The torque and Aux2 waveforms appear in the second window from the top. 1, 2

- User

You can pick which waveforms to assign to which windows, regardless of whether the waveform's displays are on or off. On the display setting table, you can select the display positions using numbers from 1 to 6.

Number 1 corresponds to the window at the top of the screen, and the window number increases for each successively lower window.

Vertical Zoom (Vertical Zoom)

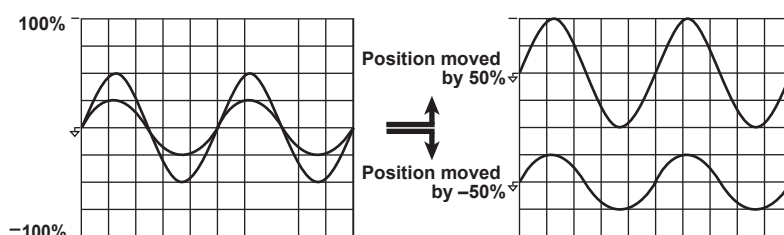
Each displayed waveform can be scaled. You can select one of the following zoom factors:

0.1, 0.2, 0.25, 0.4, 0.5, 0.75, 0.8, 1, 1.14, 1.25, 1.33, 1.41, 1.5, 1.6, 1.77, 2, 2.28, 2.66, 2.83, 3.2, 3.54, 4, 5, 8, 10, 12.5, 16, 20, 25, 40, 50, 100

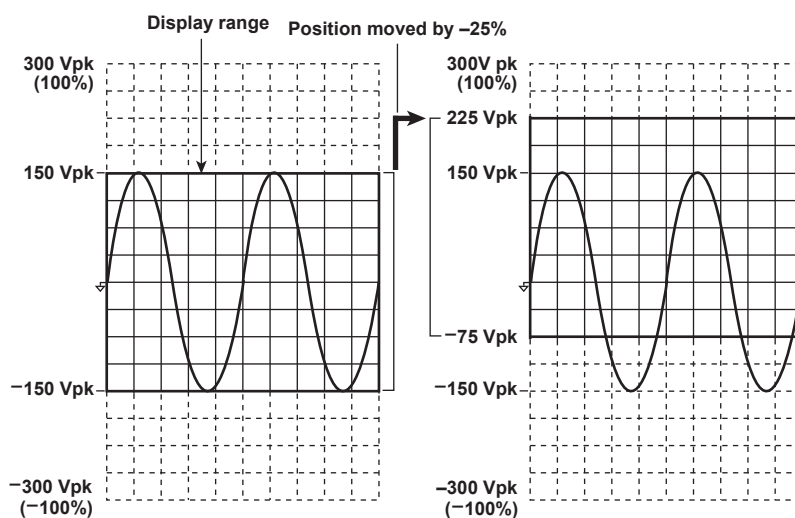
Vertical Position (Vertical Position)

This is useful when you want to view the relationship between voltage and current waveforms, or when the section of the waveform that you want to view does not fit into the display frame.

- You can select a value between 0.000 and $\pm 130.000\%$.
- When the zoom factor is set to 1, a value of 100% corresponds to half the height (display range) of the waveform display (which is three times the measurement range when the crest factor is set to CF3 and six times the measurement range when the crest factor is set to CF6 or CF6A). The upper and lower vertical display limits of the screen are 100% and -100% .



- As shown in the figure below, when the zoom factor is set to a value other than 1, the upper and lower display limits of the screen do not correspond to three times the measurement range (or to $\pm 100\%$) when the crest factor is set to CF3 and six times the measurement range (or to $\pm 100\%$) when the crest factor is set to CF6 or CF6A. You must take the zoom factor into account when setting a waveform's position. In the figure below, the crest factor is set to CF3, the voltage range is 100 V, the zoom factor is 2, and the vertical position has been shifted by -25% . The waveform is shifted by the same amount that it would be if the zoom factor were set to 1 and the vertical position was shifted by -50% .



When you want to zoom in on part of a waveform, we recommend that you take the steps below.

- Set the zoom factor to 1.
- Following the instructions in this section for shifting a waveform's vertical position, shift the part of the waveform that you want to view to the center of the display.
- Set the vertical zoom factor.

Display Format (Form, Wave)

You can configure the following display format settings.

- [Number of windows \(Format\)](#)
- [Time axis \(Time/div\)](#)
- [Advanced waveform display settings \(Advanced\)](#)

Number of Windows (Format)

You can divide the screen equally into windows, and assign waveforms to those windows. This function is useful when there are many waveforms and it is difficult to view them all in a single display.

You can choose the number of windows from one of the following options:

- Single (Single): No windows
- Dual (Dual): Two windows
- Triad (Triad): Three windows
- Quad (Quad): Four windows
- Hexa (Hexa): Six windows

Depending on the number of windows, the number of points displayed vertically in each window changes as described below.

Single: 720 points, Dual: 360 points, Triad: 240 points, Quad: 180 points, Hexa: 120 points

When the screen is split, the number of displayed points along the vertical axis of a single window is halved.

Methods for Assigning Waveforms to Screens

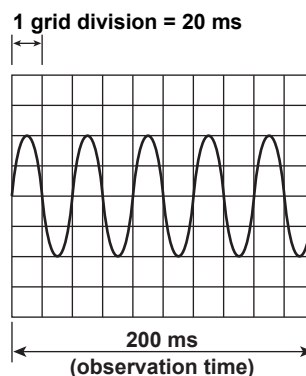
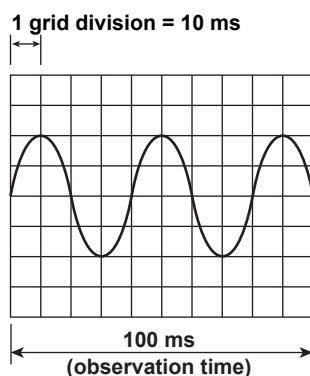
Waveforms whose displays are turned on are assigned to the divided windows in the following order.

- U1, I1 to U7, I7
- Spd1, Trq1 to Spd4, Trq4
- Aux1 to Aux8

Time Axis (Time/div)

The time axis is set in Time/div (time per grid division).

The time axis can be set up to the point in which the time corresponding to one screen is equal to the data update interval, in 1, 2, 5 steps. For example, when the data update interval is 500 ms, if you change the time-per-division in this order: 0.01 ms > 0.02 ms > 0.05 ms > 0.1 ms > 0.2 ms > 0.5 ms > 1 ms > 2 ms > 5 ms > 10 ms > 20 ms > 50 ms, the time corresponding to one screen changes in this order: 100 μ s > 200 μ s > 500 μ s > 1 ms > 2 ms > 5 ms > 10 ms > 20 ms > 50 ms > 100 ms > 200 ms > 500 ms.



Difference between Waveform Sampling Data and Waveform Display Data

Waveform sampling data and waveform display data are both measured waveform data, but they differ as described below.

- **Waveform sampling data: Data derived through A/D conversion of the input signal**

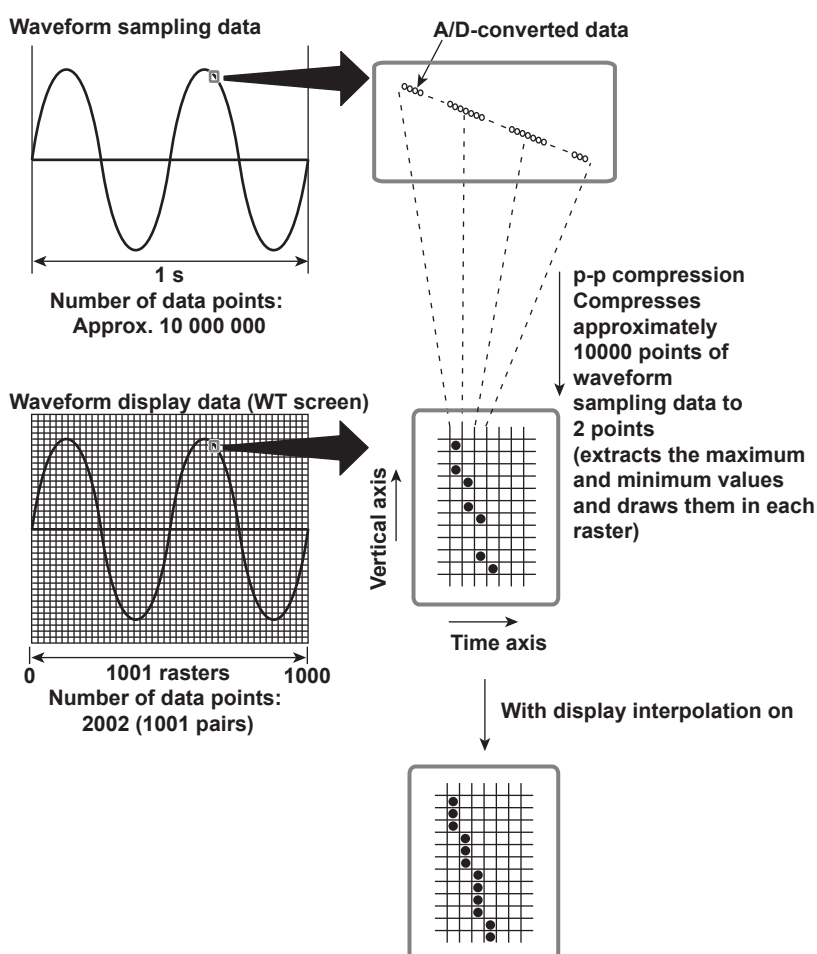
The A/D conversion rate of this instrument is approximately 10 MS/s. Therefore, if the data update interval is set to 1 s, the number of data points sampled from a single input signal in a single measurement is approximately 10 000 000 (see the figure below). Waveform sampling data is also called acquisition data (Acquisition Data) or raw wave data (Raw Wave Data).

- **Waveform display data: Waveform data displayed on this instrument's screen (2002 points)**

When this instrument displays waveforms, data points (of waveform display data) are displayed in horizontal rasters (along the time axis). The number of rasters is 1001. Each raster contains two points of waveform display data. The two data points are the maximum and minimum values of the waveform data in each raster. Therefore, the number of waveform display data points (the number of points displayed on the screen) for a single input signal is 2002.

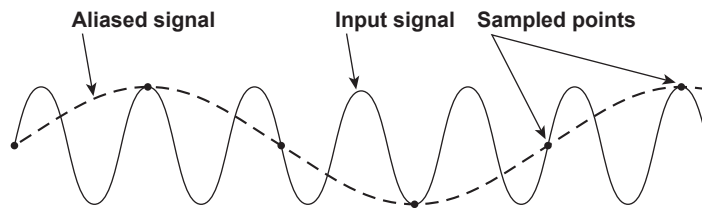
p-p Compression

p-p compression is the compression method used to derive waveform display data from waveform sampling data. For example, if a 2-Hz sine wave is measured at a data update rate of 1 s, to display this waveform, this instrument converts the number of data points from approximately 10 000 000 to 2002 (1001 pairs of maximum and minimum values). Thus, two points (a pair) of waveform display data are derived from approximately 10000 points of waveform sampling data. This conversion is called p-p (peak-peak) compression. The compression ratio of p-p compression varies depending on the data update interval and the horizontal scale (time axis) of the waveform display.



Aliasing

When the sample rate is low compared to the frequency of the input signal, the high frequency components of the signal are lost. In accordance with the Nyquist sampling theorem, the high frequency components in the signal are misread as low frequency components. This is called aliasing.

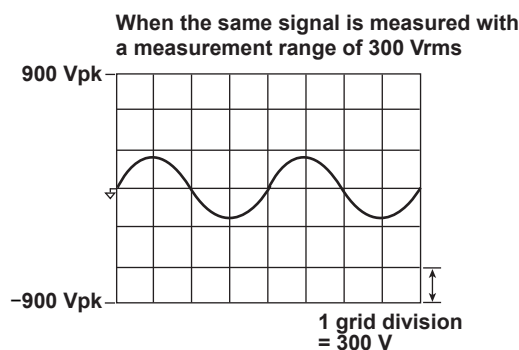
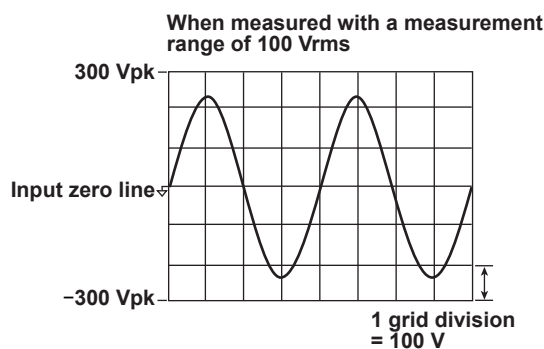


Vertical Axis (Amplitude)

The height (display range) of the vertical axis is based on the specified crest factor and measurement range.

For example, if the crest factor is set to CF3 and the voltage measurement range is set to 100 Vrms, the display range is set to ± 300 Vpk ($\pm 3 \times 100$ Vrms) with the zero input line at the center. The waveform is clipped if this range is exceeded.

In the same way, if the crest factor is set to CF6 or CF6A and the voltage measurement range is set to 50 Vrms, the display range is set to ± 300 Vpk ($\pm 6 \times 50$ Vrms) with the zero input line at the center.



Advanced Waveform Display Settings (Advanced)

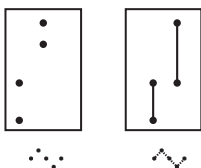
Display Interpolation (Interpolate)

When there are less than 1000 points of sampled data on the time axis, the displayed points (rasters) do not connect with each other. Numbers of sampled points below 1000 are said to be within the interpolation range. Display interpolation is a feature that connects the points linearly so that the waveform display is smooth. You can set the interpolation method to one of the settings below.

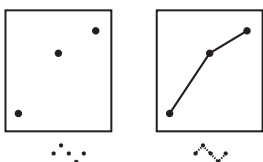
- : No interpolation is performed. Only the data points are displayed.
- : The spaces between data points are connected with straight lines.

- **Outside of the Interpolation Zone**

The dots are connected vertically. If the number of data points is 2002 or greater, the instrument determines the P-P compression values (the maximum and minimum sampled-data values in a given interval), and displays vertical lines (rasters) connecting each pair of maximum and minimum P-P compression values.



- **In the Interpolation Zone**



Grid (Graticule)

You can set the window grid to one of the following options.

- : The grid is displayed with dotted lines.
- : The grid frame is displayed.
- : The grid is displayed with a cross hair.

Turning the Scale Value Display On and Off (Scale Value)

You can select whether to display the following values for each waveform.

- The upper and lower limits of the vertical axis.
- The values at the left and right edges of the horizontal axis (time axis).

Turning the Display of Waveform Labels On and Off (Wave Label)

Select whether to display waveform labels.

Cursor Measurement (Cursors)

▶ [Click here.](#)

Trend Display (Trend)

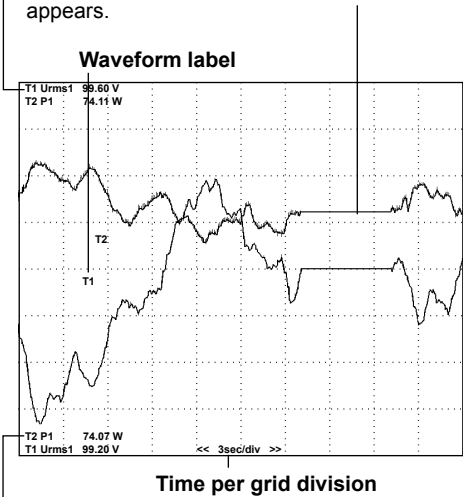
You can display the trends of measurement functions.

Trend Display Example

Scale value

The trend number, measurement function, element, and upper limit of the displayed trend

When the display is held, trend values behave the same as numeric values.
When the display is un-held, the trend data from when the display was held appears.



Scale value

The trend number, measurement function, element, and lower limit of the displayed trend

Display Group (Group)

Select the group you want to display from 1 to 4.

To assign waveforms to each group (1 to 4), set the [displayed item \(Trend\)](#).

Display Items (Items, Trend)

All ON/All OFF (All ON/All OFF)

You can collectively show or hide trend 1 (T1) to trend 16 (T16).

Trend to Display (Display)

For the trend waveforms of trend 1 (T1) to trend 16 (T16), you can select show (check box selected) or hide (check box not selected).

Function (Function)

You can select any of the measurement functions listed under “Items That This Instrument Can Measure.”

► [Click here.](#)

Element/ Σ /Motor (Element/ Σ /Motor)

- When the function (Function) is set to something other than Speed, Torque, Pm, Slip, or SyncSp
 - Depending on the function, select the element/wiring unit from the following options, or you may not need to select it. The available options vary depending on the installed elements.
Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC
 - If there are no elements assigned to a selected wiring unit, because the wiring unit has no data, its trend is displayed at the top or bottom of the screen. For example, if elements are assigned to ΣA but not to ΣB , the trends of measurement functions for ΣB appear at the top or bottom of the screen.
- If you select Speed, Torque, Pm, Slip, or SyncSp for the function (Function), select the motor number from the following options. The options vary depending on the installed motor evaluation function option.
Motor 1, Motor 2, Motor 3, Motor 4

Harmonic Order (Order (k))

When you select a function that has harmonic data, you can set the displayed harmonic order within the following range.

Total (Total value) or 0 (DC) to 500

The harmonic orders that can be specified vary depending on the measurement function. For details, see “Harmonic Measurement Function Orders.”

► [Click here.](#)

The trends of orders that exceed the maximum measurable order are displayed at the top or bottom of the screen. For information about the maximum measurable harmonic order, see “Maximum Harmonic Order to Be Measured (Max Order).”

► [Click here.](#)



- Trends for which there is no corresponding numeric data are displayed at the top or bottom of the screen.
- If you choose to display the trend of a user-defined event (Ev1 to Ev8), the trend display shows 1 when the user-defined event is occurring (True) and 0 when it is not occurring (False).
- When the data update interval is 10 ms, trend 1 (T1) to trend 8 (T8) can be used.

Trend Display Scale

Setting the Vertical Scale (Scaling)

You can set the upper and lower limits of a trend window. Set the setup mode to one of the options below.

- Auto (Auto): The upper and lower limits of the trend window are automatically determined based on the maximum and minimum trend display data values.
- Manual (Manual): You can set the upper and lower limits manually.

Upper and Lower Limits for Manual Scaling (Upper Scale and Lower Scale)

You can set the upper and lower limits within the range of $-9.999 T$ to $9.999 T$.

Display Format (Form, Trend)

Number of Trend Display Windows (Format)

You can choose the number of windows from one of the following options:

- Single (Single): No windows
- Dual (Dual): Two windows
- Triad (Triad): Three windows
- Quad (Quad): Four windows

Depending on the number of windows, the number of points displayed vertically in each window changes as described below.

Single: 720 points, Dual: 360 points, Triad: 240 points, Quad: 180 points

When the screen is split, the number of displayed points along the vertical axis of a single window is halved.

Waveform Assignment

Trends whose displays are turned on are assigned in numeric order (T1 to T16) to the split screens.

Time Axis (Time/div)

The time axis is set in Time/div (time per grid division). The time per division can be set in the range of 3 s to 1 day.

The trend data update interval is determined by the data update interval and the time axis (Time/div). For example, if the data update interval is 50 ms and you set Time/div to 3 s/div, the trend display is updated every 1 s. If you set the data update interval to 10 s and Time/div to 3 s/div, the trend display is updated every 10 s, and the trend data is displayed as a line graph, with each point separated by 10 s. If you set Time/div to 1 day/div, the trend display will be updated once every 864 s regardless of the data update interval.



One division (1 div) on the trend display is equivalent to 100 rasters. For example, if you set Time/div to 1 day/div, one raster is 864 s (which is equal to 1 day/100), the trend data update interval is 864 s, and the displayed data is P-P compressed. For information about rasters and P-P compression, see “p-p Compression.”

▶ [Click here.](#)

Restarting Trends (Clear Trend Exec)

When you restart trends, the trend display up to that point is cleared, and the trends start over from the right end of the screen.

In addition to when you execute Clear Trend Exec, trends will also restart when:

- You change a trend display function, element, or harmonic setting.
- You change the trend time axis (horizontal axis) setting.

Advanced Trend Display Settings (Advance)

These are the same as the advanced waveform display settings.

▶ [Click here.](#)



All advanced trend display settings are shared with the advanced waveform display settings. If you change the advanced settings in the trend display, the advanced settings in the waveform display also change. For example, if you set the display of the scale values to OFF in the trend display, the display of the scale values will also be set to OFF in the waveform display.

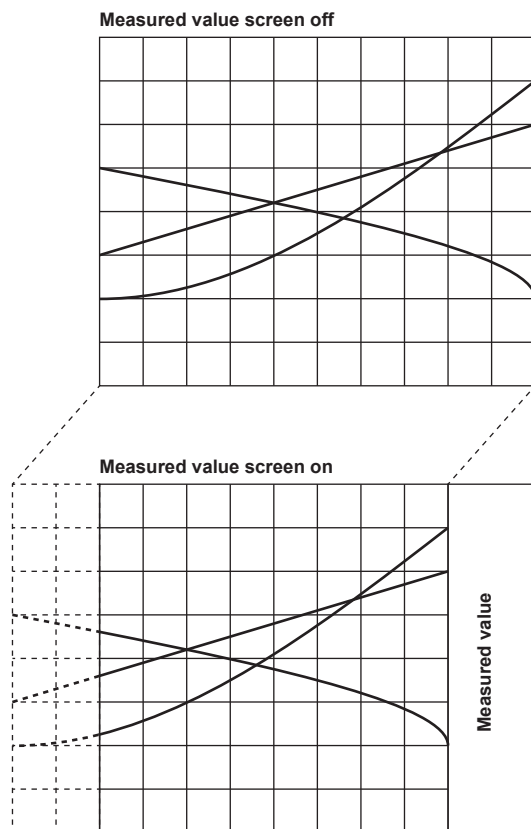
Cursor Measurement (Cursors)

► [Click here.](#)

Measurement Display (Value)

You can set whether to show or hide the current measurements (on or off) at the right edge of the trend display. When you set this setting to on (and display the current measurements), the trend waveform display will be 8 div (800 rasters). The oldest 2 div (200 rasters) that would be displayed at the left edge if this setting were set to off are not shown.

The time scale (Time/div) does not change whether this setting is on or off.



Bar Graph Display (Bar)

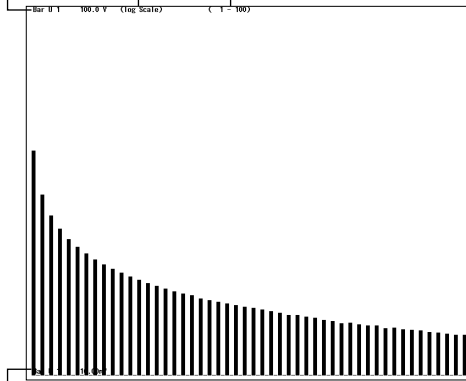
You can display harmonics using bar graphs. The harmonic orders are lined up on the horizontal axis, and the vertical axis represents the amplitude of each harmonic.

You can configure three different bar graphs.

Bar Graph Display Example

The bar graph number, measurement function, element, and upper limit of the displayed bar graph

"log Scale" only appears when logarithmic coordinates are used.
Harmonic order range of the displayed bar graph



The bar graph number, measurement function, element, and lower limit of the displayed bar graph



- When logarithmic coordinates are used (Log Scale), if a value is negative, its absolute value is displayed with a red bar graph.
- If the analysis window width (number of cycles of the fundamental signal) that is determined by the fundamental frequency is shorter than the data update interval, bar graphs are not displayed. Set a longer data update interval. For details, see "Notes about the Numeric Data Display."
▶ [Click here.](#)
- The bar graphs of harmonic orders that exceed the maximum measurable order are not displayed. For information about the maximum measurable harmonic order, see "Maximum Harmonic Order to Be Measured (Max Order)."
▶ [Click here.](#)

Display Group (Group)

Select the group you want to display from 1 to 4.

To assign waveforms to each group (1 to 4), set the [displayed item \(Bar\)](#). For example, if you assign the functions of elements 1, 2, and 3 to each group, you can easily switch the bar graph displays simply by changing the display group.

Display Items (Items, Bar)

Bar Graph Number (Item No.)

Select the number, from 1 to 3, of the bar graph that you want to select.

Function (Function)

You can select the measurement function to display from the following options.

U, I, P, S, Q, λ , Φ , ΦU , ΦI , Z, Rs, Xs, Rp, Xp

Element (Element)

You can select the element from the following options. The available options vary depending on the installed elements.

Element1, Element2, Element3, Element4, Element5, Element6, Element7

Bar Graph Display Scale

Setting the Vertical Scale Mode (Scale Mode)

You can set the upper and lower limits of a bar graph window. Set the setup mode to one of the options below.

- Fixed (Fixed)
 - When the function (Function) is U, I, P, S, or Q, the scaling is logarithmic (Log).
 - When the function (Function) is λ , Φ , ΦU , ΦI , Z, Rs, Xs, Rp, or Xp, the scaling is linear (Linear).
 - The upper and lower limits of the bar graph window are automatically determined based on the maximum and minimum displayed trend data values. The lower and upper limits for λ are -1 and 1 . For Φ , ΦU , and ΦI , the minimum and maximum values are -180 to 180° . Negative values correspond to phase lagging and positive values correspond to phase leading.

- Manual (Manual)

You can set the type, upper limit, and X-axis position of the vertical scale.

Vertical Scale Type (Vertical Scale)

This setting is valid when the vertical scale mode is set to Manual. You can set the scale type to linear (Linear) or logarithmic (Log).

Upper Limit (Upper Scale)

This setting is valid when the vertical scale mode is set to Manual. You can set the value between 0 and 9.999 T.

X-Axis Position (X Axis Position)

This setting is valid when you set the vertical scale mode to Manual and the vertical scale type to Linear. You can set the point at which the Y-axis coordinate is 0 to Bottom (the bottom of the screen) or Center (the center of the screen).

Display Format (Form, Bar)

Number of Bar Graph Display Windows (Format)

You can choose the number of windows from one of the following options:

- Single (Single): No windows. The data of bar graph (Item No.) 1 is displayed.
- Dual (Dual): Two windows. The data of bar graphs (Item No.) 1 and 2 is displayed.
- Triad (Triad): Three windows. The data of bar graphs (Item No.) 1 to 3 is displayed.

Bar Graph Display Range (Start Order/End Order)

- You can configure the range of harmonic orders to show in a bar graph.
- The range is the same for bar graphs 1 to 3.

Starting Harmonic Order (Start Order)

- You can select a value between 0 and 490. However, the starting harmonic order cannot be more than 10 orders less than the ending order.
- When the measurement function of a bar graph is Φ , order 0 has no values, so you cannot display it in the bar graph.
- When the measurement function of a bar graph is ΦU or ΦI , orders 0 and 1 have no values, so you cannot display them in the bar graph.

Ending Harmonic Order (End Order)

You can select a value between 10 and 500. However, the ending harmonic order cannot be more than 10 orders greater than the starting order. You cannot display bar graphs containing harmonic orders that are greater than the maximum measurable order (see section 6.7 in the Getting Started Guide, IM WT5000-03EN).

Cursor Measurement (Cursors)

► [Click here.](#)

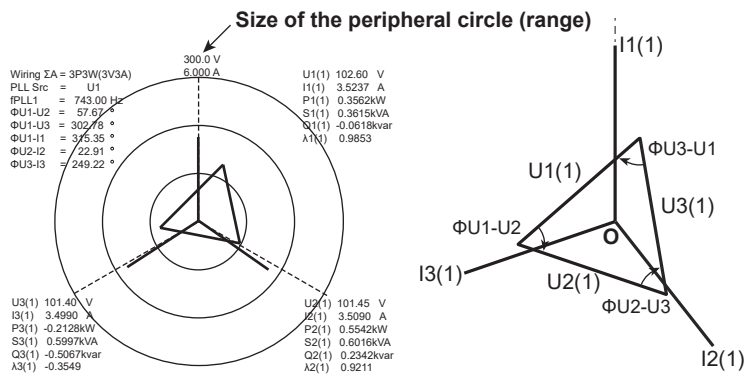
Vector Display (Vector)

You can select a wiring unit to display vectors of the phase differences and amplitudes (rms values) of the fundamental signals, U(1) and I(1), in each element in the unit. The positive vertical axis is set to zero (angle zero), and the vector of each input signal is displayed.

Vector Display Example

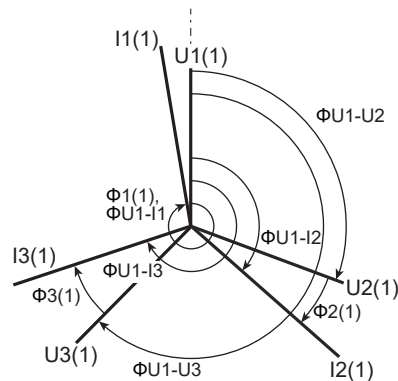
For a 3P3W system with a three-voltage three-current method

- U1(1), U2(1), and U3(1) are line voltages.
- I1(1), I2(1), and I3(1) are line currents.



For a 3P4W (three-phase four-wire system)

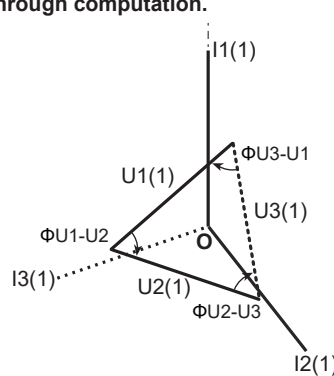
- U1(1), U2(1), and U3(1) are phase voltages.
- I1(1), I2(1), and I3(1) are line currents.



For a 3P3W (three-phase three-wire system)

- U1(1), U2(1), and U3(1) are line voltages.
- I1(1), I2(1), and I3(1) are line currents.

However, U3(1) and I3(1) are not actually measured for the 3P3W system. The vectors are displayed through computation.



If the analysis window width (number of cycles of the fundamental signal) that is determined by the fundamental frequency is shorter than the data update interval, vectors are not displayed. Set a longer data update interval. For details, see "Notes about the Numeric Data Display."

► [Click here.](#)

Display Group (Group)

Select the group you want to display from 1 to 4.

To assign waveforms to each group (1 to 4), set the [displayed item \(Vector\)](#).

Display Items (Items, Vector)

Vector Number (Item No.)

Select the vector you want to set: 1 or 2.

Vector Source (Object)

Select the element or wiring unit to display from the following options. The available options vary depending on the installed elements.

Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC

Setting Vector Zoom Factors (U Mag/I Mag)

You can change the size of vectors. You can specify separate zoom factors for the fundamental waves U(1) and I(1). When you zoom the vectors, the value that indicates the size of the vector display's peripheral circle changes according to the zoom factor.

Setting the Zoom Factor of the Vector of Fundamental Waveform U (1) (U Mag)

You can set the zoom factor to a value between 0.100 and 100.000.

Setting the Zoom Factor of the Vector of Fundamental Waveform I (1) (I Mag)

You can set the zoom factor to a value between 0.100 and 100.000.



If the zoom factor is too large, the vector will exceed the display range and will not be displayed properly. Reduce the zoom factor so that the vector is displayed within the display range.

Display Format (Form, Vector)

Number of Vector Display Windows (Format)

You can choose the number of windows from one of the following options:

- Single (Single): No windows. The data of vector (Item No.) 1 is displayed.
- Dual (Dual): Two windows. The data of vectors (Item No.) 1 and 2 is displayed. However, in the split display, the data of vector 1 is displayed.

Turning the Display of Numeric Data On and Off (Numeric)

You can select whether to show (ON) or hide (OFF) numeric data. You can display the size of each signal and the phase differences between signals. For information about phase difference display formats, see "Phase Difference Display Formats."

► [Click here.](#)

12 Custom Display

Custom Display (CUSTOM)

You can register your favorite screen configurations.

Custom Screen Registration (Custom)

Registration Tabs (1 to 5)

Select the number you want to register the screen configuration at from 1 to 5.

Registration Names (Custom 1 to Custom 5)

Set the registration name of the screen configuration.

- Number of characters: Up to 14
- Usable characters: All ASCII characters that are displayed on the keyboard

New Registration (Register)

This is displayed when a tab does not have a screen configuration registered. The current screen configuration is registered as a new configuration.

Overwrite (OverWrite)

This is displayed when a tab already has a screen configuration registered. The old configuration is overwritten with the current screen configuration.

Clear (Clear)

The registered contents are cleared.

Custom Screen Switching

Each time you press CUSTOM, the screen changes between the screen configurations registered in registration tabs 1, 2, 3, 4, and 5 in order. Unregistered tabs are skipped. If there are no screen configurations registered in any of the registration tabs, the screen does not switch to the custom screen.

The contents of the screen configurations registered in the registration tabs are saved in a dedicated memory area separate from the setup data of this instrument. Therefore, these contents are not cleared even when the setup data is initialized or when the setup data is loaded.

13 Holding Measured Values, Performing Single Measurements, and Zero-Level Compensation

You can specify or execute the following items.

- [Holding measured values \(Hold, HOLD\)](#)
- [Single measurement \(Single Execute, SINGLE\)](#)
- [Zero-level compensation \(Cal Execute, CAL\)](#)

Holding Measured Values (Hold, HOLD)

The hold operation stops data measurement and display operations for each data update interval and holds the display of all measurement function data. Numeric data list output through the D/A output and the communication values all reflect the held numeric data.



During integration, the display is held, but measurement continues without stopping.

For information about how holding works during integration, see the sections on holding integration and releasing the hold.

▶ [Click here.](#)

Single Measurement (Single Execute, SINGLE)

While the display is held, the signal is measured once at the data update interval, and then the display is re-held. If you press SINGLE when the display is not held, measurement restarts from that point.

Using an External Signal to Hold Measured Values and Perform Single Measurements (Option)

On models with the 20-channel D/A output option, you can use the remote control feature to hold measured values and perform single measurements. For details about the remote control feature, see appendix 4.5 in the Getting Started Guide, IM WT5000-03EN.

Zero-Level Compensation (Cal Execute, CAL)

Zero-level compensation is the process of creating a zero-input condition using the internal circuit of this Instrument and setting the level at that point to the zero level. It must be performed to meet the specifications of this instrument.

- Tapping Cal Execute or pressing CAL executes zero-level compensation.
- This Instrument automatically performs zero-level compensation after you change the measurement range or input filter.



-
- To make accurate measurements, we recommend that you execute zero-level compensation after warming up the instrument for at least 30 minutes. Also, the ambient temperature should be stable and within the specified range (see chapter 6 in the Getting Started Guide, IM WT5000-03EN).
 - If the measurement range and input filter remain the same for a long period of time, the zero level may change due to the changes in the environment surrounding this Instrument. If this happens, we recommend that you execute zero-level compensation.
 - There is a feature that automatically performs zero-level compensation during integration (integration auto calibration).

▶ [Click here.](#)

14 Integrated Power (Watt Hours/Ampere Hours)

Integrated Power (Integration, MENU (INTEGRATION))

This instrument can integrate the active power (watt hour), the current (ampere hour), the apparent power (volt-ampere hour), and the reactive power (var hour) values.

For a list of the measurement functions related to integrated power (watt hours) and their descriptions, see “Items That This Instrument Can Measure.”

► [Click here.](#)

Update Mode and Executing Integration

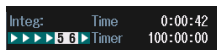
- When the update mode is constant interval, you can execute integration (start, stop, and reset).
- If the update mode is trigger and you execute integration, the update mode is automatically changed to constant interval. When integration is reset, the update mode returns to trigger.

Set the following items.

- [Integration mode \(Integration Mode\)](#)
- [Integration timer \(Integration Timer\)](#)
- [Scheduled times for real-time integration \(Start Time/End Time\)](#)
- [Enabling or disabling independent integration \(Independent Control\)](#)
- [Integration Source Elements \(Element Objects\)](#)
- [Integration auto calibration on/off \(Auto Cal\)](#)
- [Watt hour integration method for each polarity \(WP ± Type\)](#)
- [Current mode for current integration \(q Mode\)](#)
- [Rated time of integrated D/A output \(D/A Output Rated Time; option\)](#)
- [Integration resume action at power failure recovery \(Resume Action\)](#)
- [Starting, stopping, and resetting integration \(Start/Stop/Reset\)](#)

Integration-Related Display

Integration-related settings and conditions are display at the top of the screen.



At Integration Reset

The display shows the following when the integrated value is reset and integration can be started.

- When independent integration is off: No display
- When independent integration is on: Element numbers in reset mode

When Integration Is Running

When integration is running,  and the elapsed integration time are displayed.

When Integration Is Paused

When integration is paused,  and the elapsed integration time are displayed.

- If you tap Stop or press STOP causing integration to pause,  appears. Tapping Start or pressing START resumes the integration.
- If the integration mode is real-time normal integration mode or real-time continuous integration mode and the scheduled integration stop time arrives causing the integration to automatically pause,  appears. In this condition, you cannot resume integration even if you tap Start or press START. To start integration, reset it first.

14 Integrated Power (Watt Hours/Ampere Hours)

At Integration Ready

In real-time integration mode, after you tap Start or press START key, if the time is before the scheduled integration start time,  and the scheduled integration start time are displayed.



At Integration Timeout

If the integration timer expires, integration is stopped automatically, and  and the elapsed integration time are displayed.

Error

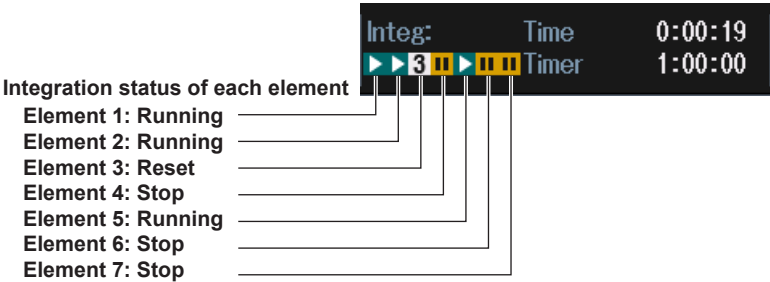
In the following situations, the integration will automatically stop and  and the elapsed integration time will appear.

- The integration time reaches the maximum integration time (10000 hours).
- The integrated value reaches its maximum or minimum displayable value.
- A power failure occurs when integration is in progress. Even when a power failure occurs, this instrument stores and holds the integration result. Set the [integration resume action at power failure recovery](#) to specify the action that will be taken when the power recovers after a power failure.

Example of the Display When the Integration Time Is Set to a Non-Zero Value



Example of the Display When Independent Integration Is Enabled



Number of Displayed Digits (Display Resolution)

The number of displayed digits (display resolution) for an integrated value is six (the maximum value is 999999). When an integrated value reaches 1000000 counts, the decimal point shifts automatically. For example, if 0.001 mWh is added to 999.999 mWh, the display shows 1.00000 Wh.

Maximum and Minimum Displayable Integrated Values

Active power (WP): ± 999999 MWh
 Current (q): ± 999999 MAh
 Apparent power (WS): ± 999999 MVAh
 Reactive power (WQ): ± 999999 Mvarh

Display When Integration Overflow Occurs

If either of the conditions below is met, integration is stopped, and the integration time and integrated value are held.

- The integration time reaches the maximum integration time (10000 hours).
- The integrated value of WP, q, WS, or WQ reaches the maximum or minimum displayable value given above.

Integration When the MAX Hold Feature Is Enabled

This instrument determines and displays the integrated value by summing the value that is measured at every data update interval, irrespective of the [MAX hold](#) feature.

Integration When the Measured Value Exceeds the Measurement Limit

If a sampled instantaneous current or voltage exceeds the maximum or minimum measurement range limits of the AD circuit, the value is measured as the maximum or minimum measurement range limit value.

Integration When Current Input Is Small

If rounding to zero is on, when the current input meets the following conditions relative to the measurement range, integration is performed assuming the current to be zero.

- When the Crest Factor Is Set to CF3
 When Irms or Iac is 0.3% or less. When Imn or Irmn is 2% or less.
- When the Crest Factor Is Set to CF6 or CF6A
 When Irms or Iac is 0.6% or less. When Imn or Irmn is 4% or less.

Sample Rate, and Valid Frequency Ranges for Integration

The sample rate is approximately 5 MHz. The voltage/current signal frequencies that are valid for integration are as follows:

Integrated Item		Valid Frequency Range for Integration
Active power		DC to approx. 2.5 MHz
Current	When integrating Irms	DC or the lower frequency limit determined by the data update interval to approximately 2.5 MHz
	When integrating Imn	DC or the lower frequency limit determined by the data update interval to approximately 2.5 MHz
	When integrating Idc	DC to approx. 2.5 MHz
	When integrating Irmn	DC or the lower frequency limit determined by the data update interval to approximately 2.5 MHz
	When integrating Iac	The lower frequency limit determined by the data update interval to approximately 2.5 MHz

Using an External Signal to Control Integration (Option)

On models with the 20-channel D/A output option, you can use the remote control feature to use an external signal to start, stop, and reset integration. For details about the remote control feature, see section 4.5 in the Getting Started Guide, IM WT5000-03EN.

Limitations on Modifying the Settings during Integration

During integration, there are some settings that you cannot change and functions that you cannot execute. For details, see appendix 9 in the Getting Started Guide, IM WT5000-03EN.

Limitations on Waveform Display during Integration

- During integration, the waveform display [trigger](#) does not function. Therefore, the signal level of the waveform display at the left end of the screen may not be stable.
- During integration, the shortest possible waveform data update interval is 1 s. If you select an update interval shorter than 1 s, the numeric data and waveform data will contain measured values for different measurement periods.

Integration Mode (Integration Mode)

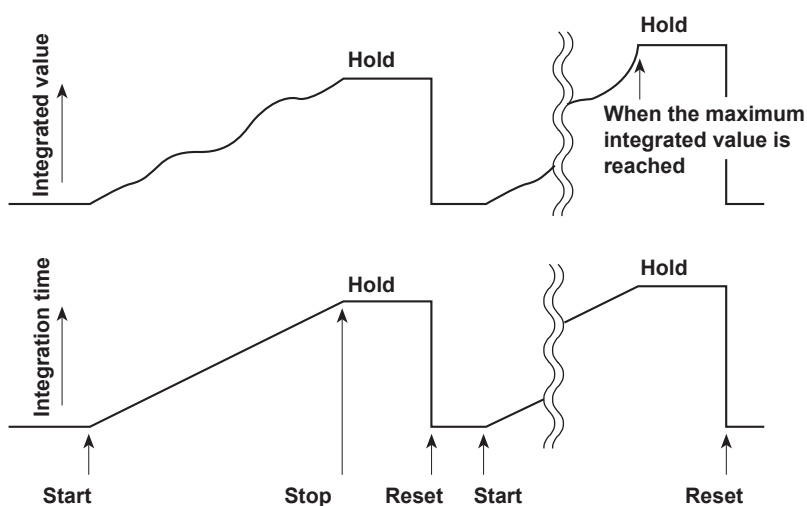
The integration feature has the following five modes.

Integration Mode	Start	Stop	Repetition
Manual integration mode (Normal)	Touch panel/key operation	Touch panel/key operation	---
Standard integration mode (Normal)	Touch panel/key operation	Stopped by the timer	---
Continuous integration mode (Continuous)	Touch panel/key operation	Touch panel/key operation	Repeats when the timer expires
Real-time normal integration mode (R-Normal)	Date and time	Date and time	---
Real-time continuous integration mode (R-Continuous)	Date and time	Date and time	Repeats when the timer expires

Manual Integration Mode

When you set the integration mode to normal and set the integration timer to 00000:00:00, this instrument performs integration in manual integration mode. After integration is started, it continues until you tap Stop or press STOP. However, if either of the conditions below is met, integration is stopped, and the integration time and integrated value are held.

- The integration time reaches the maximum integration time (10000 hours).
- The integrated value reaches its maximum or minimum displayable value.

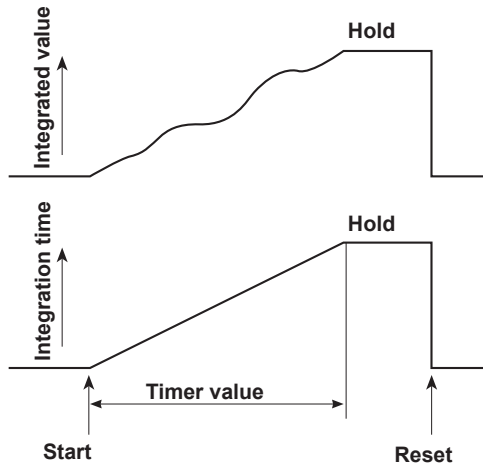


14 Integrated Power (Watt Hours/Ampere Hours)

Normal Integration Mode (Normal)

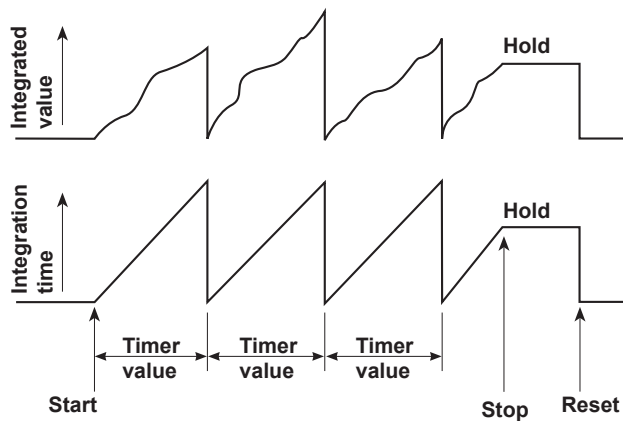
You can set a relative integration time (set a timer). Integration starts when you tap Start or press START. When one of the conditions below is met, integration is stopped, and the integration time and integrated value are held.

- The specified timer time elapses.
- The Stop button is tapped, or the STOP key is pressed.
- The integrated value reaches its maximum or minimum displayable value.



Continuous Integration Mode (Continuous integration; Continuous)

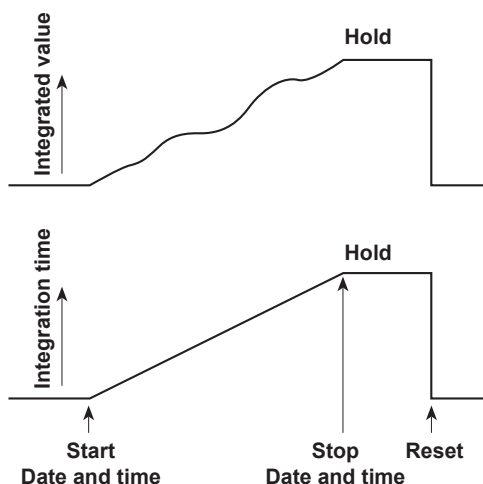
You can set a relative integration time. Integration starts when you tap Start or press START. When the specified timer time elapses, integration is automatically reset and restarted. Integration repeats until you tap Stop or press STOP. However, if the integrated value reaches its maximum or minimum displayable value before the specified amount of time has elapsed, integration is stopped, and the integration time and integrated value at that point are held.



Real-Time Normal Integration Mode (R-Normal)

Set the date and time when integration starts and stops and the duration of integration. Integration starts at the scheduled start time. When one of the conditions below is met, integration is stopped, and the integration time and integrated value are held.

- The scheduled stop time is reached.
- The specified timer time elapses.
- The integration time reaches the maximum integration time (10000 hours).
- The integrated value reaches its maximum or minimum displayable value.



In real-time integration mode, when you set the integration time to 00000:00:00, integration starts at the scheduled start time. When one of the conditions below is met, integration is stopped, and the integration time and integrated value are held.

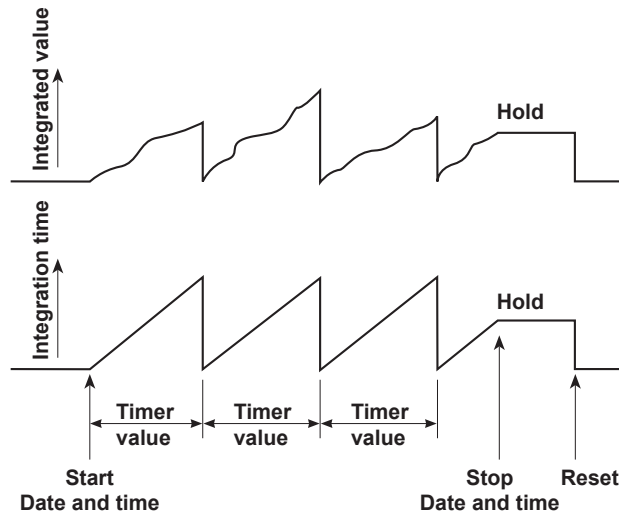
- The scheduled stop time is reached.
- The Stop button is tapped, or the STOP key is pressed.
- The integration time reaches the maximum integration time (10000 hours).
- The integrated value reaches its maximum or minimum displayable value.

14 Integrated Power (Watt Hours/Ampere Hours)

Real-Time Continuous Integration Mode (Continuous integration; R-Continuous)

Set the date and time when integration starts and stops and the duration of integration. Integration starts at the scheduled start time. When the specified timer time elapses, integration is automatically reset and restarted. If either of the conditions below is met, integration is stopped, and the integration time and integrated value are held.

- The scheduled stop time is reached.
- The Stop button is tapped, or the STOP key is pressed.
- The integrated value reaches its maximum or minimum displayable value.



Integration Timer (Integration Timer)

You can set the hour, minute, and second within the following range.
00000: 00: 00 to 10000: 00: 00

When Independent Integration Is Disabled

The integration timer that you specified above applies to every element.

When Independent Integration Is Enabled

• Setting (Setting)

You can select the method for setting the integration timer from the following options.

- Each (Each): Set it separately for each input element.
- All (All): Set it for all installed input elements at the same time.

• Element1 to Element7

You can set the integration timers for each element within the range given above.

Scheduled Times for Real-Time Integration (Start Time/End Time)

This setting is valid in real-time normal integration mode and real-time continuous integration mode.

You can set the year, month, day, hour, minute, and second of the integration start and stop times. Be sure to set the integration stop time to a time after the integration start time. You can set the values within the following ranges.

- Year: Any four-digit Gregorian calendar value
- Hour:Minute:Second: 00:00:00 to 23:59:59
- Copy Current Time (Copy Current Time): The scheduled integration start time is set to the current time.
- Copy Start Time (Copy Start Time): The scheduled integration start time is copied to the scheduled integration stop time.

When Independent Integration Is Disabled

The scheduled times that you specified above apply to every element.

When Independent Integration Is Enabled (Scheduled time: Real-time Control)

- **Setting (Setting)**

You can select the method for setting the scheduled times from the following options.

- Each (Each): Set it separately for each input element.
- All (All): Set it for all installed input elements at the same time.

- **Element1 to Element7**

You can set the scheduled times for each element within the range given above.

- **Copy Current Time (Copy Current Time)**

The scheduled integration start time is set to the current time.

- **Copy Start Time (Copy Start Time)**

The scheduled integration start time is copied to the scheduled integration stop time.



- You can set the day for the scheduled start or stop time in February to a value as high as the 31st day. If you do so, an error message will appear when you start integration. Reset the scheduled stop time.
- This instrument recognizes leap years when it executes the integration operation.
- In real-time normal integration mode and real-time continuous integration mode, after you tap Start or press START and this instrument enters into an integration-ready state, the numeric data may not be updated immediately. This is because the numeric data is updated in sync with the clock of this instrument. This ensures that the numeric data is updated at the same time as the scheduled integration start time and that the integration time is accurate.

Enabling or Disabling Independent Integration (Independent Control)

You can select whether to start, stop, and reset integration on all elements simultaneously or separately.

- OFF: All elements are controlled simultaneously.
- ON: Integration works differently depending on the [range \$\Sigma\$ link](#) setting.
 - When Range Σ link is enabled
Elements whose wiring system is 1P2W are controlled separately. For elements whose wiring system is not 1P2W, integration starts, stops, and is reset at the same time for all elements in the same wiring unit.
 - When Range Σ link is disabled
The integration of each element is controlled separately.



When independent integration is enabled, range Σ link is disabled, and integration is controlled separately for elements in the same wiring unit, because the elements' integration periods differ, the Σ functions for those elements (the functions that deal with wiring unit integration, such as the integrated active power and apparent power functions) return errors.

Integration Source Elements (Element Objects)

This setting is valid when independent integration is enabled.

- You can select which elements to start, stop, and reset the integration of by selecting the elements' check boxes.
- All ON (All ON): All elements are controlled.
- All OFF (All OFF): No elements are controlled.



Even if you enable independent integration, when [range \$\Sigma\$ link](#) is disabled, the integration of elements in the same wiring unit is controlled simultaneously regardless of whether the elements' check boxes are selected.

Example

- Elements 1, 2, and 3 are assigned to wiring unit ΣA as a three-phase, four-wire system.
- Under Element Object, the check box of element 1 is selected, but the check boxes of elements 2 and 3 are not.

If you start or stop the integration of element 1 under the above conditions, the integration of elements 2 and 3, whose check boxes are not selected, also starts or stops.

To independently control the integration of input elements that are assigned to the same wiring unit, you must enable independent integration and disable range Σ link.

Integration Auto Calibration On/Off (Auto Cal)

Ordinary zero-level compensation takes place when the measurement range or line filter is changed, but you can also automatically calibrate the zero level during integration.

- ON: Zero-level compensation takes place automatically approximately once every hour during integration.
- OFF: Zero-level compensation does not take place automatically during integration.



When integration auto calibration is on and zero-level compensation is in progress, the power or current value measured immediately before is integrated.

Watt Hour Integration Method for Each Polarity (WP ± Type)

Setting (Setting)

You can select the method for setting the integration method from the following options.

- Each (Each): Set it separately for each input element.
- All (All): Set it for all installed input elements at the same time.

Element1 to Element7

Set the integration method to one of the options below.

- Charge/Discharge (Charge/Discharge): Measure DC watt hours (for each sampled data item) by polarity.
- Sold/Bought (Sold/Bought): Measure AC watt hours (for each sampled data item) by polarity.

For information about the equations used in each method, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.

Current Mode for Current Integration (q Mode)

Setting (Setting)

You can select the method for setting the current mode from the following options.

- Each (Each): Set it separately for each input element.
- All (All): Set it for all installed input elements at the same time.

Element1 to Element7

You can select the current mode from the following options. For information about the equations used in each current mode, see appendix 1 in the Getting Started Guide, IM WT5000-03EN.

- rms: True rms value
- mean: Rectified mean value calibrated to the rms value
- dc: Simple average
- r-mean: Rectified mean value
- ac: AC component

When the current mode is dc, the polarity (+ or -) is displayed.

Integration resume action at power failure recovery (Resume Action)

You can set how to resume the integration operation when the instrument is turned off due to a power failure or interruption and then turns back on.

Restart (Start)

The integration result at the time the power is turned off is stored. When the power recovers, integration starts (continues) automatically.

Stop (Stop)

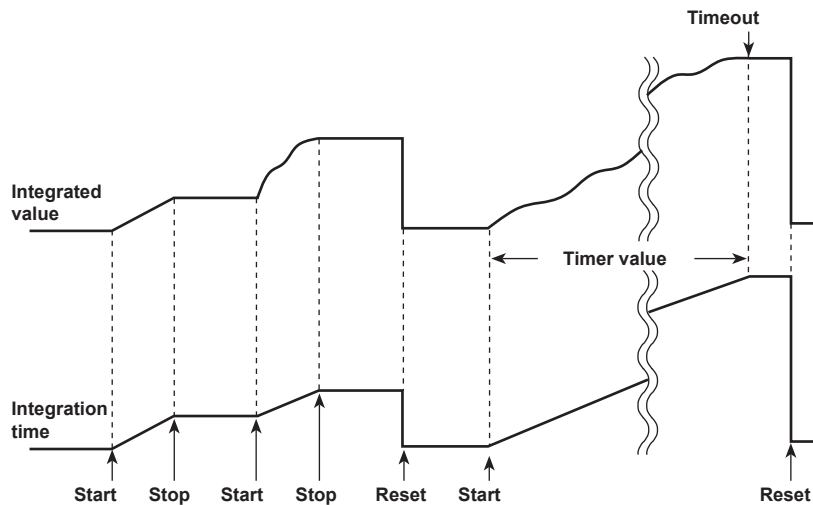
The integration result at the time the power is turned off is stored. When the power recovers, the integration result up to the point when the power was turned off is displayed in the integration stopped state. You can start (continue) integration.

Error (Error)

The integration result at the time the power is turned off is stored. When the power recovers, the integration result up to the point when the power was turned off is displayed in the integration error state. You can start integration by resetting it. When integration is reset, the measurement result is displayed as "-----" (no data). If necessary, record the integration result up to that point before resetting it.

Starting, Stopping, and Resetting Integration

You can start, stop, and reset integration using the touch panel buttons, front panel keys, or communication commands. The relationships between integration and starting, stopping, and resetting are indicated below.



Starting Integration (Start, START)

- Integration starts under the different conditions indicated below depending on the integration mode.
 - Manual integration mode, standard integration mode, and continuous integration mode
Integration starts immediately.
 - Real-time normal integration mode and real-time continuous integration mode
This instrument enters into an integration-ready state. Integration starts when the scheduled start time is reached.
- When integration starts, the START key illuminates, and the integration status shows .
- When this instrument enters an integration-ready state, the START key blinks, and the integration status shows .

Stopping Integration (Stop, STOP)

- You can force integration to stop. The integration time and integrated value are held.
- When you force integration to stop, the STOP key blinks, and the integration status shows . Tapping Start or pressing START resumes the integration. However, after the automatic stopping of integration, which is discussed later, you cannot tap Start or press START to resume integration.

Automatic Stopping of Integration

- Integration stops automatically under the different conditions indicated below depending on the integration mode. The integration time and integrated value are held. After integration stops automatically, you cannot resume it by tapping Start or pressing START. To start integration, reset it first.
 - When the integration mode is manual integration mode, standard integration mode, or real-time normal integration mode
After the specified timer time elapses, integration stops automatically. The STOP key illuminates, and the integration status shows .
 - When the integration mode is real-time normal integration mode or real-time continuous integration mode
Integration stops automatically when the scheduled integration end time is reached. The STOP key illuminates, and the integration status shows .

Resetting Integration (Reset, RESET)

The integration time and integrated value are reset. The STOP key turns off. The displays for integration-related functions change to “-----” (no data).



When an integration error occurs, the ERROR indicator blinks, and the integration status shows .

Holding Integration and Releasing the Hold

Holding Integration

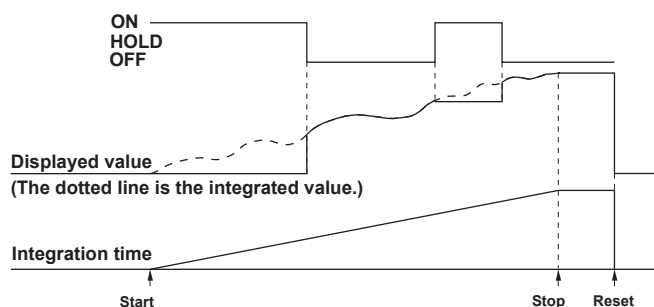
When you tap Hold or press HOLD, it illuminates, and the display and communication output of the integration result are held. Integration continues regardless of whether the display is held.

Releasing the Hold on Integration

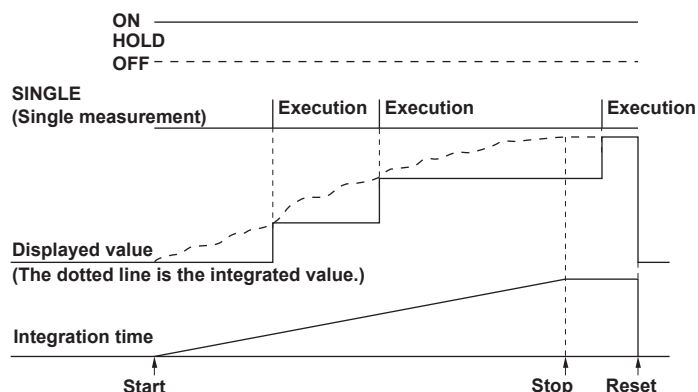
If you tap Hold or press HOLD when integration is held, the HOLD key light turns off, and the numeric data display is updated. While the display is held, you can update the display by tapping Single or pressing SINGLE to execute a single measurement.

The relationship between the hold function and the start and stop operations is as follows:

- If you start integration while the display is held, the display and communication output do not change. When you release the hold function (turn it off) or make a single measurement, the integration result at that point is displayed and transmitted.



- If you stop integration while the display is held, the displayed and transmitted values do not change. When you release the hold function (turn it off) or make a single measurement, the integration result at the point when integration was stopped is displayed and transmitted.

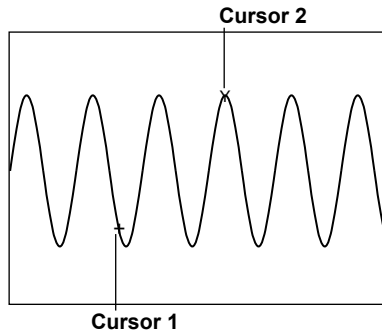


15 Cursor Measurement

Cursor Measurement (Cursors)

You can place cursors on displayed waveforms, trends, and bar graphs and display the values at the cursor locations.

Example of cursors in the waveform display



You can specify the following items.

- [Turning cursor measurement on and off \(Cursors\)](#)
- [Waveform measured by cursor 1 \(+\) \(C1+ Trace\)](#)
- [Position of cursor 1 \(+\) \(C1+ Position\)](#)
- [Position of cursor 1 \(+\) \(C1+ Order\)](#)
- [Waveform measured by cursor 2 \(x\) \(C2x Trace\)](#)
- [Position of cursor 2 \(x\) \(C2x Position\)](#)
- [Position of cursor 2 \(x\) \(C2x Order\)](#)
- [Cursor path \(Cursor Path\)](#)
- [Linking cursor movement \(Linkage\)](#)

Turning Cursor Measurement On and Off (Cursors)

- ON: Cursor measurement is performed.
- OFF: Cursor measurement is not performed.

Waveform Measured by Cursor 1 (+) (C1+ Trace)

This item only appears in the waveform and trend displays. It does not appear in the bar graph display.

In the Waveform Display

You can select the waveform to measure with cursor 1 (+) from the following options. The available options vary depending on the installed elements.

- U1, I1, U2, I2, U3, I3, U4, I4, U5, I5, U6, I6, U7, I7
- Speed1, Speed2, Torque1, Torque2, Aux1 to 4 (models with the motor evaluation 1 option)
- Speed3, Speed4, Torque3, Torque4, Aux5 to 8 (models with the motor evaluation 2 option)

In the Trend Display

You can set the trend to measure with cursor 1 (+) to a trend from T1 to T16.

Position of Cursor 1 (+) (C1+ Position)

Set the position of cursor 1 (+) to a value within one of the following ranges.

- Waveform display: 0 (the left edge of the screen) to 1000 (the right edge of the screen)
- Trend display: 0 (the left edge of the screen) to 2001 (the right edge of the screen)

Position of Cursor 1 (+) (C1+ Order)

For the bar graph display, set the position of cursor 1 (+) to a value in the range of 0 (DC) to 500 (500th).

Waveform Measured by Cursor 2 (x) (C2x Trace)

You can select the waveform to measure with cursor 2 (x). The options are the same as those for cursor 1 (+) (C1+ Trace).

► [Click here.](#)

Position of Cursor 2 (x) (C2x Position)

Set the position of cursor 2 (x). The ranges within which you can set the position are the same as those for cursor 1 (+) (C1+ Position).

► [Click here.](#)

Position of Cursor 2 (x) (C2x Order)

Set the position of cursor 2 (x) for the bar graph display. The ranges within which you can set the position are the same as those for cursor 1 (+) (C1+ Order).

► [Click here.](#)

Cursor Path (Cursor Path)

Because this instrument uses [P-P compression](#) on sampled data, two values (a maximum and a minimum value) are displayed at each time-axis point. You can choose the path that the cursors move through and the data points that are measured by the cursors from one of the options below.

- Max (Max): Cursors move along and measure the maximum values on the time axis.
- Min (Min): Cursors move along and measure the minimum values on the time axis.
- Mid (Mid): Cursors move through the middles of the maximum and minimum values on the time axis, and they measure the values in the middle of the maximum and minimum values.

This item only appears in the waveform display. It does not appear in the trend or bar graph display.

Linking Cursor Movement (Linkage)

Set Linkage to ON to move cursor 1 (+) and cursor 2 (x) without changing the distance between them. Set the positions of the cursors by setting C1+Position.

Measured Items

In the Waveform Display

Y+	The vertical-axis (Y-axis) value of cursor 1 (+)
Yx	The vertical-axis (Y-axis) value of cursor 2 (x)
ΔY	The difference between the vertical-axis (Y-axis) values of cursor 1 (+) and cursor 2 (x)
X+	The horizontal-axis (X-axis) value of cursor 1 (+)
Xx	The horizontal-axis (X-axis) value of cursor 2 (x)
ΔX	The difference between the horizontal-axis (X-axis) values of cursor 1 (+) and cursor 2 (x)
$1/\Delta X$	The reciprocal of the difference between the horizontal-axis (X-axis) values of cursor 1 (+) and cursor 2 (x)

In the Trend Display

Y+	The vertical-axis (Y-axis) value of cursor 1 (+)
Yx	The vertical-axis (Y-axis) value of cursor 2 (x)
ΔY	The difference between the vertical-axis (Y-axis) values of cursor 1 (+) and cursor 2 (x)
X+	The horizontal-axis (X-axis) value of cursor 1 (+) With the left edge of the screen being 0 seconds, the time from the left edge of the screen is indicated.
Xx	The horizontal-axis (X-axis) value of cursor 2 (x) With the left edge of the screen being 0 seconds, the time from the left edge of the screen is indicated.
ΔX	The difference between the horizontal-axis (X-axis) values of cursor 1 (+) and cursor 2 (x)
D+	The date and time at the position of cursor 1 (+) The date and time of measurement are displayed in this format: Year/Month/Day Hour:Minute:Second.
Dx	The date and time at the position of cursor 2 (x) The date and time of measurement are displayed in this format: Year/Month/Day Hour:Minute:Second.



- If immeasurable data exists, "****" is displayed in the measured value display area.
- ΔY can be measured even when the units of the cursors are different. The measured result will not have a unit.

In the Bar Graph Display

Y1+	The vertical-axis (Y-axis) value of cursor 1 (+) of bar graph 1
Y1x	The vertical-axis (Y-axis) value of cursor 2 (x) of bar graph 1
$\Delta Y1$	The difference between the vertical-axis (Y-axis) values of cursor 1 (+) and cursor 2 (x) of bar graph 1
Y2+	The vertical-axis (Y-axis) value of cursor 1 (+) of bar graph 2
Y2x	The vertical-axis (Y-axis) value of cursor 2 (x) of bar graph 2
$\Delta Y2$	The difference between the vertical-axis (Y-axis) values of cursor 1 (+) and cursor 2 (x) of bar graph 2
Y3+	The vertical-axis (Y-axis) value of cursor 1 (+) of bar graph 3
Y3x	The vertical-axis (Y-axis) value of cursor 2 (x) of bar graph 3
$\Delta Y3$	The difference between the vertical-axis (Y-axis) values of cursor 1 (+) and cursor 2 (x) of bar graph 3

Cursor Movement

In the Waveform Display

- Cursors move along the selected waveform.
- The unit of cursor movement is the amount of time contained in one screen $\div$ 1000.



-
- If immeasurable data exists, "****" is displayed in the measured value display area.
 - ΔY can be measured even when the units of the cursors are different. The measured result will not have a unit.
 - The range of the vertical axis that can be measured using cursors is within $\pm 300\%$ when the crest factor is set to CF3 and within $\pm 600\%$ when the crest factor is set to CF6 or CF6A.
-

In the Trend Display

- Cursors move along the selected trend.
- You can set the cursor position relative to the left edge of the screen in points, with the left edge itself being 0 points and the right edge being 2001 points.
- You can move through the displayed data one point at a time.

In the Bar Graph Display

- Two cursors (+ and x) are displayed in each graph (Graph1 to Graph3).
- You can set the cursor positions as orders.
- The bar graph display indicates what harmonic order each cursor is located in. For example:
 - The location of cursor 1 (+) is indicated in this format: "Order+:2."
 - The location of cursor 2 (x) is indicated in this format: "Orderx:55."
- The orders indicating the locations of cursors 1 (+) and 2 (x) are the same for each bar graph, from 1 to 3.



If immeasurable data exists, "****" is displayed in the measured value display area.

16 IEC Harmonic Measurement (Option)

The Function of IEC Harmonic Measurement

This mode in combination with the Harmonic/Flicker Measurement Software sold separately allows you to perform harmonic measurement conforming to IEC 61000-3-2. Use this mode to check that the harmonics of electric home appliances and office automation equipment comply with the IEC standards.

Connecting to the Harmonic/Flicker Measurement Software

For details on connecting this instrument to the Harmonic/Flicker Measurement Software, see the user's manual of the Harmonic/Flicker Measurement Software.

When you use the Harmonic/Flicker Measurement Software, this instrument is set to remote mode, and all key operations and touch panel operations on the instrument become invalid. The settings described in the subsequent sections are set automatically or set from the setup screen of the software.



Do not release the remote mode of this instrument and change the settings while operating this instrument with the Harmonic/Flicker Measurement Software. Doing so may impede harmonic measurements conforming to the IEC standard. If you release the remote mode of this instrument, close the Harmonic/Flicker Measurement Software.

Limitations on the Function and Measurement Function

IEC harmonic measurement mode performs internal computation differently from other measurement modes in order to achieve measurements conforming to the IEC standard. Therefore, some functions such as waveform or bar graph display on the screen, store function, motor evaluation function (option) cannot be used in this measurement mode. In addition, some measurement functions such as peak measurement, integration, and efficiency computation cannot be carried out. For a list of functions with limitations and measurement functions that cannot be measured, see appendices 9 and 10 in the Getting Started Guide IM WT5000-03EN.

Differences from Other Harmonic Measurement in Normal Measurement Mode

- **Harmonic Measurement in Normal Measurement Mode**

Various functions such as integration, waveform display, trend display, and efficiency computation can be used simultaneously with the harmonic measurement. In addition, the rms voltage and current are the total of the rms values of all frequency components in the measurement frequency bandwidth. This rms value and harmonics can be measured simultaneously.

* This harmonic measurement does not conform to IEC 61000-3-2 or IEC 61000-3-12.

- **IEC Harmonic Measurement Mode**

This mode in combination with the Harmonic/Flicker Measurement Software sold separately allows you to perform harmonic measurement conforming to IEC 61000-3-2 or IEC 61000-3-12. Use this mode to check that the harmonics of electric home appliances and office automation equipment comply with the IEC standards.

Description of Other Functions Related to Harmonic Measurement

- [Harmonic measurement functions](#)
- [Measurement period of harmonic measurement functions](#)

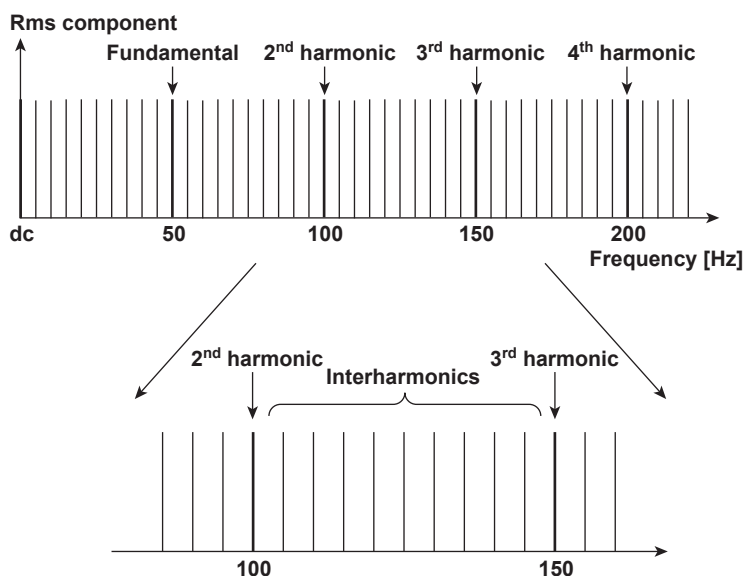
16 IEC Harmonic Measurement (Option)

In IEC harmonic measurement, this instrument performs Fourier transform on the input signal and divides the signal into frequency components as follows:

Interharmonics

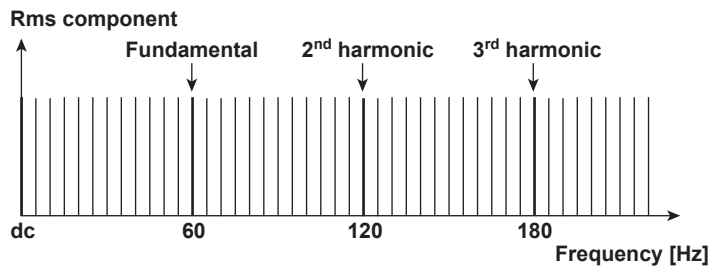
If the input signal is 50 Hz, 10 periods of the waveform are divided in 5-Hz resolution. Thus, the section between each harmonic order is divided into 10 sections. The components between each harmonic order are called interharmonics.

When the fundamental signal is 50 Hz



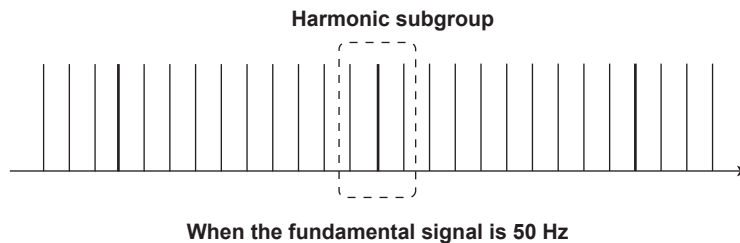
If the input signal is 60 Hz, 12 periods of the waveform are divided in 5-Hz resolution. Thus, the section between each harmonic order is divided into 12 sections.

When the fundamental signal is 60 Hz



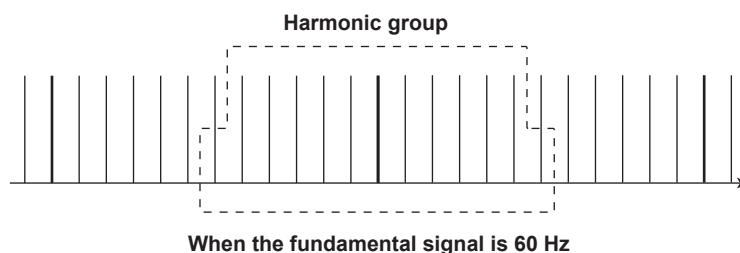
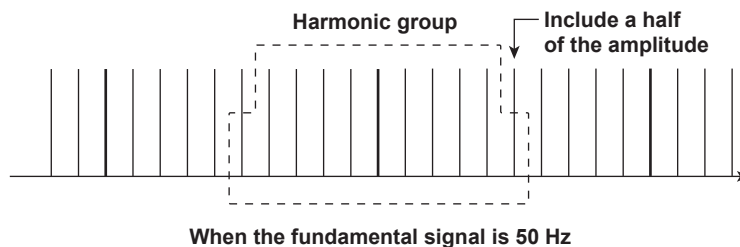
Harmonic Subgroup

A harmonic and its two directly adjacent interharmonics are collectively called harmonic subgroup. The computing method to combine the harmonic and its two adjacent interharmonics is not simple addition, but the square root of the sum of the square of each component.



Harmonic Group

A harmonic and its adjacent interharmonics are collectively called harmonic subgroup. The computing method to combine the components is the average of the sum of the squares as with the harmonic subgroup. A half of the amplitude is included for the interharmonic that is in the middle of two orders.



Grouping of Harmonics in IEC Harmonic Measurement

There are three types of grouping of harmonics in IEC harmonic measurement. The method to calculate the amplitude of the rms value of the harmonics varies depending on the grouping method.

No Grouping (OFF)

Only the components of the integer multiples of the fundamental wave are considered harmonics. Therefore, interharmonic components are not included.

Grouping Type 1

The harmonic subgroup is considered a component of the corresponding order. Therefore, harmonics take on a larger value when harmonic subgroups are included in the input signal as compared to when grouping is turned OFF.

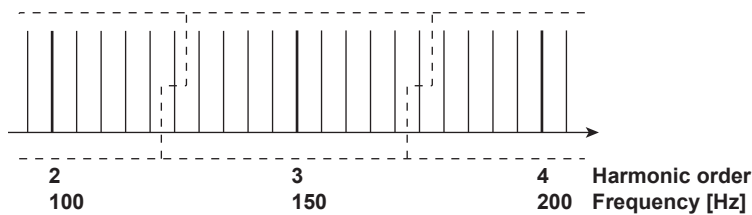
Grouping Type 2

The harmonic group is considered a component of the corresponding order. Therefore, harmonics take on a larger value when harmonic groups are included in the input signal as compared to when grouping is turned OFF.

Example of Grouping Type 2

For example, the 3rd order (150-Hz) harmonic component of the 50-Hz input signal is determined by averaging the sum of the squares of the following frequency components.

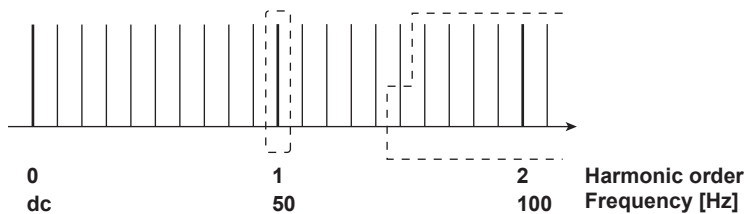
- 1/2 of the 125-Hz component The other 1/2 is included in the 2nd order (100-Hz) component.
- 130-Hz component
- 135-Hz component
- 140-Hz component
- 145-Hz component
- 150-Hz component 3rd order harmonic
- 155-Hz component
- 160-Hz component
- 165-Hz component
- 170-Hz component
- 1/2 of the 175-Hz component The other 1/2 is included in the 4th order (200-Hz) component.



The component of each order between the 2nd and 50th order is determined as shown above. The computation of the 1st order (fundamental) component differs from the method shown above.

1st Order (Fundamental) Component

When measuring and computing the 1st order (fundamental) component, interharmonics are not included regardless of the grouping setting.



In other words, components such as 40 Hz, 45 Hz, 55 Hz, and 60 Hz are not included in the 1st order (fundamental) component. However, the interharmonic components are included in the 1st order (fundamental) component according to the grouping setting when computing the harmonic distortion.

Selecting the IEC Harmonic Measurement Mode

Set the [measurement mode \(Measurement Mode\)](#) to IEC harmonic (IEC Harmonic).

If you use the Harmonic/Flicker Measurement Software, this instrument automatically switches to IEC harmonic measurement mode.

This instrument cannot switch to IEC harmonic measurement mode in the following conditions.

- When the master/slave synchronization measurement is set to slave.
- When the integration is started or stopped.
- While storage operation is in progress.
- While the storage medium is being accessed.

Harmonic Measurement Conditions (Harmonics)

- [Measured Source \(Object\)](#)
- [PLL Source\(PLL Source\)](#)
- [Measured Harmonic Orders \(Min Order/Max Order\)](#)
- [Distortion Factor Equation \(Thd Formula\)](#)
- [IEC 61000-4-7 Edition \(IEC 61000-4-7\)](#)
- [Voltage/Current Grouping \(U Grouping/I Grouping\)](#)

Measured Source (Object)

- You can select the measured source from the following elements/wiring units. The selectable items vary depending on the installed elements.

Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , and ΣC

- If there are no elements that are assigned to the selected wiring unit, there is no numeric data. Thus, [-----] (no data) is displayed in this case. For example, if elements are assigned to ΣA and no elements are assigned to ΣB , then the measurement function for ΣB shows [-----] (no data).

PLL Source (PLL Source)

This is the same feature as the [PLL source](#) of normal measurement. However, in IEC harmonic measurement mode, select the PLL source of the measurement target (Object) rather than the input element group (Hrm1, Hrm2), which is selected in normal measurement.

Measured Harmonic Orders (Min Order/Max Order)

This is the same feature as the [measured harmonic orders](#) of normal measurement. However, in IEC harmonic measurement mode, select the measured harmonic order of the measurement target (Object) rather than the input element group (Hrm1, Hrm2), which is selected in normal measurement.

For the upper limit on measured harmonic orders in IEC harmonic measurement mode, see section 6.7 in the Getting Started Guide, IM WT5000-03EN.

Distortion Factor Equation (Thd Formula)

This is the same feature as the [distortion factor equation](#) of normal measurement.

IEC 61000-4-7 Edition (IEC 61000-4-7)

You can select the IEC 61000-4-7 edition number from the list below.

- Edition 1.0
- Edition 2.0
- Edition 2.0 A1

IEC 61000-4-7 define requirements for measurement instruments. For details, see the following manuals.

- Harmonic Measurement Software for WT5000 (IEC 61000-3-2 Compliant) User's Manual, IM D024-01EN chapter 14
- Harmonic Measurement Software for WT5000 (IEC 61000-3-12 Compliant) User's Manual, IM D024-04EN chapter 14

Voltage/Current Grouping (U Grouping/I Grouping)

The harmonics in IEC harmonic measurement are determined from the component of each order and the interharmonics between the orders. You can select the computing equation of the harmonic from the list below.

- OFF
Only the components of the integer multiples of the fundamental wave are considered harmonic component of each order. Interharmonic components are not included.
- Type1
The harmonic subgroup is considered a harmonic component of the corresponding order.
- Type2
The harmonic group is considered a harmonic component of the corresponding order.

Limitations on Changing Settings and Executing Functions

In IEC harmonic measurement mode, the following items may be different from normal measurement mode.

- Setting options may be different. There may be limitations on setting options.
- Settings may be fixed.
- Functions may not be executable.

For details on the following features, see the references.

Line Filter (Line Filter)

▶ [Click here.](#)

Frequency Filter (Freq Filter)

▶ [Click here.](#)

For details on other features, see appendix 9 in the Getting Started Guide, IM WT5000-03EN.

17 IEC Voltage Fluctuation and Flicker Measurement (Option)

The Function of IEC Voltage Fluctuation and Flicker Measurement

This function allows you to perform voltage fluctuation and flicker measurements conforming to IEC 61000-3-3. If you use the Harmonic/Flicker Measurement Software sold separately, you can print a report of the measurement judgement results.

Connecting to the Harmonic/Flicker Measurement Software

For details on connecting this instrument to the Harmonic/Flicker Measurement Software, see the user's manual of the Harmonic/Flicker Measurement Software.

When you use the Harmonic/Flicker Measurement Software, this instrument is set to remote mode, and all key operations and touch panel operations on the instrument become invalid. The settings described in the subsequent sections are set automatically or set from the setup screen of the software.



Do not release the remote mode of this instrument and change the settings while operating this instrument with the Harmonic/Flicker Measurement Software. Doing so may impede voltage fluctuation and flicker measurements conforming to the IEC standard. If you release the remote mode of this instrument, close the Harmonic/Flicker Measurement Software.

Measurement Items (Measurement Functions)

Measurement Items	Limit ^{*1}
Rated voltage Un	—
Voltage frequency Freq	—
Relative steady-state voltage change dc	3.3% or less
Maximum relative voltage change dmax	4% or less ^{*2}
	6% or less ^{*2}
	7% or less ^{*2}
Period during which relative voltage change exceeds the threshold level Tmax ^{*3}	500 ms or less ^{*4}
Short-term flicker value Pst	1.0 or less
Long-term flicker value Plt	0.65 or less
Instantaneous flicker sensation (Pinst) ^{*5}	—
Cumulative probability function (CPF) ^{*5}	—

*1 The limit is defined only for 230 V/50 Hz.

*2 The limits varied depending on the EUT.

*3 Tmax for IEC 61000-3-3 Edition 3.0, d(t) for IEC 61000-3-3 Edition 2.0.

This chapter describes about the example when setting the edition number of IEC 61000-3-3 as Ed3.0. When setting the edition number of IEC 61000-3-3 as Ed2.0, please paraphrase Tmax in this chapter as d(t).

*4 The limits of threshold level is 3.3%.

*5 Cannot be displayed on this instrument screen. The value can be displayed on the screen of the Harmonic/Flicker Measurement Software.

Measurement Method

The following two voltage fluctuation and flicker measurement methods are available.

- Normal flicker measurement
Calculates all the values of dc, dmax, Tmax, Pst, and Plt, compares them to the preset limits, and indicates the total judgement.
- Measurement of dmax caused by manual switching
Measures the maximum relative voltage change, dmax, when the EUT switch is manually turned ON and OFF, determines the average over 24 measurements, and compares and judges against the limit.

17 IEC Voltage Fluctuation and Flicker Measurement (Option)

Data Update Interval

The display update interval in IEC voltage fluctuation and flicker measurement mode is 2 s.

Limitations on the Function and Measurement Function

In IEC voltage fluctuation and flicker measurement mode, the internal computation is different from other measurement modes in order to achieve measurements conforming to the IEC standard. Therefore, some functions such as waveform or bar graph display on the screen, store function, motor evaluation function (option) cannot be used in this measurement mode. In addition, some measurement functions such as integration and efficiency computation cannot be carried out. For a list of functions with limitations and measurement functions that cannot be measured, see appendices 9 and 10 in the Getting Started Guide, IM WT5000-03EN.

Saving the Voltage Fluctuation and Flicker Measurement Data

The voltage fluctuation and flicker measurement data cannot be saved on this instrument. Use the Harmonic/Flicker Measurement Software and save the data on the PC.

For details on the power supply for testing, test conditions, and terminology, see IEC 61000-3-3.

Terminology

Flicker

Flicker refers to the unstable impression perceived by the human eye that is induced by the fluctuating intensity or spectral distribution of light. It expresses the irritation that the people receive due to the fluctuation of brightness.

Steady-state condition

A condition in which the rms voltage for each half period is stable for 1 s or more.

Relative steady-state voltage change dc

A value obtained by dividing the difference between two steady-state voltages before and after a single voltage fluctuation by the rated voltage expressed as a percentage. For example, for a power supply with a rated voltage of 230 V, the relative steady-state voltage change is as shown below if the steady-state voltage before the fluctuation is 231 V and that after the fluctuation is 229 V.

$$\left| \frac{229 - 231}{230} \right| \times 100 (\%) = 0.87\%$$



- If no voltage fluctuation occurs in the measurement period, dc is zero.
- IEC 61000-4-15 specifies if a steady-state condition does not occur during the measurement period, it is considered to be a fluctuating condition. The measured value of dc is displayed as Undef (undefined, IEC 61000-4-15 Ed1.1) or 0 (IEC 61000-4-15 Ed2.0), and the judgment is displayed as Error (IEC 61000-4-15 Ed1.1) or Pass (IEC 61000-4-15 Ed2.0).

Maximum relative voltage change dmax

- For IEC 61000-4-15 Ed1.1

A value obtained by dividing the difference between the maximum and minimum values in a single voltage fluctuation* by the rated voltage expressed as a percentage.

- For IEC 61000-4-15 Ed2.0

The absolute value of the difference between the maximum value and the value in the previous steady-state condition is compared with the absolute value of the difference between the minimum value and the value in the previous steady-state condition in a single voltage fluctuation.* dmax is the value obtained by dividing the larger of the two values by the rated voltage expressed as a percentage.

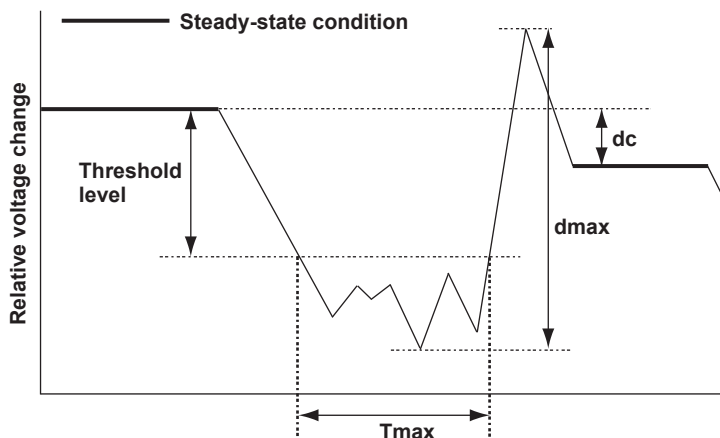
* Condition between two steady-state conditions.

Period during which relative voltage change exceeds the threshold level T_{max}

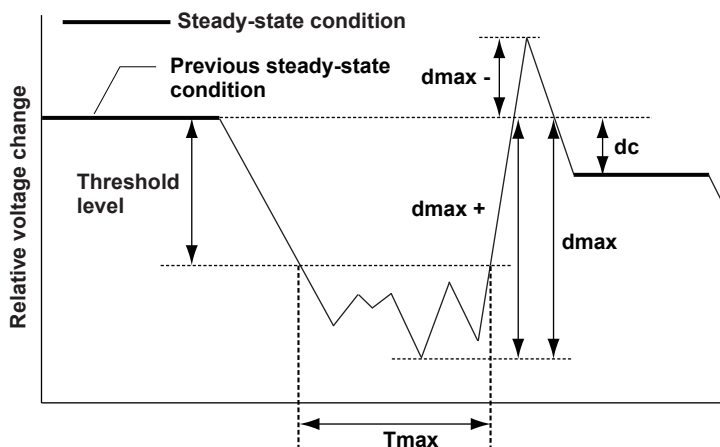
The time during which the relative voltage change during a voltage fluctuation period exceeds the threshold level.

Relationship between d_c , d_{max} , and T_{max}

- For IEC 61000-4-15 Ed1.1



- For IEC 61000-4-15 Ed2.0

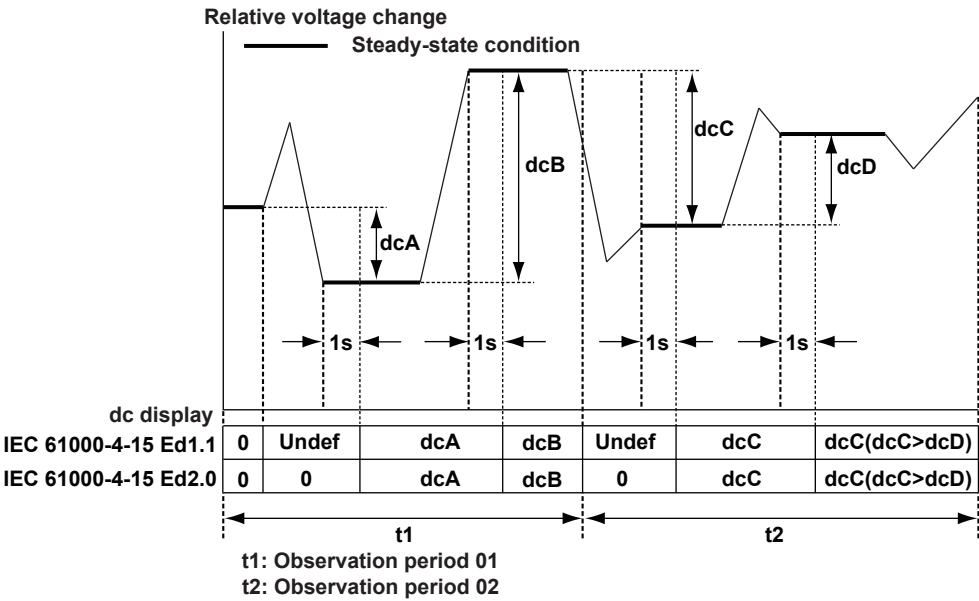


$d_{max} +$: The difference between the minimum value and the value in the previous steady-state condition

$d_{max} -$: The difference between the maximum value and the value in the previous steady-state condition

d_{max} : The larger of the absolute values of $d_{max} +$ and $d_{max} -$

Display Example of dc



Short-Term Flicker Value Pst

The method using the flicker meter is standard in IEC 61000-3-3. For details on the flicker meter, see IEC 61000-4-15. The normal observation period of Pst is 10 minutes.

Long-Term Flicker Value Plt

The long-term flicker value is normally determined from 12 Pst values using the equation below. The normal observation period is 2 hours. If the number of observation periods is less than constant N (12) in the calculating equation, the Plt values that are not observed are computed as 0.0.

$$Plt = \sqrt[3]{\frac{Pst_1^3 + Pst_2^3 + \dots + Pst_{12}^3}{12}}$$

- Pst₁ :Pst of the first 10 minutes
- Pst₂ :Pst of the second 10 minutes
- :
- Pst₁₂:Pst of the 12th 10 minutes

Flicker Measurement Status

The following five flicker measurement statuses are available.

Display	Meaning
 Reset	Condition in which the measured value is reset and initialization can be executed.
 Init.	Initializing
 Ready	Initialized condition in which measurement can be started.
 Start	Measurement in progress. The elapsed time is displayed to the right.
 Cmpl	Complete

Limitations on the Setting Changes and Execution of Operations in IEC Voltage Fluctuation and Flicker Measurement Mode

There are some functions whose settings cannot be changed or functions that cannot be executed in IEC voltage fluctuation and flicker measurement mode as shown below.

Setup Item	Flicker Measurement Status				
	Reset	Init. (Initializing)	Ready	Start	Cmpl (Complete)
Measurement method	Yes	View	View	View	View
Measurement conditions	Yes	View	View	View	View
Initialize	Yes	No	Yes	No	No
Measurement start	No	No	Yes	No	No
Reset	Yes	Yes	Yes	Yes	Yes
Judge*	No	No	Yes	No	No
Re-measure*	No	No	Yes	No	No
Display element	Yes	Yes	Yes	Yes	Yes
Judgement conditions	Yes	View	View	View	Yes

Yes: The settings can be changed, and the function can be executed.

No: The settings cannot be changed, and the function cannot be executed.

View: The settings can be viewed but cannot be changed, and the function cannot be executed.

* Measurement of dmax caused by manual switching only

For other limitations on changing settings and executing operations, see appendix 9 in the Getting Started Guide, IM WT5000-03EN.

Selecting the IEC Voltage Fluctuation and Flicker Measurement Mode

Set the [measurement mode \(Measurement Mode\)](#) to Flicker (Flicker).

If you use the Harmonic/Flicker Measurement Software, this instrument automatically switches to IEC voltage fluctuation and flicker mode.

This instrument cannot switch to IEC voltage fluctuation and flicker measurement mode in the following conditions.

- When the master/slave synchronization measurement is set to slave.
- When the integration function is started or stopped.
- While storage operation is in progress.
- While the storage medium is being accessed.

Measurement Conditions (Measured Settings)

Measurement Mode (Measurement Mode)

Select the voltage fluctuation and flicker measurement method from the two methods below.

- Flicker (normal flicker measurement)
Judges the voltage fluctuation and flicker from dc, dmax, Tmax, and Pst.
- dmax (measurement of dmax caused by manual switching)
You manually turn the EUT switch ON. This instrument measures the voltage fluctuation caused by the inrush current that flows when the power is turned ON, and judges the voltage fluctuation and flicker from the dmax average.

Edition Number of IEC 61000-4-15 (IEC 61000-4-15)

You can select the edition number of IEC 61000-4-15.

- Edition 1.1
- Edition 2.0

IEC 61000-4-15 specifies requirements for measurement instruments.

Edition Number of IEC 61000-3-3 (IEC 61000-3-3)

You can select the edition number of IEC 61000-3-3.

- Edition 2.0
- Edition 3.0

IEC 61000-3-3 specifies the voltage fluctuation and flicker.

Measured Element (Element Objects)

Set the element to perform voltage fluctuation and flicker measurement on. Up to 3 elements can be specified.

Assignment Method of the Rated Voltage (Un Mode)

You can select the assignment method of the rated voltage.

- Auto
Automatically retrieves the measured voltage at the start of the voltage fluctuation and flicker measurement as the rated voltage.
- Set
You can set the rated voltage.

Default rated voltage (Un Set)

This is valid when the assignment method of the rated voltage is Set. You can set the rated voltage in the range of 0.01 to 999.99 V.

Frequency (Frequency)

You can set the measurement target frequency to 50 Hz or 60 Hz.

Set the measurement source frequency appropriately as the transfer function of the flicker meter and other parameters change accordingly.



The limit is defined only for 230 V/50 Hz. It is not defined for others.

If the measurement method is set to Flicker (normal flicker measurement), you must set the voltage, single observation period, measurement count, and steady-state range.

Voltage (Voltage)

When the edition is IEC 61000-4-15 Ed2.0, you can set the measurement target voltage to 230 V or 120 V.

Set the measurement source voltage appropriately as the transfer function of the flicker meter and other parameters change accordingly.

Steady-State Range (dmin)

You can set steady-state range (dmin: allowable range of relative voltage change to be considered steady-state) in the range of 0.10 to 9.99%.

Single Observation Period (Interval)

You can set the single observation period of short-term flicker value Pst in unit of minutes and seconds in the following range.

00:30 to 15:00 (the resolution for seconds is 2 s.)

Measurement Count (Count)

You can set the measurement count of short-term flicker value Pst in the range of 1 to 99.



You can change the measurement conditions only when the flicker measurement status is Reset.

Limitations on Changing Settings and Executing Functions

In IEC voltage fluctuation and flicker measurement mode, the following items may be different from normal measurement mode.

- Setting options may be different. There may be limitations on setting options.
- Settings may be fixed.
- Functions may not be executable.

For details on the following features, see the references.

Line Filter (Line Filter)

► [Click here.](#)

Frequency Filter (Freq Filter)

► [Click here.](#)

For details on other features, see appendix 9 in the Getting Started Guide, IM WT5000-03EN.

Judgement Conditions (Limit Settings)

Relative Steady-State Voltage Change (dc)

Turning ON/OFF the Judgement of Relative Steady-State Voltage Change dc (Judgement)

You can select whether to include relative steady-state voltage change dc in the flicker measurement judgement.

- ON: Include dc.
- OFF: Not include dc.

Limit on Relative Steady-State Voltage Change dc (Limit)

You can set the limit in the range of 1.00 to 99.99%.

Maximum Relative Voltage Change (dmax)

Turning ON/OFF the Judgement of Maximum Relative Voltage Change dmax (Judgement)

You can select whether to include maximum relative voltage change dmax in the flicker measurement judgement.

- ON: Include dmax.
- OFF: Not include dmax.

Limit on Maximum Relative Voltage Change dmax (Limit)

You can set the limit in the range of 1.00 to 99.99%.

Time during Which the Relative Voltage Change Exceeds the Threshold Level (Tmax)

Turning ON/OFF the Judgement of Time Tmax during Which the Relative Voltage Change Exceeds the Threshold Level (Judgement)

You can select whether to include time Tmax during which the relative voltage change exceeds the threshold level in the flicker measurement judgement.

- ON: Include Tmax.
- OFF: Not include Tmax.

Limit on Time Tmax during Which the Relative Voltage Change Exceeds the Threshold Level (Limit Time)

You can set the limit in the range of 1 to 99999 ms.

Threshold Level (Limit Threshold Lv)

You can set the threshold level in the range of 1.00 to 99.99%.

Short-Term Flicker Value (Pst)

Turning ON/OFF the Judgement of Short-Term Flicker Value Pst (Judgement)

You can select whether to include short-term flicker value Pst in the flicker measurement judgement.

- ON: Include Pst.
- OFF: Not include Pst.

Limit on Short-Term Flicker Value Pst (Limit)

You can set the limit in the range of 0.10 to 99.99.

Long-Term Flicker Value (Plt)

Turning ON/OFF the Judgement of Long-Term Flicker Value Plt (Judgement)

You can select whether to include long-term flicker value Plt in the flicker measurement judgement.

- ON: Include Plt.
- OFF: Not include Plt.

Limit on Long-Term Flicker Value Plt (Limit)

You can set the limit in the range of 0.10 to 99.99.

Constant N of the Calculating Equation of Long-Term Flicker Value Plt (N Value)

You can set constant N in the range of 1 to 99.



The long-term flicker value (Plt) is computed using the following equation.

$$Plt = \sqrt[3]{\frac{\sum_{i=1}^{Count} Psti^3}{N}}$$

The variable Count in the equation is the [measurement count](#) of short-term flicker value (Pst).

The variable N in the equation is the constant of the calculating equation of long-term flicker value (Plt).

In general, set Count and N to the same value.

If N is set greater than Count, the short-term flicker value is measured the number of times specified by Count. The short-term flicker values that are not measured are substituted with zeroes in the above equation to calculate the long-term flicker value (Plt). N is set greater than Count such as when the measured source automatically stops within the specified observation time.

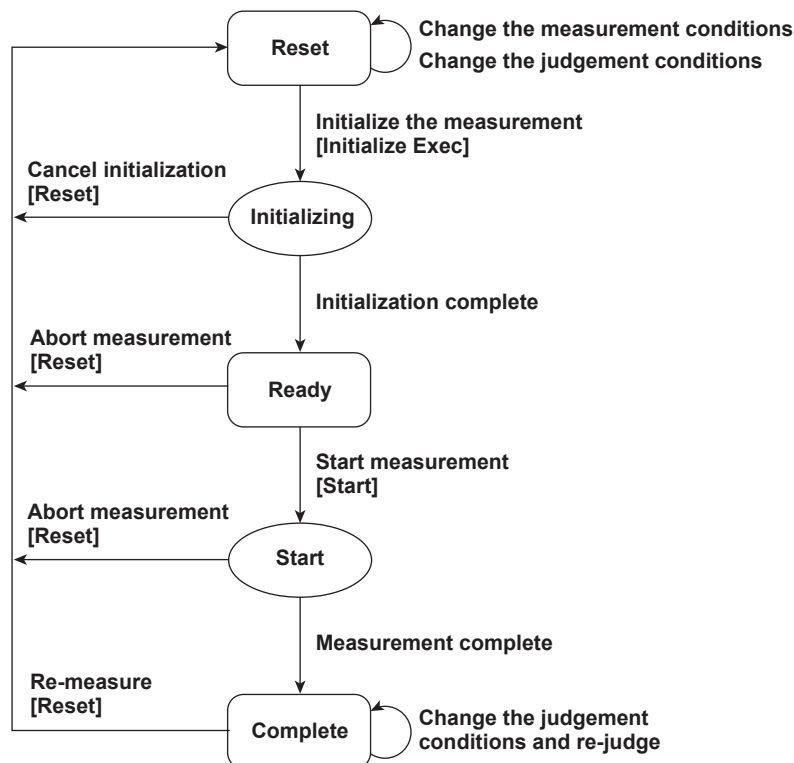


You can change the judgement conditions only when the flicker measurement status is Reset or Complete.

Executing the Normal Voltage Fluctuation and Flicker Measurement

You can initialize, start, and reset normal voltage fluctuation and flicker measurement using the touch panel buttons or communication commands.

The relationships between measurement operation (transition of the flicker measurement status) and initializing, starting, and resetting are indicated below.



Touch panel buttons that you operate are indicated in brackets.

Initializing the Voltage Fluctuation and Flicker Measurement (Initialize Exec)

- The initialization takes approximately 30 s.
- Rms voltage U_n and voltage frequency F_{eq} are updated every 2 s when the flicker measurement status is indicating Init (initializing) in the same manner as when the voltage fluctuation and flicker measurement is reset.
- Keep the voltage of the power supply to be measured in steady-state condition when the flicker measurement status is indicating Init (initializing) or Ready.

Starting the Voltage Fluctuation and Flicker Measurement (Start)

You can start a measurement after the voltage fluctuation and flicker measurement has been initialized and the flicker measurement status is indicating Ready. When the measurement of all observation periods is complete, the voltage fluctuation and flicker measurement automatically stops. The result and judgment are displayed.

Resetting the Voltage Fluctuation and Flicker Measurement (Reset)

To initialize and restart the measurement, execute reset after the voltage fluctuation and flicker measurement is complete and the flicker measurement status is indicating Complete. You cannot initialize or start the measurement in the Complete status.

Reset the voltage fluctuation and flicker measurement to change the following settings.

- Measurement range and other measurement conditions
- Measurement conditions of the voltage fluctuation and flicker measurement

Rated Voltage Un and Voltage Frequency FreqU

- If the assignment method of rated voltage is Auto, rms voltage at the start of measurement is used as rated voltage Un. The measured data is calculated with respect to rated voltage Un.
- If the assignment method of rated voltage is Set, the rated voltage setting is displayed as Un(Set).
- Rated voltage Un and voltage frequency FreqU are fixed to the first measured values after the flicker measurement is started and are not updated.

Switching the Element for Displaying the Measurement Data (Display Element)

You can select elements from the following. The selectable items vary depending on the installed elements. Element1, Element2, Element3, Element4, Element5, Element6, and Element7



If an element that is not being measured is assigned to a display target element, <OFF> is displayed by the element number, and all measured data and judgement are displayed as blank.

Page Scrolling the Screen (Page)

A single page displays a list of measured data and judgements for 12 observation periods. If the measurement count exceeds 12, the data is displayed on multiple pages. In this case, you can page scroll to switch the displayed page.

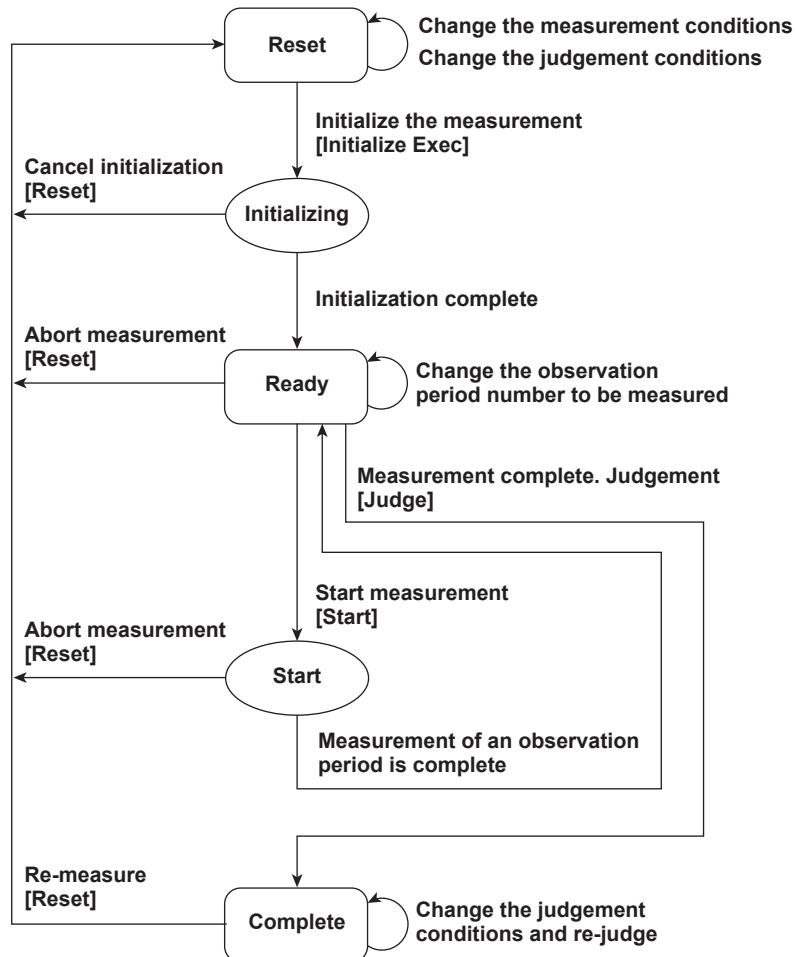
Page scrolling is possible only in the following cases:

- When the flicker measurement status is Reset or Complete
- When measurement hold (Hold) is on

Executing the Measurement of $d_{\max}$ Caused by Manual Switching

You can initialize, start, and reset measurement of $d_{\max}$ caused by manual switching using the touch panel buttons or communication commands.

The relationships between measurement operation (transition of the flicker measurement status) and initializing, starting, and resetting are indicated below.



Touch panel buttons that you operate are indicated in brackets.

Initializing the Measurement of $d_{\max}$ Caused by Manual Switching (Initialize Exec)

- The initialization takes approximately 30 s.
- Rms voltage U_n and voltage frequency F_{req} are updated every 2 s when the flicker measurement status is indicating Init (initializing) in the same manner as when the voltage fluctuation and flicker measurement is reset.
- Keep the voltage of the power supply to be measured in steady-state condition when the flicker measurement status is indicating Init (initializing) or Ready.

Starting the Measurement of $d_{\max}$ Caused by Manual Switching (Start)

You can start a measurement after the measurement of $d_{\max}$ caused by manual switching has been initialized and the flicker measurement status is indicating Ready. When the measurement of one observation period (1 minute) is complete, the flicker measurement status changes to Ready. Measure $d_{\max}$ 24 times.

Re-measuring the Measurement of dmax Caused by Manual Switching (Move Period)

If a measurement of a given observation period is not performed correctly, you can change the observation period to be measured and redo the measurement. If you start the re-measurement, the measurement count and graph display shown in Count decrease by one. In addition, the total elapsed measurement time decreases by one observation period. When re-measurement is complete, the asterisk moves to an observation period number that has not yet been measured.

Completing the Measurement of dmax Caused by Manual Switching and Displaying the Judgement (Judge)

Measurement of dmax caused by manual switching is completed. The flicker measurement status changes to Complete, the dmax data of all observation periods is finalized, and the judgment is displayed.

Resetting the Measurement of dmax Caused by Manual Switching (Reset)

To initialize and restart the measurement, execute reset after the measurement of dmax caused by manual switching is complete and the flicker measurement status is indicating Complete. You cannot initialize or start the measurement in the Complete status.

Reset the measurement of dmax caused by manual switching to change the following settings.

- Measurement range and other measurement conditions
- Measurement conditions of the measurement of dmax caused by manual switching

Rated Voltage Un and Voltage Frequency FreqU

- If the assignment method of rated voltage is auto, the rms voltage at the start of the first measurement is used as rated voltage Un. The measured data is calculated with respect to rated voltage Un.
- If the assignment method of rated voltage is Set, the rated voltage setting is displayed as Un(Set).
- Rated voltage Un and voltage frequency FreqU are fixed to the first measured values after the measurement of dmax caused by manual switching is started and are not updated.

Switching the Element for Displaying the Measurement Data (Display Element)

You can select elements from the following. The selectable items vary depending on the installed elements. Element1, Element2, Element3, Element4, Element5, Element6, and Element7



If an element that is not being measured is assigned to a display target element, <OFF> is displayed by the element number, and all measured data and judgement are displayed as blank.

18 Data Storage

Data Storage (Store, MENU (STORE))

You can store numeric data in binary format to the internal memory or a USB memory device. You can store the data at the data update interval or at a specified time interval (if the waveform display is enabled and the update mode is set to trigger, the data update interval depends on the trigger operation). You can convert stored binary data to ASCII (.csv) format. You can analyze the converted data on a PC. You cannot use this instrument to recall stored data.

Storage-Related Display

When the storage state is any state other than that of being reset, the storage state and store count appear at the top of the screen.



Rec **Rec**

Storage in progress.

Pause **Pause**

Storage paused.

Ready **Ready**

The storage mode is real-time storage mode, integration-synchronized storage mode, or event-synchronized storage mode, and this instrument is ready to begin storing.

Cmpl(Complete) **Cmpl**

- This instrument has completed the specified number of storage operations.
- This instrument is in real-time storage mode and the scheduled storage stop time has passed.

When storage is reset, no storage state is displayed at the top of the screen.

Limitations on Changing the Settings during Storage

While data is being stored, there are some settings that you cannot change and functions that you cannot execute. For details, see appendix 9 in the Getting Started Guide, IM WT5000-03EN.

Storage Conditions

The following storage configuration menus are available.

- [Storage control](#)
- [Stored items](#)
- [File save conditions](#)

Storage Control

Store Mode (Store Mode)

You can choose from one of the following methods for starting and pausing storage.

- **Manual (Manual)**

When you tap Rec or press REC, numeric data is stored at the storage interval for the number of times specified by the storage count.

- **Real-Time Control (Real Time)**

Storage starts after you tap Rec or press REC and the scheduled storage start time is reached. You can store numeric data at the storage interval until the storage stop time (or just the storage count) is reached.

- **Integration Synchronization (Integ Sync)**

- Storage starts after you tap Rec or press REC and integration starts. You can store numeric data at the storage interval until integration stops (or just until the storage count is reached) is reached.
- Storage continues even when integration is reset by the [integration timer](#). When the integration timer is reset, the storage interval timer is also reset.



-
- When independent integration is enabled, storage cannot be performed in integration-synchronized storage mode.
-

- **Event Synchronization (Event)**

Storage starts after you tap Rec or press REC, the measured data is updated, and a user-defined event occurs. You can store numeric data each time the measured data is updated until the storage count is reached.

- **Single Shot (Single Shot)**

Numeric data is stored whenever you tap Rec or press REC. You can store numeric data until the storage count is reached.

Store Count (Store Count)

- The storage count can be set to infinity or to a value from 1 to 9999999.
- When the storage count is set to infinity, it is set to 9999999.
- Storage will stop before the specified storage count if the storage destination runs out of available memory or the stored data size exceeds the maximum value (1 GB).

Viewing and Optimizing the Maximum Storage Count (Optimize Count)

- This instrument computes the maximum storage count for the storage destination according to the number of data types specified in the [Item Settings](#).
- You can set the storage count to a value from 0 to the computed maximum storage count.
- You can select Set to set the maximum storage count to the current storage count. However, you cannot do this if the current storage count is 0.



-
- If you enable automatic CSV conversion (Auto CSV Conversion) and set the storage destination to a USB memory device, the maximum storage count is computed with 20% of the available USB memory designated as valid for stored data (*.WTS and *.HDS files).
 - If the maximum storage count is displayed as 0, there is not enough available space in the storage destination. Make more space available, by deleting files for example.
 - If you change the number of stored items specified in [Item Settings](#) after you set the storage count, the maximum storage count will change, and you will need to set the storage count again.
-

Storage Interval (Interval)

You can set the interval at which numeric data is stored.

- You can set the hour, minute, and second within the following range. If you set the interval to 00:00:00, the numeric data will be stored at the numeric data update interval.
00: 00: 00 to 99: 59: 59
- When the storage mode is set to Integ Sync, storage continues even when integration is reset by the [integration timer](#). When the integration timer is reset, the storage interval timer is also reset.
- This setting is invalid when the storage mode is set to Event or Single Shot.
- If the update mode is set to trigger, the data update interval depends on the trigger operation.

► [Click here.](#)

Scheduled Storage Times for Real-Time Storage Mode (Start Time/End Time)

These settings are only valid when the storage mode is set to real-time control. You can set the year, month, day, hour, minute, and second of the storage start and stop times. Be sure to set the storage stop time to a time after the storage start time. You can set the values within the following ranges.

- Year: Any four-digit Gregorian calendar value
- Hour:Minute:Second: 00:00:00 to 23:59:59
- Copy Current Time: The scheduled storage start time is set to the current time.
- Copy Start Time: The scheduled storage start time is copied into the scheduled storage stop time.



- You can set the day for the scheduled start or stop time in February to a value as high as the 31st day. If you do so, an error message will appear when you start storage. Reset the scheduled stop time.
- This instrument recognizes leap years when it executes the storage operation.

Trigger Event for Event-Synchronized Storage Mode (Trigger Event)

This setting is only valid when the storage mode is set to Event. You can select the user-defined event whose occurrence will cause storage to start. If you select a disabled user-defined event, storage cannot start.

For information about configuring user-defined events, see “User-Defined Events.”

► [Click here.](#)

Storage of the Numeric Data at Store Start (Store At Start)

- Select whether to store the numeric data at store start.
- You can configure this setting when:
 - The storage mode is set to Manual, and the storage interval is not 00:00:00.
 - The storage mode is set to real-time control, and the storage interval is not 00:00:00.
 - The storage mode is set to Integ Sync.

Stored Items

You can set which numeric data items to store.

Stored Items (Stored Items)

This is fixed to selected items (Selected Items).

Selected Items (Selected Items)

You can select the types of numeric data to store. To select which types of numeric data to store, use items (Select Stored Items).

Select Stored Items (Select Stored Items)

If you set the numeric data items to store to Selected Items, you can select which types of numeric data to store.

All ON (All ON)

The data of all measurement functions is stored.

All OFF (All OFF)

None of the data for any of the measurement functions is stored.

Preset 1 (Preset 1)

The data of the following measurement functions is stored for all elements and wiring units.*

Urms, Irms, FreqU, FreqI, P, S, Q, λ , Φ

Preset 2 (Preset 2)

The data of the following measurement functions is stored for all elements and wiring units.*

WP, WP+, WP-, q, q+, q-, ITime, WS, WQ

Element (Element/ Σ)

To select an element or wiring unit that you want to store the data of, select or clear its check box. You can select from the following options.

Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC

* If the wiring system setting (Wiring) is configured so that a wiring unit does not exist, the data for the functions of that wiring unit is not stored. For example, if ΣC does not exist, the data for ΣC is not stored.

Motor Number (Motor)

Select whether to store the data of motor input 1 to 4 by selecting or clearing their check boxes.

Auxiliary Input (Aux)

Select whether to store the data of auxiliary input 1 to 8 by selecting or clearing their check boxes.

Data to Store

Select whether to store the data by selecting or clearing the check boxes.

- Voltage, current, power, frequency (Voltage/Current/Power/Frequency)
- Integrated power, efficiency (Integ/Efficiency)
- User-defined function, user-defined event (User Func/User/Event)
- Harmonics (Harmonics)
- Delta computation (Δ Measure)
- Motor/Auxiliary inputs (Motor/Aux)
- Measurement range (Range)

You can select any of the measurement function types listed under “Items That This Instrument Can Measure.”

► [Click here.](#)



- For measurement functions that have functional restrictions or those that are disabled depending on setup conditions, such as harmonic measurement, motor evaluation, and auxiliary input measurement, data may not be stored even when the Data to Store check box is selected.
- For example, when the data update interval is 10 ms, harmonic measurement is disabled. Therefore, even when the check box is selected, data of measurement functions related to harmonics is not stored.

Selecting the Storage Time (Store Time Stamp)

You can select the timing at which storage time is taken for storage data files in binary format (.WTS) from the following:

- **Store (Store)**

The storage time is set to the time when the storage feature saves data to the memory.

This is the same time format as that used on WT5000s with firmware versions 3.01 and earlier.

The time format used when data is converted to CSV files (ASCII format) is as follows:

Example: Date, Time
 2021/01/01, 23:59:59

- **Measure (Measure)**

The storage time is set to the timestamp (included during measurement) at the head of the data update interval.

Time data less than a second is also saved in the storage data file (binary format).

The following is the time information format used when data, including data less than a second [μ s], is converted to CSV files (ASCII format).

Example: TS Date, TS Time, TS Subsec [μ sec]
 2021/01/01, 23:59:59, 123456

File Save Conditions

- When you store data, two types of binary files are created: *.WTS and *.HDS.
 - Stored measured data is stored in binary format to storage data files (.WTS).
 - Measurement conditions, settings, and storage information are stored in binary format to storage header files (.HDS).
 - File name extensions are added automatically.
 - The maximum storage data file (.wts) size is 1 GB.
 - You cannot load stored data using this instrument.
- ▶ [Click here.](#)

File List (File List)

On the file list, specify the save destination. You can select the destination storage device (drive) from the following options.

- Internal memory (User)
- USB memory device (USB-0/USB-1)

You cannot store to a network drive.

▶ [Click here.](#)



If the destination storage device is set to a USB memory device (drive) and you remove it, destination storage device automatically changes to internal memory.

Auto Naming (Auto Naming)

This is the same as the auto naming feature for saving setup data.

▶ [Click here.](#)

File name (File Name)

This is the same as the file name setting for saving setup data.

▶ [Click here.](#)

Comment (Comment)

This is the same as the comment setting for saving setup data.

▶ [Click here.](#)

Automatic CSV Conversion (Auto CSV Conversion)

You can choose whether to automatically create an ASCII format storage data file (.csv) from the storage data file (.wts) and the header file (.hds) that are saved when storage finishes or is reset.

A CSV file is saved in the same folder as the storage data file.

Manually Converting to CSV Format (Convert WTS to CSV)

You can convert the stored data selected in the file list to ASCII format (.csv). This menu item appears when you press File List to display the file list.

A CSV file is saved in the same folder as the storage data file you are converting.



- Data storage may fail under the following circumstances. When this happens, an asterisk appears in the storage state indication. The storage count includes the missing stored data.
 - When you perform consecutive operations in the setup menu.
 - When this instrument receives consecutive communication commands.
 - When you operate this instrument over FTP.
 - If a new numeric data storage operation begins before the previous operation is finished, some of the numeric data may be lost. When this happens, an asterisk appears in the storage state indication. The storage count includes the missing stored data. You can avoid the loss of numeric data during storage by:
 - Setting a longer data update interval.
 - Reducing the number of stored data types.
 - Using a faster USB memory device.
 - When it takes a long time for data to be written to the USB memory device, storage may be stopped forcefully, and some data may not be saved. When this happens, the storage state indication is "Error."
 - Conversion to ASCII format (.csv) uses a pair of files that consists of a stored numeric data file (.wts) and a header file (.hds) with the same name. Do not change the names of stored numeric data (.wts) and header (.hds) files for different sets of data to the same name. If you do so, this instrument may malfunction and the USB memory may be damaged when you convert the data to ASCII format (.csv).
 - CSV conversion is possible up to 2 GB. The conversion stops immediately before storing the data that would cause 2 GB to be exceeded.
 - If you remove the USB memory during storage and the storage state indication is "Error," the storage data file may be incomplete or corrupted. If this is the case, you will not be able to convert the data to ASCII format (.csv). Be sure to remove the USB memory after storage has been reset or has completed (Cmpl).
 - Please be aware that the number of times that you can write to USB memory is limited.
-

Starting, Pausing, and Ending Storage Recording

Starting Storage Recording (Rec, REC)

- When you tap Rec or press REC, storage starts under one of the conditions described below, depending on the storage mode.
 - Manual (Manual)
Storage starts immediately.
 - Real-Time Control (Real Time)
This instrument enters into a storage-ready state. Storage starts when the scheduled storage start time is reached.
 - Integration Synchronization (Integ Sync)
This instrument enters into a storage-ready state. Storage starts when integration starts.
 - Event Synchronization (Event)
This instrument enters into a storage-ready state. Storage starts when a user-defined event occurs.
 - Single Shot (Single Shot)
Storage starts immediately. Numeric data is stored whenever you tap Rec or press REC.
- When storage starts, the REC key illuminates, and “Rec” appears at the top of the screen.
- When this instrument is in a storage-ready state, the REC key blinks, and “Ready” appears at the top of the screen.
- After storage is reset, a storage data file (.wts) and header file (.hds) are created when storage starts again.
- When the storage is paused (Pause), you can restart storage. When you restart storage, the stored data continues to be written to the file from before storage was paused.
- When the storage has been completed (Cmpl), you cannot restart storage until you end the storage (END). After you end storage and then start it, a new storage data file is created and written to.

Pausing Storage (Pause, PAUSE)

- Tap Pause or press PAUSE to pause the storage operation.
 - When storage is paused, the PAUSE key blinks, and “Pause” appears at the top of the screen.
 - When the storage count is zero and this instrument is in a storage-ready state (Ready) and you tap Pause or press PAUSE, storage ends.* The storage data file (.wts) and storage header file (.hds) are deleted.
- * This state can occur in real-time storage mode when you have tapped Rec or pressed REC but the scheduled storage start time has not yet arrived (the storage operation has not begun).

Storage Completion

- Depending on the storage mode, storage automatically stops and the storage state changes to “Cmpl” under one of the following conditions.
 - Manual (Manual)
Storage continues until the storage count is reached.
 - Real-Time Control (Real Time)
Storage continues until the storage count or the scheduled storage stop time.
 - Integration Synchronization (Integ Sync)
Storage continues until the storage count is reached, and then storage is completed (Cmpl). When integration stops, the following occurs.
 - If integration cannot be restarted without being reset, the storage is paused (Pause).
 - If integration can be restarted without being reset, the storage state changes to “Ready.”
 - Event Synchronization (Event)
Storage continues until the storage count is reached.
 - Single Shot (Single Shot)
Storage continues until the storage count is reached.
- After storage is completed, the following occurs.
 - The PAUSE key illuminates, and “Cmpl” appears at the top of the screen.
 - Writing to the storage data file (.wts) and header file (.hds) finishes, and the files are closed.
 - When automatic CSV conversion (Auto CSV Conversion) is enabled, an ASCII format storage data file (.csv) is created.



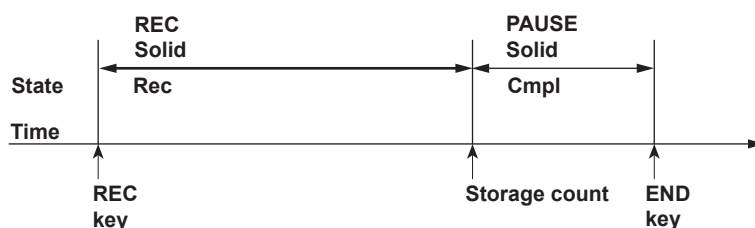
Storage will stop before the specified storage count if the storage destination runs out of available memory or the stored data size exceeds the maximum value (1 GB).

Ending Storage (End, END)

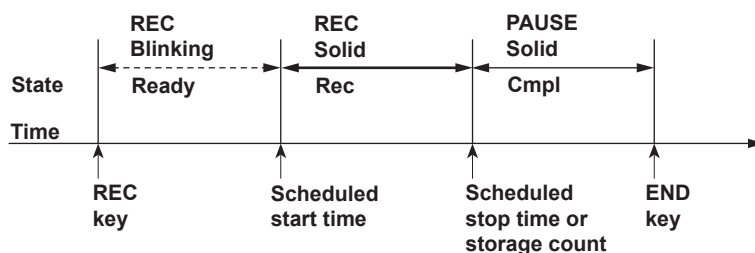
- Tap End or press END to end the storage operation. The storage state indicator disappears.
- If you end storage when storage is paused (Pause), writing to the storage data file (.wts) and header file (.hds) finishes, and the files are closed. When automatic CSV conversion (Auto CSV Conversion) is enabled, an ASCII format storage data file (.csv) is created.
- When storage has been completed (Cmpl), the storage data file (.wts) and header file (.hds) are already closed, so no file operations are performed when you end storage.
- If storage recording is in progress (Rec) and you end storage, the storage is paused and then ended.

Storage Operations in Each Storage Mode

Manual (Manual)

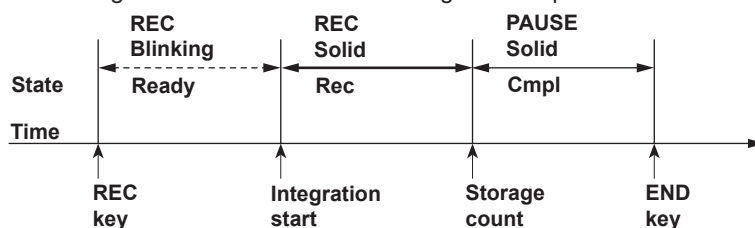


Real-Time Control (Real Time)

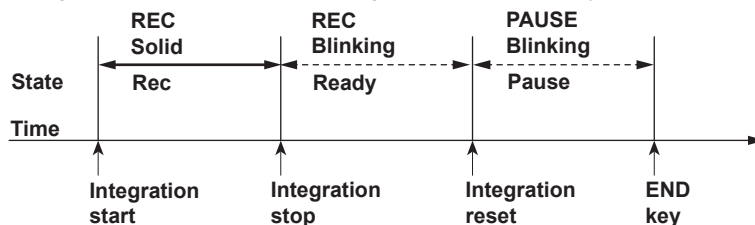


Integration Synchronization (Integ Sync)

When the storage count is reached before integration stops

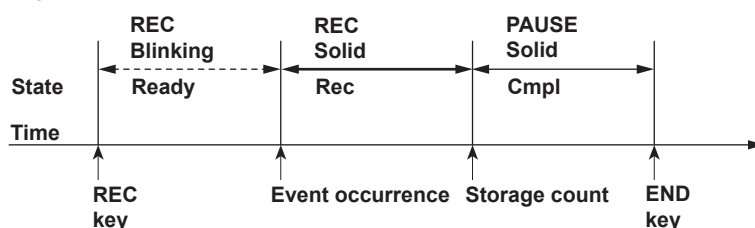


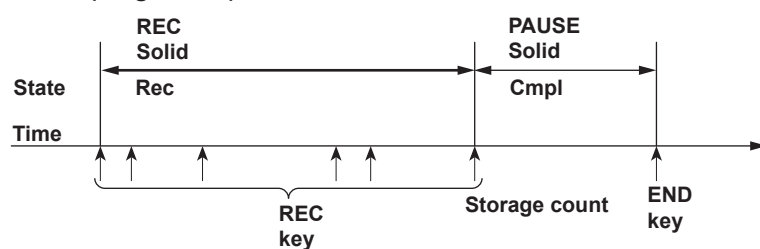
When integration stops before the storage count is reached (illustration of operations after integration starts)



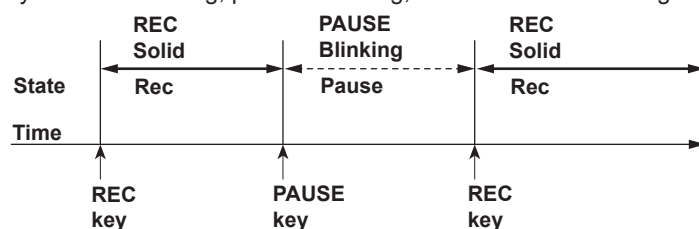
- If you reset integration after it has been stopped, the store state changes to complete (Cmpl). Writing to the stored data file (.wts) and header file (.hds) finishes, and the files are closed.
- If you restart integration after it has been stopped, the store state changes to recording (Rec). The stored data continues to be written to the file from before storage was paused.

Event Synchronization (Event)

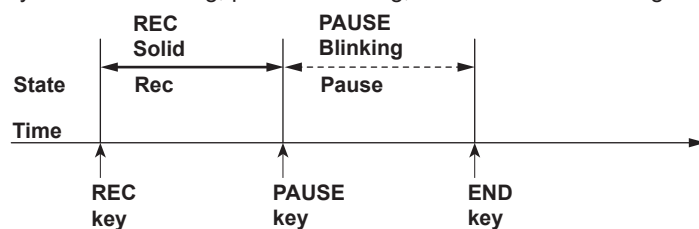


Single Shot (Single Shot)**Storage Operations Performed When Storage in Progress Is Paused****Restarting Storage**

When you start recording, pause recording, and then start recording

**Ending Storage**

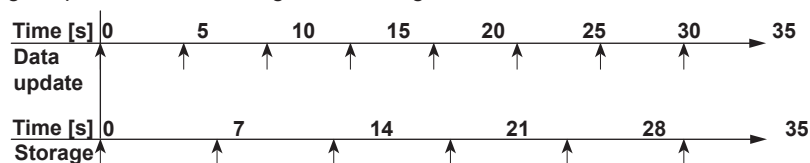
When you start recording, pause recording, and then end recording

**Storage Operation When the Storage Interval Is Not an Integer Multiple of the Data Update Interval**

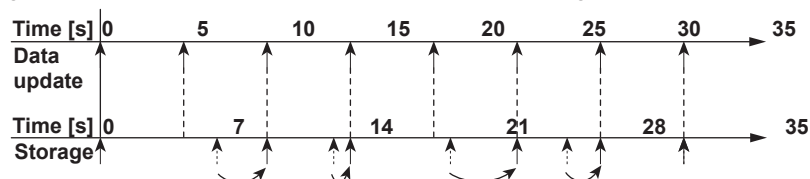
Here we will use the case when the data update interval is 5 s and the storage interval is 7 s as an example. How storage is performed varies as indicated below depending on the storage mode.

When the Storage Mode Is Not Set to Integration Synchronization

Storage is performed according to the storage interval.

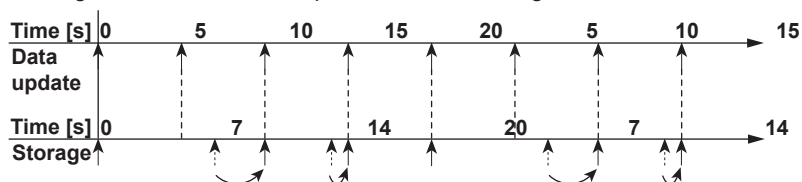
**When the Storage Mode Is Integration Synchronization and the Integration Mode Is Not Continuous or Real-Time Continuous**

Storage is performed at the first data update after the storage interval passes.



When the Storage Mode Is Integration Synchronization and the Integration Mode Is Continuous or Real-Time Continuous

Storage is performed at the first data update after the storage interval passes. Storage continues even when integration is reset by the integration timer. When the integration timer is reset, the storage interval timer is also reset. The figure below is an example for when the integration timer is set to 20 s.



- When the storage of numeric data at store start (Store At Start) is enabled, storage starts when the time is at 0 s (store start).
- Storage is performed when the integration mode is continuous integration mode or real-time continuous integration mode, the integration timer time elapses, and the integrated values are reset. In the above example, the integration timer is set to 20 s, so the data is stored after 20 s have passed, and then the integrated values are reset.

Operations when Values Are Held

If you press HOLD when storage recording is in progress, the displayed values are held, and storage is performed as indicated below.

- When the storage mode is set to Manual and the storage interval is 00:00:00, when the storage mode is set to real-time control and the storage interval is 00:00:00, or when storage mode is set to event synchronization
The storage operation stops, but integration does not.
- When the storage mode is set to Single Shot
The held display values are stored. Even during integration, the held display values are stored.
- In all other cases
The held display values are stored. During integration, the values being measured are stored.



-
- Media access indicator only illuminates when this instrument creates files at the start of storage and closes them at the completion or end of storage, but this instrument is actually always accessing the storage device. During the period between when the files are created and when they are closed, do not remove the USB memory or turn off the power. Doing so may damage the storage device or corrupt its data.
 - When a point has no numeric data, NAN, OL, OF, ERROR, or a blank space will be stored instead. The places that contain blank spaces are in measurement functions such as the ones for the 0th (DC) and 1st harmonic orders of ΦU and ΦI , where the screen display is also blank.
 - Functions $\Delta U1$ to $\Delta P\Sigma$ are stored according to the delta computation type that you selected in the delta computation settings.
 - When this instrument automatically changes the range during storage, because measured data is not updated, the storage operation is suspended and no measured data is stored. After this instrument finishes changing the range, storage resumes.
-

19 Saving Numeric Data, Waveform Data, and Screen Images

Saving Data (Data Save, MENU (DATA SAVE))

You can save numeric data, waveform data, and screen images to a USB memory device, the internal memory, or a network drive.

For information about saving setup data, see “Saving Setup Data.”

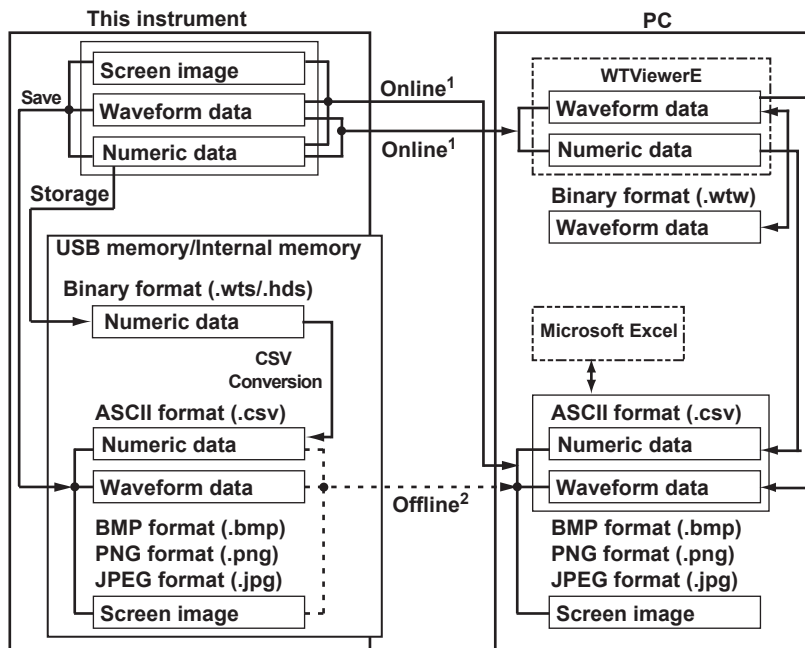
► [Click here.](#)

You can load the setup data from a storage device into this instrument. See “Loading Setup Data.”

► [Click here.](#)

You can also rename, copy, and delete data files.

Loading Numeric Data, Waveform Data, and Screen Images into a PC



1 Data acquisition using USB, Ethernet, or GP-IB

2 Data acquisition using USB memory

Storage Device

This instrument can access the following three types of storage devices for saving and loading data.

Internal Memory (User)

The internal memory of this instrument.

USB Memory Device (USB-0/USB-1)

A USB memory device that is connected to the USB port of this instrument. USB2.0 mass storage devices compatible with USB Mass Storage Class Ver. 1.1 can be connected to the instrument.

Network Drive (Network)

A storage device on the network. You can use a network storage device by connecting the instrument to an Ethernet network.



Notes about Using USB Devices

- Connect the USB memory device to the USB port for peripherals (type A) directly, not through a USB hub.
 - Use portable USB storage devices that are compatible with USB Mass Storage Class version 1.1.
 - You cannot use protected USB storage devices (such as those that contain encrypted content).
 - Only connect compatible USB keyboards, mouse devices, or memory devices to the USB ports for peripherals.
 - Do not connect and disconnect multiple USB devices repetitively. Provide at least a 10-second interval between removal and connection.
 - Do not connect or remove USB devices from the time when this instrument is turned on until key operation becomes available (approximately 20 to 30 seconds).
 - This instrument can handle up to two USB memory devices.
-

Saved Items (Saved Objects)

Select the type of data to save from the following:

- **Numeric Data (Numeric)**

You can save the numeric data that this instrument has measured to a file in ASCII format (.csv).

► [Click here.](#)

- **Waveform Data (Wave)**

You can save the waveform data that this instrument has measured to a file in ASCII format (.csv). All waveforms are saved.



- The waveform data that this instrument saves is not the sampled waveform data that is acquired at this instrument's sample rate.* Waveform data is the 2002 points obtained by applying [P-P compression](#) to the sampled waveform data for the purpose of displaying the waveform.
 - * Sample rate: Approx. 10 MS/s, but approx. 5 MS/s during integration
- On models with the data streaming option, waveform streaming data can be loaded into a PC using communication commands. For details on data streaming communication commands, see the Communication Interface User's Manual, IM WT5000-17EN.

- **Screen Image (Image)**

You can save screen image data to files in BMP, PNG, and JPEG formats.

► [Click here.](#)

Conditions for Saving Numeric Data

You can save the numeric data that this instrument has measured to a file in ASCII format (.csv).

Saved Numeric Items (Saved Numeric Items)

Select the type of items to save from the following:

- Displayed numeric items (Displayed Numeric Items)
- Selected items (Selected Items)

Displayed numeric items (Displayed Numeric Items)

The saved items vary as indicated below depending on the display.

- When numeric values are displayed in the 4-, 8-, or 16-value display or the matrix display
All the measurement functions on the page that is displayed when saving starts are saved in the order that they are displayed.
- When numeric values are displayed in the harmonics list single screen or harmonics list dual screen
In addition to the data described above, the data of harmonics that are not displayed on the screen is saved up to the maximum measurable order (Max Order).
- When numeric values are displayed in the all display
The data cannot be saved. If you attempt to save the data, an error message is displayed.
- In non-numeric displays (e.g., waveform display, trend display)
Numeric data is not saved.

Selected Items (Selected Items)

You can select the types of numeric data to save.

Selecting Numeric Items to Save (Select Saved Numeric Items)

If you selected Selected Items, select which numeric data to save.

All ON (All ON)

The data of all measurement functions is saved.

All OFF (All OFF)

None of the data for any of the measurement functions is saved.

Preset 1 (Preset 1)

The data of the following measurement functions is saved for all elements and wiring units.*

Urms, Irms, FreqU, FreqI, P, S, Q, λ , Φ

Preset 2 (Preset 2)

The data of the following measurement functions is saved for all elements and wiring units.*

WP, WP+, WP-, q, q+, q-, ITime, WS, WQ

Element (Element/ Σ)

To select an element or wiring unit that you want to save the data of, select or clear its check box. You can select from the following options.

Element1, Element2, Element3, Element4, Element5, Element6, Element7, ΣA , ΣB , ΣC

- * If the wiring system setting (Wiring) is configured so that a wiring unit does not exist, the data for the functions of that wiring unit is not saved. For example, if ΣC does not exist, the data for ΣC is not saved.

Motor Number (Motor)

Select whether to save the data of motor input 1 to 4 by selecting or clearing their check boxes.

Auxiliary Input (Aux)

Select whether to save the data of auxiliary input 1 to 8 by selecting or clearing their check boxes.

Data to Save

Select whether to save the data by selecting or clearing the check boxes.

- Voltage, current, power, frequency (Voltage/Current/Power/Frequency)
- Integrated power, efficiency (Integ/Efficiency)
- User-defined function, user-defined event (User Func/User/Event)
- Harmonics (Harmonics)
- Delta computation (Δ Measure)
- Motor/Auxiliary inputs (Motor/Aux)
- Measurement Range (Range)

You can select any of the measurement function types listed under “Items That This Instrument Can Measure.”

► [Click here.](#)



- When you save numeric data and a point has no numeric data, NAN, OL, OF, ERROR, or a blank space will be saved instead. The places that contain blank spaces are in measurement functions such as the ones for the 0th (DC) and 1st harmonic orders of ΦU and ΦI , where the screen display is also blank.
- If sensor correction is in use, deskewed data is saved.

Conditions for Saving Screen Images

You can save screen image data to files in BMP, PNG, and JPEG formats.

Format of Screen Image Data (Image File Format)

You can select the format to save to from the options listed below.

- The extension is .BMP. The file size is approximately 130 KB for black and white mode and approximately 2 MB for color mode.
- PNG: The extension is .PNG. The file size is approximately 30 KB for black and white mode and approximately 100 KB for color mode.
- JPEG: The extension is .JPG. The file size is approximately 200 KB for color mode.



The file sizes listed here are for reference. Actual file sizes will vary depending on the image that is saved.

Screen Image Colors (Image Color)

You can select the color format to save to from the options below.

- Black and white (Black & White): Data is saved in black and white.
- Color (Color): Data is saved in 65536 colors.
- Reverse (Reverse): Data is saved in 65536 colors. The image background will be white.
- Grayscale (Gray): Data is saved in 16 grayscale levels.

File Save Conditions

File List (File List)

On the file list, specify the save destination. You can perform file operations such as creating folders on the storage device, deleting and copying files, and changing file names.

Auto Naming (Auto Naming)

This is the same as the auto naming feature for saving setup data.

▶ [Click here.](#)

File name (File Name)

This is the same as the file name setting for saving setup data.

▶ [Click here.](#)

Comment (Comment)

This is the same as the comment setting for saving setup data.

▶ [Click here.](#)

Saving (Save Exec, EXEC)

Saves the data to the specified save destination with the specified file name.

- It can take anywhere from a few seconds to a few tens of seconds for this instrument to save the data, depending on the number of waveforms being saved, the data update interval, and the speed to transfer data to the destination storage device. It will take longer for this instrument to save the data when there many waveforms are saved or the data update interval is long.
- Measurement stops while this instrument is saving data. After this instrument finishes saving or saving is cancelled, measurement resumes.
- To save data when the data update interval is 20 s, enable the hold feature, perform a single-shot measurement, and then save the data after the data update for the single-shot measurement has completed.



Because the header files saved by this instrument use a format that is common to YOKOGAWA measurement devices, they contain some data that is not used by this instrument.

20 Ethernet Communication

Ethernet Communication (Network)

You can configure TCP/IP parameters and use the optional Ethernet interface to perform the following tasks.

TCP/IP

TCP/IP settings for connecting to an Ethernet network.

Set the IP address, subnet mask, and default gateway.

▶ [Click here.](#)

FTP Server (FTP/Web Server)

You can connect the instrument as an FTP server to a network.

You can connect to this Instrument from a PC on the same network and retrieve setup data, numeric data, waveform display data, and screen image data.

▶ [Click here.](#)

Web Server (FTP/Web Server)

You can connect this Instrument as an Web server to a network.

You can connect to this Instrument from a PC on the same network and monitor the display of this instrument from the PC.

▶ [Click here.](#)

Network Drive (Net Drive)

You can save the setup data of this Instrument, numeric data, waveform display data, and screen image data to a network drive. You can also load the setup data from a network drive into this Instrument.

▶ [Click here.](#)

SNTP

The instrument clock can be set using SNTP. When this Instrument is turned on, the date and time are set automatically.

▶ [Click here.](#)



To connect a PC to this Instrument, use a hub or router, and connect to a network. Do not connect a PC directly to the instrument.

TCP/IP(TCP/IP)

Configure the settings that the instrument needs to connect to a network.

DHCP

DHCP is a protocol that temporarily allocates settings that a PC needs to connect to the Internet.

To connect to a network that has a DHCP server, turn the DHCP setting on. When DHCP is turned on, the IP address can be automatically obtained when the instrument is connected to a network. (You do not have to set it manually.)

When DHCP is turned off, you must set the appropriate IP address, subnet mask, and default gateway for the network.

DNS

DNS is a system used to associate Internet host names and domain names with IP addresses. Given AAA.BBBBBB.com, AAA is the host name and BBBBBB.com is the domain name. You can use host names and domain names to access the network instead of using IP addresses, which are just numbers. The instrument allows you to specify the host by name, instead of by IP address. Set the domain name and the DNS server address (0.0.0.0 by default). For details, consult your network administrator.

DNS Servers (DNS Server1/DNS Server2)

You can specify up to two DNS server addresses: primary and secondary. If querying fails with the primary DNS server, the secondary DNS server is automatically used to find the mapping of the host name and domain name to the IP address.

Other Domain Names: Domain Suffix1/Domain Suffix2

The domain suffix is a piece of information that is automatically added when a query is made to a DNS server using only a portion of the domain name. For example, if BBBBBB.co.jp is registered as another domain name and a query is made using "AAA," the name "AAA.BBBBBB.co.jp" is searched.

You can specify up to two other domain names: Domain Suffix1 and Domain Suffix 2.

You can use up to 127 characters. The characters that you can use are 0 to 9, A–Z, a–z, and dashes.

Applying the Settings (Bind)

TCP/IP settings are applied when you tap Bind in the dialog box or when you turn on the instrument the next time.

FTP Server (FTP/Web Server)

You can connect the instrument as an FTP server to a network.

Set the user name and password that will be used by devices on the network to access the instrument. Also, set the access timeout value.

User Name (User Name)

Set the user name that will be used to access the instrument from a PC. If you set the user name to “anonymous,” you can connect to the instrument without entering a password.

- Number of characters: Up to 32
- Usable characters: All ASCII characters that are displayed on the keyboard

Password (Password)

Set the password that will be used to access the instrument from a PC.

- Number of characters: Up to 32
- Usable characters: All ASCII characters that are displayed on the keyboard

Timeout (Time Out)

If a connection cannot be established between the instrument and the PC within the amount of time specified here, the instrument aborts the connection process.

You can set the timeout time to a value between 30 s and 3600 s.



To apply the settings that you specified, press Entry.

FTP Server Overview

When the instrument is connected to the network as an FTP server, the following features become available.

FTP Server Feature

From a PC, you can view a list of files that are stored in the instrument storage device (the internal memory or a storage device that is connected to it) and retrieve files.

Web Server (FTP/Web Server)

You can connect this instrument as a Web server to a network.

Set the user name and password that will be used by devices on the network to access this instrument. Also, set the access timeout value.

User Name (User Name)

Set the user name that will be used to access the instrument from a PC. If you set the user name to "anonymous," you can connect to the instrument without entering a password.

- Number of characters: Up to 32
- Usable characters: All ASCII characters that are displayed on the keyboard

Password (Password)

Set the password that will be used to access the instrument from a PC.

- Number of characters: Up to 32
- Usable characters: All ASCII characters that are displayed on the keyboard



-
- Time Out is a setting used by the FTP server feature. It is not necessary for the Web server feature.
 - To apply the settings that you specified, press Entry.
-

Web Server Overview

When this instrument is connected to the network as an Web server, you can display the screen of this instrument on the PC and control this instrument through the Ethernet network.

Side navigation

The following items are available.

Home (Home)

Information about the instrument is displayed.

LAN Configuration (LAN Configuration)

You can change the TCP/IP settings of this instrument.

Pressing submit applies the changes.

* Depending on the settings, the connection to the instrument may be disconnected.

Remote View (Remote View)

The statuses of the instrument's LCD and key panel are displayed. Remote control is not possible on this screen. The following operations can be performed on the display screen.

- sec/frame: Set the refresh interval of the display screen. Select off, 200msec, 500msec, 1sec, 3sec, or 5sec.
- Update: Updates the display screen.
- Save: Saves the LCD display screen to an image file in png format (.png) to the PC.
- FullScreen: Opens the LCD display screen on a full-screen image (1280×800) tab.
- Draw: Opens the LCD display screen on an image tab. You can paint and insert text.

Remote Control (Remote Control)

You can display the statuses of the instrument's LCD and key panel and control them remotely on the screen.

The following operations can be performed on the display screen.

- By controlling the LCD and key panel display screen with a mouse, you can perform the same operations as when you operate the instrument directly.
 - * Only single tapping is possible when controlling the LCD with a mouse. Operations such as pinching out and zooming in are not possible.
- sec/frame: Set the refresh interval of the display screen. Select off, 200msec, 500msec, 1sec, 3sec, or 5sec.
- Update: Updates the display screen.
- Save: Saves the LCD display screen to an image file in png format (.png) to the PC.
- FullScreen: Opens the LCD display screen on a full-screen image (1280×800) tab.
- Draw: Opens the LCD display screen on an image tab. You can paint and insert text.

File Downloading (File download)

Files in the instrument's internal memory can be saved to the PC.

Link (Link)

You can access linked pages.

Recommended Browsers

Internet Explorer 11

Google Chrome (latest version)

Environment

Enable JavaScript.

Network Drive (Net Drive)

You can save the setup data of this Instrument, numeric data, waveform display data, and screen image data to a network drive. You can also load the setup data from a network drive into this Instrument.

FTP Server (FTP Server)

Specify the IP address of an FTP server on the network. You can save numeric data, waveform display data, and screen image data to the server and load setup data from it. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Login Name (Login Name)

Specify the login name.

- Number of characters: Up to 32
- Usable characters: All ASCII characters that are displayed on the keyboard

Password (Password)

Specify the password that corresponds to the login name.

- Number of characters: Up to 32
- Usable characters: All ASCII characters that are displayed on the keyboard

FTP passive Mode (FTP Passive)

Turn FTP passive mode on or off.

In passive mode, the FTP client sets the port number for data transfer. Enable passive mode when you have set an external FTP server as a network drive or when you are accessing an FTP server through a firewall.

Timeout (Time Out)

If the instrument cannot transfer files for a certain amount of time, it disconnects from the FTP server.

You can set the timeout time to a value between 1 s and 3600 s.

Connecting to the Network Drive(Connect/Disconnect)

When you press Connect, this instrument connects to the specified network drive. When you press Disconnect, the network drive is disconnected.

SNTP(SNTP)

The instrument clock can be set using Simple Network Time Protocol (SNTP). When this Instrument is turned on, the date and time are set automatically.

SNTP Server (SNTP Server)

Specify the IP address of the SNTP server that the instrument will use. In a network with a DNS server, you can specify the host name and domain name instead of the IP address.

Timeout (Time Out)

If the instrument cannot connect to the SNTP server for a certain amount of time, it aborts the operation. You can set the timeout time to a value between 1 s and 60 s.

Automatic Adjustment at Power-On (Adjust at Power ON)

You can configure the instrument so that its clock is automatically synchronized to the SNTP server clock when the instrument is turned on when it is connected to the network.

Time Difference from Greenwich Mean Time (Time Difference From GMT)

This is the same as the “Setting the Time Difference from Greenwich Mean Time (Time Difference From GMT)” setting in the date and time settings.

► [Click here.](#)



The Time Difference from GMT setting is shared with the same setting found in the SNTP settings in the date and time settings (Date/Time). If you change this setting in the Ethernet communication (Network) settings, the Time Difference from GMT in the date and time settings (Date/Time) also changes.

Executing Time Adjustment (Adjust)

The instrument clock is synchronized to the SNTP server clock.

21 Utility

Utility (Utility, UTILITY)

You can specify the following settings.

Instrument Information (System Overview)

You can view the system and setup data of this Instrument.

▶ [Click here.](#)

System Configuration (System Configuration)

You can set the date and time, time synchronization, the menu and message languages, the LCD intensity, whether the backlight is on or off, environmental settings, and the USB keyboard language.

▶ [Click here.](#)

Remote Control (Remote Control)

You can select the method for connecting a PC to this Instrument to control it.

▶ [Click here.](#)

Network (Network)

You can configure TCP/IP, FTP server, network drive, and SNTP settings.

▶ [Click here.](#)

Self-test (Selftest)

You can test the keyboard and memory operations.

▶ [Click here.](#)

Message Log Display (Message Log)

Messages that occurred in the past are listed.

▶ [Click here.](#)

Current Sensor Status Display (Sensor Status)

The status of the power supply to the current sensor is displayed.

▶ [Click here.](#)

Upgrade (Upgrade)

You can upgrade the instrument's firmware and add options.

▶ [Click here.](#)

Instrument Information (System Overview)

You can display the following information about this Instrument.

Item	Description
Model	The model number
Suffix	The suffix code
No.	The instrument number and MAC address
Version	The firmware version
Element Configuration	The input element type
Options	The options
Link Date	The firmware date
Product ID	A unique number assigned to each instrument (This number is necessary for the purchase of additional options.)

System Configuration (System Configuration)

The following settings can be configured.

- Date and time
- Language
- LCD adjustment
- Environmental settings (Preference)
- USB keyboard language

Date and Time (Date/Time)

The instrument date and time.

Display ON/OFF (Display)

Set whether to show the date and time on this Instrument.

Setting Method (Setting Method)

You can set the method for setting the date and time to one of the following options.

- Manual (Manual): Set the date or time manually.
- SNTP: Use an SNTP server to set the time (valid when Ethernet communication is being used).

Date and Time (Date/Time)

This setting is valid when the method for setting the date and time is set to Manual.

Set the date and time of the region where this instrument will be used.

- Setting the date
The format for setting the date is YYYY/MM/DD (year/month/day). Set the year using the last two digits of the year according to the Gregorian calendar.
- Setting the time
The format for setting the time is HH:MM:SS (hour:minute:second). The hour can be set to a value from 0 to 23.

Time Zone (Time Zone)

Set the time difference between the region where you are using the instrument and Coordinated Universal Time (UTC) to a value within the following range.

–12 hours 00 minutes to 13 hours 00 minutes

For example, Japan standard time (JST) is ahead of UTC by 9 hours. In this case, set Hour to 9 and Minute to 00.

Checking the Standard Time

Using one of the methods below, check the standard time of the region where you are using the instrument.

- Check the Date, Time, Language, and Regional Options on your PC.
- Check the website at the following URL: <http://www.worldtimeserver.com/>



- This instrument does not support Daylight Saving Time. To set the Daylight Savings Time, reset the time difference from Greenwich Mean Time.
 - Date and time settings are backed up using an internal lithium battery. They are retained even if the power is turned off.
 - This instrument has leap-year information.
 - The Time Zone setting is shared with the Time Difference from GMT setting found in the SNTP settings in the Ethernet communication (Network) settings. If you change this setting in the date and time settings, the Time Difference from GMT in the Ethernet communication (Network) settings also changes.
 - The time zone setting is shared with the IEEE 1588 time synchronization feature.
-

IEEE1588 Time Synchronization Feature (IEEE1588)

IEEE1588 is a standard protocol for precise time synchronization in local area networks (LANs).

This instrument operates as a IEEE1588 slave device and can synchronize the time by receiving Precision Time Protocol (PTP) packets from a master device.

For details on the packet format and protocol, see the IEEE1588 specifications.

Turning the IEEE1588 Time Synchronization Feature On and off (IEEE1588)

You can select whether to use time synchronization based on IEEE1588 PTP packets (ON/OFF).

Before enabling the IEEE1588 time synchronization feature, set the delay mechanism, network layer, and domain number described below.

Delay Control Mechanism (Delay Mechanism)

You can set the time difference calculation method to E2E (End-to-End) or P2P (Peer-to-Peer). We recommend the E2E method, which produces relatively small offset from the master device.

Network Layer (Network Layer)

Set the packet type to receive to Layer2 (Ethernet) or Layer3 (UDP/IPv4).

Domain Number (Domain Number)

Set the domain number of the synchronization target device.

Selectable range: 0 to 255

Information (Information)

Displays the IEEE1588 time synchronization information.

- Master Clock Identity
Displays the master clock ID (64-bit identifier).
Display format: 16 characters (hexadecimal)
- Local Clock Identity
Displays the local clock ID (64-bit identifier).
Display format: 16 characters (hexadecimal)
- Port State
Displays the port state (the state defined by IEEE 1588-2008).

Off	The IEEE 1588 time synchronization feature is off.
Unlock	Status in which communication is not established with the master
Lock	Status in which communication is established with the master and the time is being adjusted
Stable	Status in which time synchronization is established with the master
Unstable	Status in which time adjustment (Lock) has been executed at least once after time synchronization has been established with the master
SyncErr	Status in which time synchronization with the master failed
Initializing	States defined in IEEE 1588-2008
Faulty	
Disabled	
Listening	
Uncalibrated	
Slave	

- Local Time
Displays the local time.
- Offset from Master
Displays the offset from the master device.

Time Synchronization State

The time synchronization feature has the following four states.

 (Unlock)	The time is not synchronized.
 (Lock)	Time synchronization signal is being received correctly. When several minutes elapses after transiting to the Lock state, the instrument transits to the Stable state.
 (Stable)	The instrument's internal clock and the time synchronization signal are synchronized within 1 μ s.
 (Unstable)	The time has been synchronized once but is out of sync.



To obtain highly accurate time measurements, start measuring after the time synchronization state become stable. If an out-of-sync condition occurs even once, the state will change to Unstable, but this is not an error. The time is synchronized if the IEEE1588 Information Port State is Unstable (Slave). To clear the unstable state, turn off the time synchronization once and then turn it back on.



- The time indicated by Offset from Master is based on values calculated from the packet timestamps, so it is an approximate value.
- Perform measurement after time synchronization with the master has become stable.
- When stable, the instrument does not synchronize the date or time during a measurement.
- Time synchronization with the master is performed again when you perform any of the following operations in the Stable or Unstable state.
 - Measurement mode (Measurement Mode)
 - Computing method (Measurement Method)
 - Initialize settings (Initialize Settings)
 - Loading setup data (Load Setup)
- To reset the Stable, Unstable, or SyncErr state, turn the IEEE 1588 time synchronization feature off and then back on.
- When the IEEE 1588 time synchronization feature is on, you cannot perform the following operations until the instrument is in the Stable or Unstable state.
 - Start integration
 - Initialize IEC voltage fluctuation and flicker measurement
 - Turn on the waveform streaming feature

Language (Language)

Sets the language that is used in the setup menu and messages.

Menu Language (Menu Language)

You can choose to display menus in any of the following languages.

- English
- Japanese
- Chinese
- German

Message Language (Message Language)

Error messages appear when errors occur. You can choose to display these messages and the help using one of the following languages. The error codes for error messages are the same for all languages. For details on error messages, see the appendix in the User's Manual, IM WT5000-02EN.

- English
- Japanese
- Chinese
- German



Even if you set the menu or message language to a language other than English, some terms will be displayed in English.

LCD (LCD)

You can turn off the LCD and adjust its brightness.

Turning Off the Screen (LCD Turn OFF)

You can turn off the LCD. When the LCD is off, you can turn it back on by pressing a key.

Automatically Turning Off the Screen (Auto OFF)

The LCD turns off automatically when there are no key operations for a given time period. The LCD turns back on when you press a key.

Time until the Screen Is Automatically Turned Off (Auto OFF Time)

You can set the time after which the LCD turns off automatically to a value within the following range.

1min to 60min

Brightness (Brightness)

You can adjust the brightness in the range of 1 (darkest) to 10 (brightest). You can prolong the LCD service life by decreasing the LCD brightness or by turning off the LCD when you do not need to view it.

Grid Intensity (Grid Intensity)

You can set the grid (Grid) intensity to a value from 1 (darkest) to 8 (brightest).

Environment Settings (Preference)

Frequency Display for Low Frequency Input (Freq Display at Low Frequency)

When the frequency of the input signal is lower than the frequency that this Instrument can measure, you can choose to display the frequency as "0" or "Error."

MTR Display for Low Frequency Pulse Input (MTR Display at Low Pulse Freq, option)

When the pulse frequency of the torque or speed input signal and auxiliary input (Aux) is lower than the frequency that this Instrument can measure, you can choose to display the values of motor evaluation measurement functions as "0" or "Error."

Decimal Point Format for CSV Files(Decimal Point for CSV File)

When you save data in ASCII format (.csv), you can choose what type of decimal point to use and how to separate the data.

- Period (Period): The decimal point is a period, and the separator is a comma.
- Comma (Comma): The decimal point is a comma, and the separator is a semicolon.

Rounding to Zero (Rounding to Zero)

- ON

When the voltage or current measurement is one of the following values with respect to the measurement range, Urms, Umn, Urmn, Irms, Imn, Irmn, and other measurement functions based on these measurement functions are displayed and output as zero. λ or Φ is displayed and output as error [Error].

 - When the Crest Factor Is Set to CF3

When Urms, Uac, Irms, or Iac is 0.3% or less. When Umn, Urmn, Imn, or Irmn is 2% or less.
 - When the Crest Factor Is Set to CF6 or CF6A

When Urms, Uac, Irms, or Iac is 0.6% or less. When Umn, Urmn, Imn, or Irmn is 4% or less.
- OFF

The measured values are displayed and output as they are.

USB Keyboard Language (USB Keyboard)

Select the USB keyboard language to use when entering file names, comments, etc. You can use the following keyboards that conform to USB Human Interface Devices (HID) Class Ver. 1.1.

- English: 104 keyboard
- Japanese: 109 Keyboard

For details on how the keys of this instrument are mapped to the keys on a USB keyboard, see appendix 7 in the Getting Started Guide, IM WT5000-03EN.

Remote Control (Remote Control)

Communication interface for controlling this Instrument from a PC. GP-IB, USB, and Network are the available communication interfaces.

For details, see the Communication Interface User's Manual, IM WT5000-17EN.



- Only use one communication interface: GP-IB, USB, or Network. If you send commands simultaneously from more than one communication interface, the instrument will not execute the commands properly.
 - The REMOTE indicator on the front panel illuminates when the instrument is communicating with a PC in remote mode. All keys except UTILITY (LOCAL) are disabled in Remote mode.
-

Network (VXI-11) (Network (VXI-11))

Connects this Instrument to a PC using Ethernet.

IP Address (IP Address)

Displays the TCP/IP setting that you specified in the Ethernet communication settings.

▶ [Click here.](#)

Timeout (Time Out)

If a connection cannot be established between the instrument and the PC within the amount of time specified here, the instrument aborts the connection process.

You can set the timeout time to Infinity or a value between 1 s and 3600 s.



You must set TCP/IP parameters to connect this Instrument to an Ethernet network.

▶ [Click here.](#)

Notes about Connections

- To connect the instrument to a PC, be sure to use straight cables and to connect through a hub or router. Proper operation is not guaranteed for a one-to-one connection using a crossover cable.
- Use one of the following types of network cable that conforms to the transfer speed of your network.
 - A UTP (Unshielded Twisted-Pair) cable
 - An STP (Shielded Twisted-Pair) cable

GP-IB

Connects this Instrument to a PC using GP-IB.

Address (Address)

- You can select a value between 0 and 30.
- Each device that is connected by GP-IB has its own unique address in the GP-IB system. This address is used to distinguish between different devices. Therefore, you must assign a unique address to the instrument when connecting it to a PC or other device.



When the controller is communicating with the instrument or with other devices through GP-IB, do not change the address.

Notes about Connections

- Multiple cables can be used to connect multiple devices. However, no more than 15 devices, including the controller, can be connected on a single bus.
- When connecting multiple devices, you must assign a unique address to each device.
- Use cables that are no longer than 2 m in length to connect devices.
- Make sure the total length of all cables does not exceed 20 m.
- When devices are communicating, have at least two-thirds of the devices on the bus turned on.
- To connect multiple devices, use a star or daisy-chain configuration. Loop and parallel configurations are not allowed.

USB(USB-TMC)

Connects this Instrument to a PC using USB.

To connect the instrument to a PC through the USB port, carry out the following procedure.

Install the YOKOGAWA USB driver on your PC. For information about how to obtain the YOKOGAWA USB driver, contact your nearest YOKOGAWA dealer. You can also access the YOKOGAWA USB driver download webpage and download the driver (<https://tmi.yokogawa.com/library/>).

WT-Compatible Command Type (Command Type)

Many of the functions of this instrument can be controlled using the communication commands of other WT series instruments.

For details, see the Communication Interface User's Manual, IM WT5000-17EN.

Releasing Remote Mode (UTILITY)

Press UTILITY to switch from remote mode (in which the REMOTE indicator is illuminated) to local mode (in which front panel key operations are valid). This key is disabled when the instrument is in local lockout mode.

Key Lock (KEY LOCK)

When you enable the key lock, this Instrument behaves as described below. You can use the key lock to prevent unintentional operations.

- All key operations are disabled except the power switch and KEY LOCK.
- The KEY LOCK key illuminates.



The key lock remains on or off even after the power is turned off.

Touch Lock (TOUCH LOCK)

When you enable the touch lock, this Instrument behaves as described below. You can use the key lock to prevent unintentional operations.

- Touch panel operations are disabled.
- The TOUCH LOCK key illuminates.



The touch lock remains on or off even after the power is turned off.

Self-test (Selftest)

You can test the keyboard and memory operations.

Test Item (Test Item)

You can perform the following tests.

Memory (Memory)

Tests whether the internal memory is operating properly. If it is, "Pass" appears. If an error occurs, "Failed" appears. After the test is completed, "Test Completed" appears.

Key Test (Key Board)

- Tests whether or not the front-panel keys are operating properly. If the name of the key that you press is displayed, the key is operating properly.
- If the indicators on the front panel turn on and off in order when you press the left and right cursor keys, they are operating properly.
- To exit the key test, press ESC twice.

Keyboard (Soft Key)

This test appears when you set Test Item to Key Board. You can test whether the keyboard displayed on the screen is functioning properly. If the characters that you type appear correctly in the keyboard's input box, the keyboard is functioning properly.

Test Execution (Test Exec)

The selected self-test starts.

If an Error Occurs during a Self-Test

If an error occurs even after you perform self-tests numerous times, contact your nearest YOKOGAWA dealer.

Message Log Display (Message Log)

Messages that occurred in the past are listed.

For details on error codes (Code), see the appendix in the User's Manual, IM WT5000-02EN.

Message Log Icon

If there are unread messages, the number of unread messages is displayed in the message log icon in the upper left of the screen.

When you tap the message log icon, a Message Log menu appears, and all read and unread messages are displayed.

Clearing the Message Log (Clear All Messages)

Clears the message log.

Current Sensor Status Display (Sensor Status)

▶ [Click here.](#)

Upgrade (Upgrade)

You can upgrade the instrument's firmware and add options.

Upgrading the Firmware (Firmware)

You can upgrade the firmware.

Access the firmware download page at the YOKOGAWA website (<https://tmi.yokogawa.com/library/>), and download the firmware. For the firmware upgrade procedure, see the manual attached to the downloaded file.

Option Licenses (Option License)

You can add or delete this instrument's options by entering the option license keys. To order option licenses, contact your nearest YOKOGAWA dealer.

History

The history of the latest 100 sets of numeric data can be retrieved into a PC using communication commands.

For details on communication commands related to the history feature, see the Communication Interface User's Manual, IM WT5000-17EN.

Data Streaming (Option)

The waveform streaming data acquired at the specified sample rate can be loaded into a PC using communication commands. For details on data streaming communication commands, see the Communication Interface User's Manual, IM WT5000-17EN.

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nbn Austria GmbH

Riesstraße 146, 8010 Graz

Tel. +43 316 40 28 05 | Fax +43 316 40 25 06

nbn@nbn.at | www.nbn.at

