HIOKI

TS2400

Instruction Manual

WPT TEST SYSTEM

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Performing Measurements

Introduction

Thank you for purchasing the Hioki TS2400 WPT Test System. To obtain maximum performance from the instrument over the long term, please read this manual carefully, and keep it handy for future reference.

For the safety, inspection, precautions, handling, and disposal of the optional instruments and the Z5015 PC System, please refer to the Instruction Manuals provided with the instruments and PC.

Trademark

- Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and other countries.
- SERVOPACK is the trademarks of YASKAWA Electric Corporation in the US and Japan.

Precautions during shipment

Handle it carefully so that it is not damaged due to a vibration or shock.

Target audience

This manual has been written for use by individuals who use the product in question or who teach others to do so. It is assumed that the reader possesses basic electrical knowledge (equivalent to that of someone who graduated from the electrical program at a technical high school).

Term Description

Term	Explanation
WPT	Wireless power transmission
Workpiece	Indicates an evaluation target, such as a WPT coil, electrode, etc.

Product Configuration

The configuration of the TS2400 WPT Test System (the instrument) is as follows.

Product name		Description	Accessories
☐ **SF2400**	**WPT Testing Software**	Measurement/control software The latest version can be downloaded from our website.	• Instruction manual (this manual) • License key (USB) • Sample measurement data
☐ **Z5015**	**PC System**	PC	• AC adapter for PC • Display ×2 • Keyboard • Mouse • Instruction Manual • Recovery media (USB flash drive)
☐ **Z5016**	**WPT Testing Platform**	Workpiece positioning stage	• Grease gun • Grease
☐ **Z5017**	**PLC Rack**	• Stage control instrument • Above instrument and measuring instrument storage rack	–
☐ **Z5018**	**Switch Box**	Change of transmission and reception coils connection method Primary side change Secondary side short circuit/open	–

Options

The options listed below are available for the instrument. To order an option, please contact your authorized Hioki distributor or reseller.
Options are subject to change. Please check Hioki's website for the latest information.

Product name		Description	Measurement/calculation item
☐ **PW6001***	**Power Analyzer**	Measurement and calculation	Current, voltage, active power, frequency, voltage/current/power phase, power factor, and efficiency
☐ **IM3570**	**Impedance Analyzer**	Measurement and calculation	Inductance, capacity, and DC resistance
☐ **IM3536**	**LCR Meter**		
☐ **8423**	**Memory HiLogger**	Measurement and calculation	Voltage and temperature
☐ **FT3470-51, -52***	**Magnetic Field HiTester**	Measurement and calculation	Field intensity
☐ **Z5025**	**WPT Vehicle Assembly Mount**	Secondary-side coil positioning turret	-
☐ **EHP-200A**	**Electric and Magnetic Field Probe - Analyzer**	Measurement and calculation	Electric field intensity, Field intensity
☐ **USB-8502**	**CAN Interface Device**	Measurement and calculation	CAN communication
☐ **FLIR E53**	**Optic - Advanced Thermal Camera**	Measurement and calculation	Temperature

*: Two instruments can be controlled.

Safety Notes

Using the instrument in a way not described in the Instruction Manual may negate the provided safety features. Before using the instrument, be certain to carefully read the following safety notes:

⚠DANGER

Mishandling during use could result in injury or death, as well as damage to the instrument. Be certain that you understand the instructions and precautions in the manual before use.

⚠ WARNING

With regard to the electricity supply, there are risks of electric shock, heat generation, fire, and arc flash due to short circuits. Individuals using an electrical measuring instrument for the first time should be supervised by a technician who has experience in electrical measurement.

Intended users of the manual

Personnel who perform procedures described in this manual should be familiar with the instrument and the way in which the instrument is operated.

Notation

In this document, the risk seriousness and the hazard levels are classified as follows.

⚠DANGER	Indicates an imminently hazardous situation that will result in death or serious injury to the operator.
⚠ WARNING	Indicates a potentially hazardous situation that may result in death or serious injury to the operator.
⚠ CAUTION	Indicates a potentially hazardous situation that may result in minor or moderate injury to the operator or damage to the instrument or malfunction.
IMPORTANT	Indicates information related to the operation of the instrument or maintenance tasks with which the operators must be fully familiar.
	Indicates prohibited actions.
	Indicates the action which must be performed.

Boldface	Indicates the names and keys on the windows in **boldface**. The operation display unit and pendant unit display are indicated with **[ ]**.
*	Additional information is presented below.

Symbols affixed to the instrument

	Indicates cautions and hazards. When the symbol is printed on the instrument, refer to a corresponding topic in the Instruction Manual.
	Indicates a protective conductor terminal.
	Indicates that dangerous voltage may be present at this terminal.

Usage Notes

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions. Ensure that your use of the instrument falls within the specifications not only of the instrument itself, but also of any accessories, options and other equipment being used.

Before using the instrument for the first time

Upon delivery, check that the main unit and all necessary accessories are included in the package. Furthermore, check that the main unit, accessories, panel switches, and terminals are all functioning normally and that none is faulty or damaged.

⚠ WARNING

If any item is faulty or damaged, do not use the instrument in its present state. Contact your authorized Hioki distributor or reseller.

Inspection

Before using the instrument each time, verify that it operates normally to ensure that there is no damage.
If you find any damage, contact your authorized Hioki distributor or reseller.

⚠ WARNING

- **Tape switches are installed around the moving parts of the model Z5016 WPT Testing Platform so that any unsafe contact is detected and the testing platform is stopped. In addition, EMERGENCY STOP buttons are installed on the front side and the pendant unit of the model Z5017 PLC Rack. Prior to using this instrument, check the following. If the operation of the instrument is different from the description below, turn off the main breaker on the front side of the Z5017 PLC Rack and contact your authorized Hioki distributor or reseller.**
  1. The [EMERGENCY STOP] indicator lights up when something comes in contact with the tape switches and the EMERGENCY STOP button is pressed.
  2. When the [READY] button is pressed when the [EMERGENCY STOP] indicator lit, the instrument does not start up.
- **Always turn off the main breaker before lubricating the axis guide and ball screw units.**

Operating environment

⚠ WARNING

Installing the instrument in inappropriate locations may cause a malfunction of instrument or may give rise to an accident. Avoid the following locations:

- **Exposed to direct sunlight or high temperature**
- **Exposed to corrosive or combustible gases**
- **Susceptible to vibration**
- **Exposed to water, oil, chemicals, or solvents**
- **Exposed to high humidity or condensation**
- **Exposed to high quantities of dust particles**

Wire material

⚠ WARNING

To avoid electric shock, use the recommended wire type to connect to the current input terminals, or otherwise ensure that the wire used has sufficient current handling capacity and insulation.

Connection of the power input terminals and external I/O terminals

⚠ WARNING

- **Connect wires to the power input terminals and external I/O terminals securely. If a terminal is loose, the contact resistance will increase, resulting in overheating, equipment burnout, fire, or malfunction.**
- **To avoid electric shock or damage to the instrument, always observe the following precautions when connecting to the power input terminals or external I/O terminals.**
  - **Always turn off the power to the instrument and to any devices to be connected before making connections.**
  - **Be careful to avoid exceeding the ratings of the power input terminals and external I/O terminals.**
  - **During operation, a wire becoming dislocated and contacting another conductive object can be serious hazard. Use screws to secure for the connection to the power input terminals and external I/O terminals.**
  - **Ensure that instruments and systems to be connected to the power input terminals and external I/O terminals are properly isolated.**

Connection of the USB terminal

⚠ CAUTION

- To avoid equipment failure, do not disconnect the USB cable while communications are in progress.

- Use a common ground for both the instrument and the computer. Using different ground circuits will result in a potential difference between the instrument's ground and the computer's ground. If the USB cable is connected while such a potential difference exists, it may result in equipment malfunction or failure.

Earth bar (protective conductor terminal)

⚠ WARNING

Observe the following to avoid electric shock.

- **Connect the protective conductor terminal to earth (earth ground) before making any other connections.**
- **Be sure to connect the protective conductor to earth (earth ground).**

Handling the Z5018 Switch Box

⚠ CAUTION

To avoid damaging the measurement terminal of the LCR meter, be sure to release the locking mechanism, and grip the head of the BNC connector (not the cord) of Model Z5018, and pull it out.

Turning on the power

⚠ WARNING

Before turning the instrument on, make sure the supply voltage matches that indicated on its power connector. Connection to an improper supply voltage may damage the instrument and present an electrical hazard.

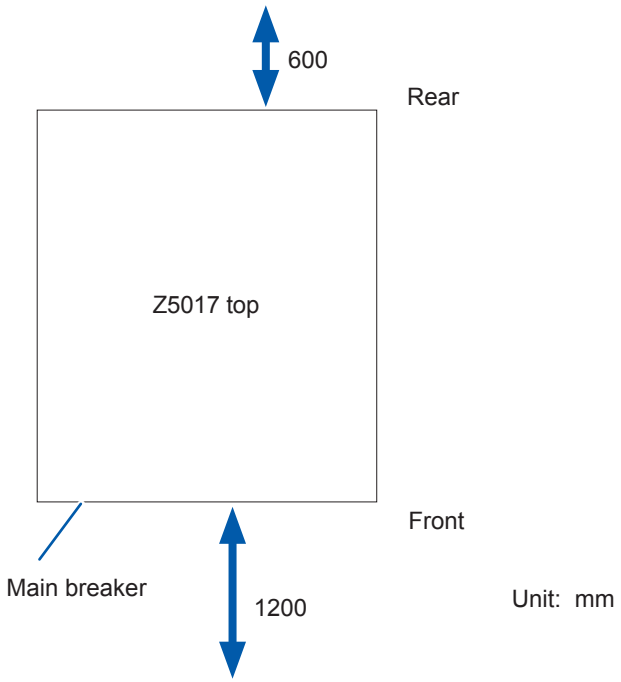
Installing the Instrument

Installing the Z5016 WPT Testing Platform

Surroundings of the Z5017 PLC Rack

⚠ WARNING

There are vent holes on the model Z5017 PLC Rack to release heat. Do not block the vent holes by placing objects around them. Doing so may cause a malfunction of the instrument or fire.



Installing the instrument

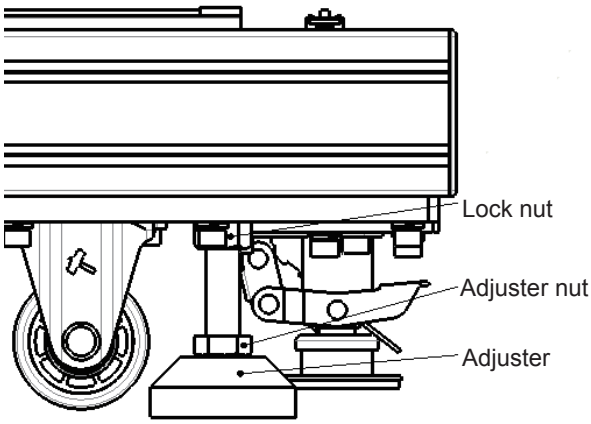
⚠ CAUTION

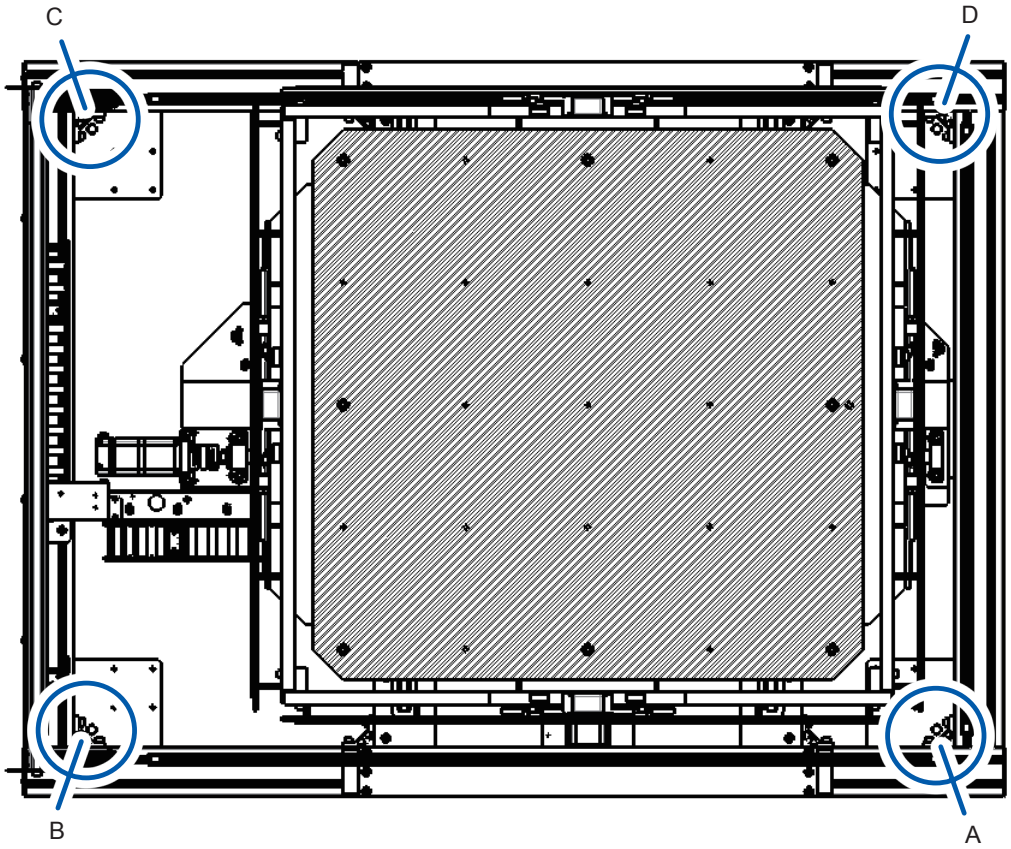
- Secure the adjusters in place to prevent from falling and shifting out of position.
- Improper installation may result in significant vibration, which can cause damage to the instrument and peripheral equipment.
- When a lift or jack is used, be sure to jack up the main unit at the specified fork positions. Otherwise, the exterior panels may be deformed.

When moving the instrument, remove any workpieces from the instrument and position the stage at the following position.
X-axis and Y-axis: Stroke center, Z-axis: Lowest point

Required items:

Wrench (for adjusting the leveling jacks) with width across flat of 24 mm
Level (sensitivity of 0.05 or higher)





1 **Move the instrument to the desired installation location.**

2 **Loosen the lock nuts using a 24 mm wrench.**

3 **Place a level at the center of the work table (shaded area in the figure).**

4 **Turn the adjuster nuts of adjusters A, C, and D and set the adjusters on the floor. Turn the adjuster nuts twice (720°) in the direction in which the adjusters stick out.**
Level along the X-axis with adjusters C and D and along the Y-axis with adjusters A and D.

5 **Adjust so that the level readings are within 5 seconds of level.**

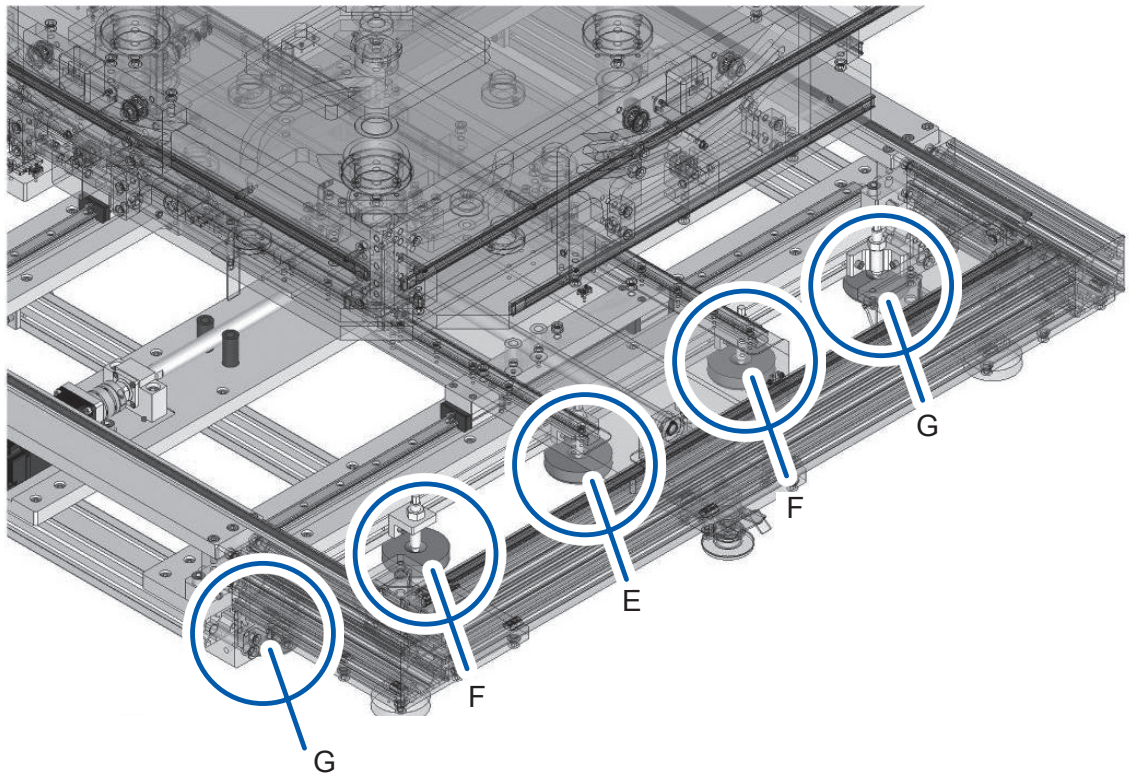
6 **Tighten the lock nuts and lock the adjusters.**

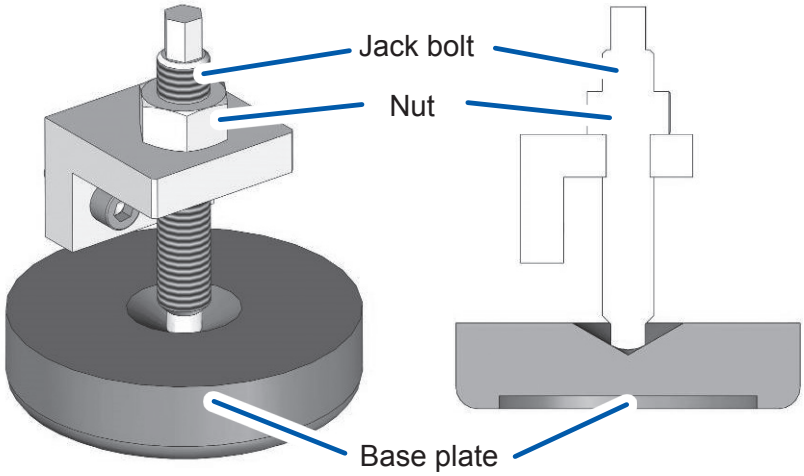
7 **Check that the reading of the level is within 5 seconds.**

8 **With jack bolt E against the base plate, turn it 90° in the direction in which it approaches the base plate and then tighten the nut to secure the jack bolt. (Secure jack bolt E on the opposite side as well.)**

9 **Secure jack bolt F in the same manner (on the opposite side as well).**

10 **Secure jack bolt G in the same manner (on the opposite side as well).**

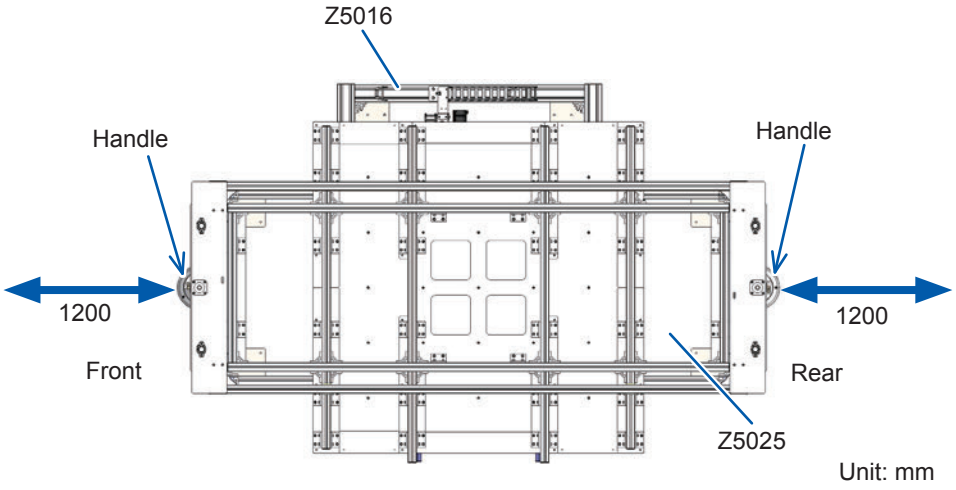




Installing the Z5025 WPT Vehicle Assembly Mount

Surroundings

The handles move the Z5025's vehicle assembly mount plate up and down.
Leave space between the Z5025 and any nearby objects that could impede its movement.



Installing the instrument

⚠ CAUTION

Be sure to secure the instrument so that it cannot move. Do not place it on an unstable or inclined surface. Doing so could allow it to fall off the surface or overturn, causing injury or damage.

Required items:

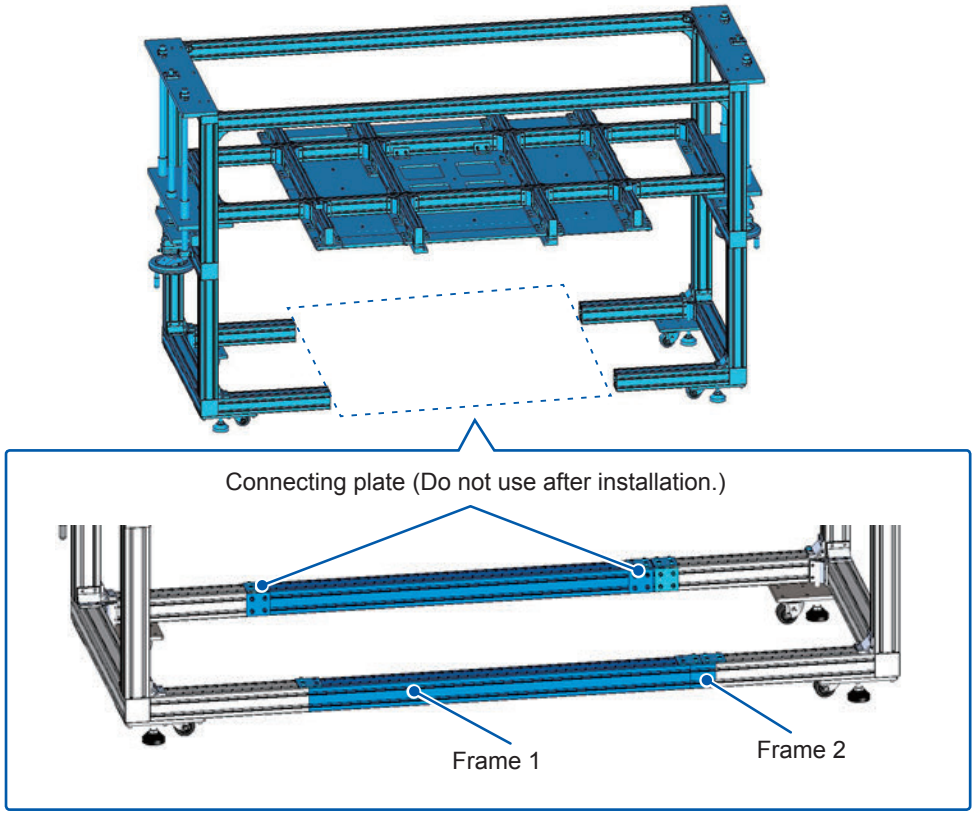
Wrench (for adjusting the leveling jacks) with width across flat of 24 mm
Hexagon wrench (for use with M8 low-head hexagon socket bolts) with width across flat of 5 mm
Hexagon wrench (for use with M8 hexagon socket bolts) with width across flat of 6 mm

- Install the Z5025 WPT Vehicle Assembly Mount after installing the Z5016 WPT Testing Platform.
- Lower the Z5016's Z-axis to the limit position.

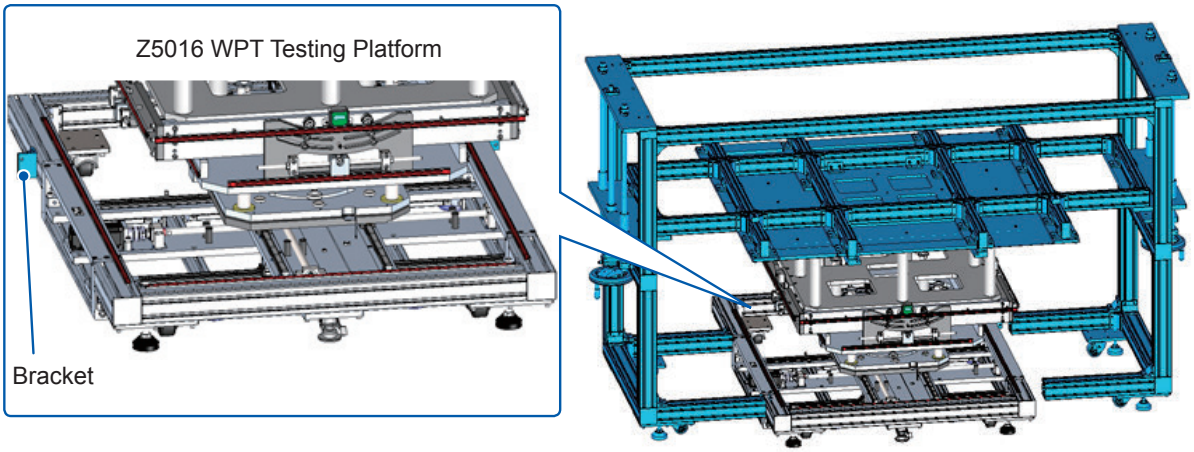
1 **Remove frame 1 (×2), frame 2 (×2), and the connecting plates (×12).**
*** After installation, do not use frame 1 (×2) or the connecting plates (×4).**

2 **Move the Z5025 to the bracket's position.**

Z5025 WPT Vehicle Assembly Mount



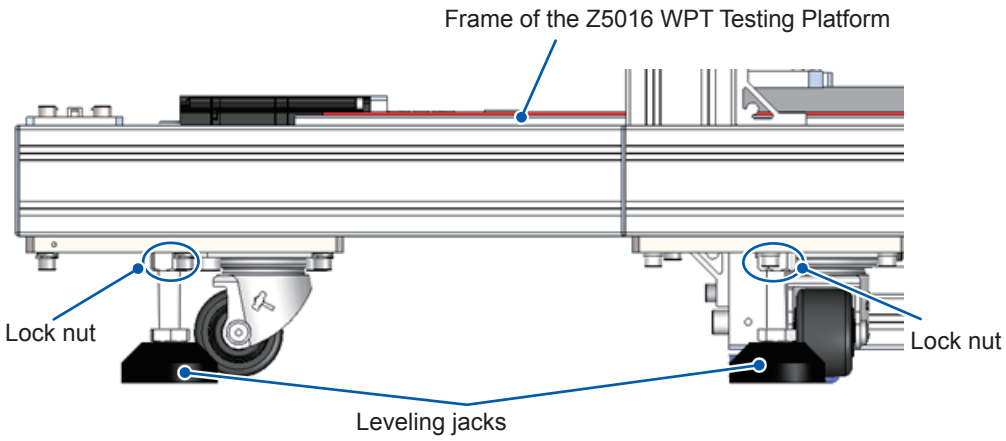
Z5016 WPT Testing Platform

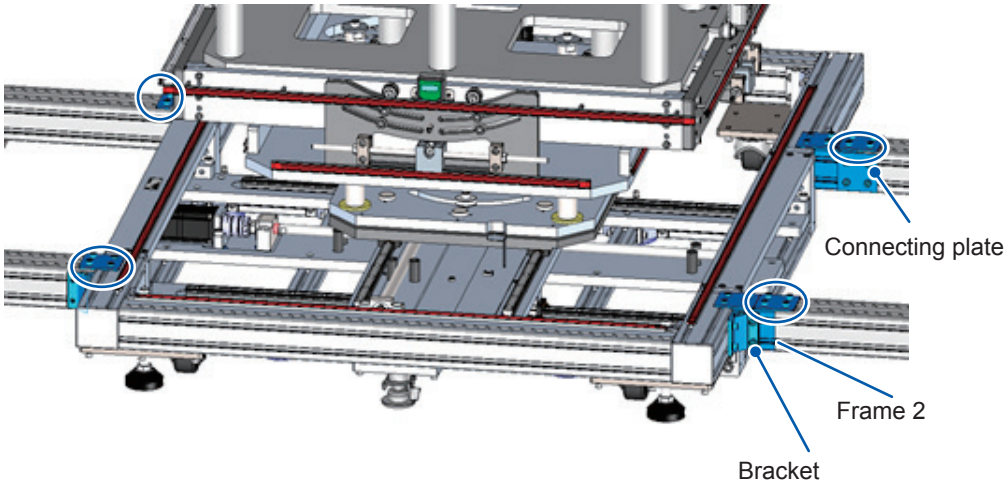


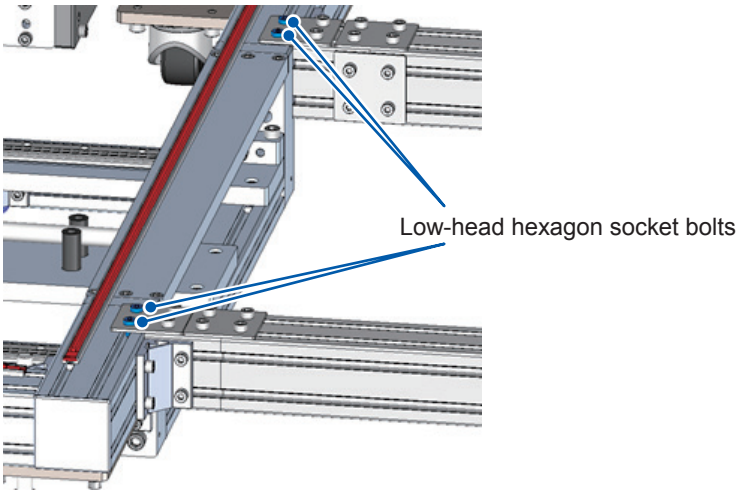
3 **Loosen the four leveling jack lock nuts and rotate the leveling jacks uniformly.**
Adjust to match the height of the Z5016 frame.

4 **Reattach frame 2 (×2) and the connecting plates (×8) at their original positions to connect the Z5025 to the Z5016.**
- Connect the Z5016 and the Z5025 with the brackets (×4).
- Use the low-head hexagon socket bolts (×8) at the locations shown below.

5 **Tighten the lock nuts on the leveling jacks.**







1 Overview

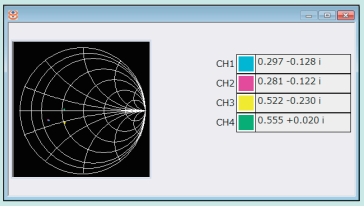
1.1 Product Overview

Model TS2400 WPT Test System is an automatic measurement system for reproducible data required for wireless power transmission (WPT) evaluation.
One software program can control the setting of various measuring instruments, positioning of power transmission and reception workpieces, and data collection.

☐ Multiple points can be measured in a short period of time.

☐ Various graph display and calculation functions

Combining the above features, WPT devices can be analyzed in detail and the evaluation man-hours can be reduced significantly.



1.2 Features

❍ **Automatic positioning of power transmission and reception workpieces**

The workpiece position can be automatically set using the 3-axis (X, Y, and Z) control on the model Z5016 WPT Testing Platform.
It improves the repeatability of evaluation and can reduce man-hours.

❍ **Automatic measurement data collection**

The measurement data of the connected measuring instrument can be automatically collected using the timing or period specified by the model SF2400 WPT Testing Software.
(Other settings required for measurement can also be set in the SF2400.)

❍ **Relative graph display of measurement data**

The collected measurement data and workpiece position correlation can be displayed in a graphical format. The parameters to be displayed can be arbitrarily set.

❍ **User-defined calculation function**

In addition to the standard calculation items, any calculation can be defined as required.
The defined parameters can be handled in the same way as for other parameters in the model SF2400 WPT Testing Software.

❍ **Compatible with various measuring instruments (Hioki) as the standard specification**

The following Hioki measuring instruments that are required for WPT evaluation are supported as the standard specification.

- PW6001 Power Analyzer
- IM3570 Impedance Analyzer
- IM3536 LCR Meter
- FT3470-51, -52 Magnetic Field HiTester
- 8423 Memory HiLogger

2 Parts Names and Functions

2.1 Model SF2400 WPT Testing Software

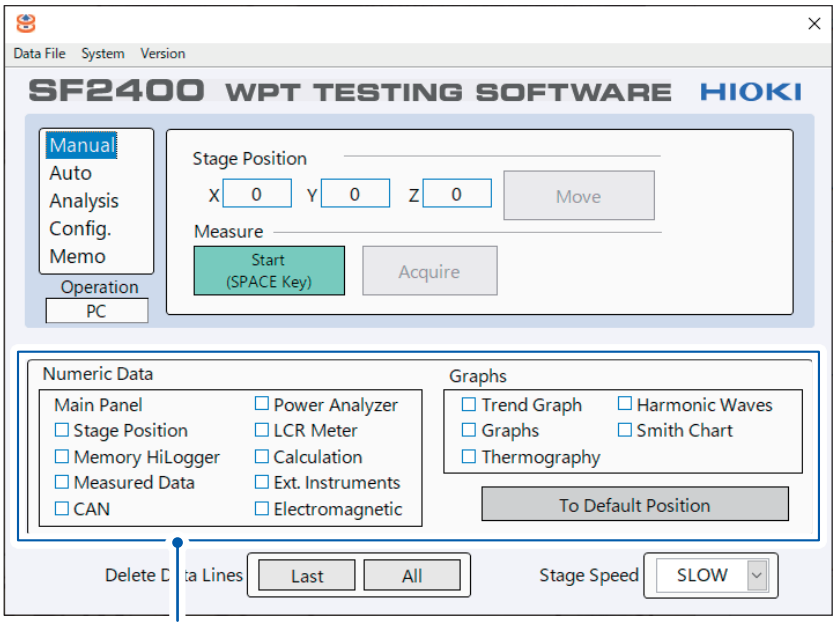
License key

The license key is inserted into the USB port of the PC.
Only when it is inserted, the stage and measuring instrument control is enabled.

Serial number
Serial number is tagged to the license key.
The serial number consists of 9 digits.
The first two (from the left) indicate the year of manufacture, and the next two indicate the month of manufacture.

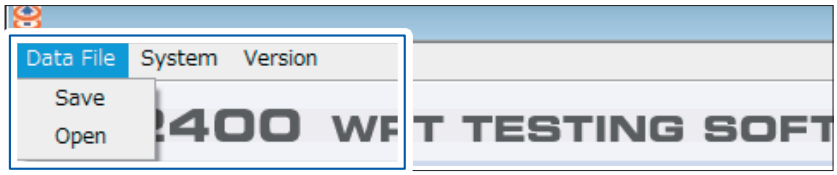
Main window

The window display is set.
The measuring instrument and stage control are set.



Items selected here are displayed in the window.

Menu bar



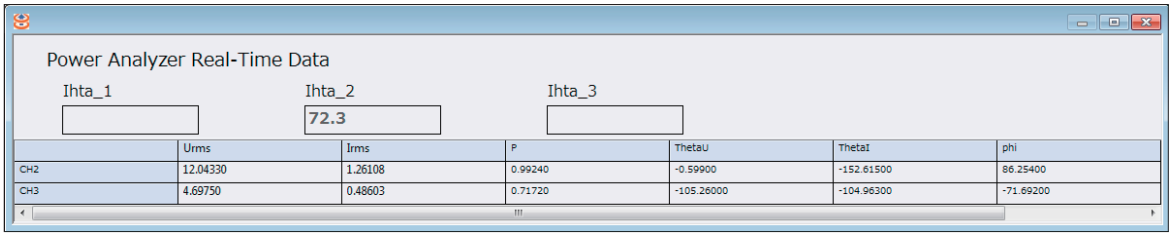
Menu	Explanation
Data File	**Save**: Saves the measurement file. **Open**: Opens the measurement file for the data to be checked. Sample measurement data of the accessories can also be checked. (Sample.csv in the SF2400 folder in the C drive)
System	The application's language can be set to Chinese, Japanese, or English.
Version	Displays the version of the application and PLC.

Numerical data window

Various numerical data can be checked.

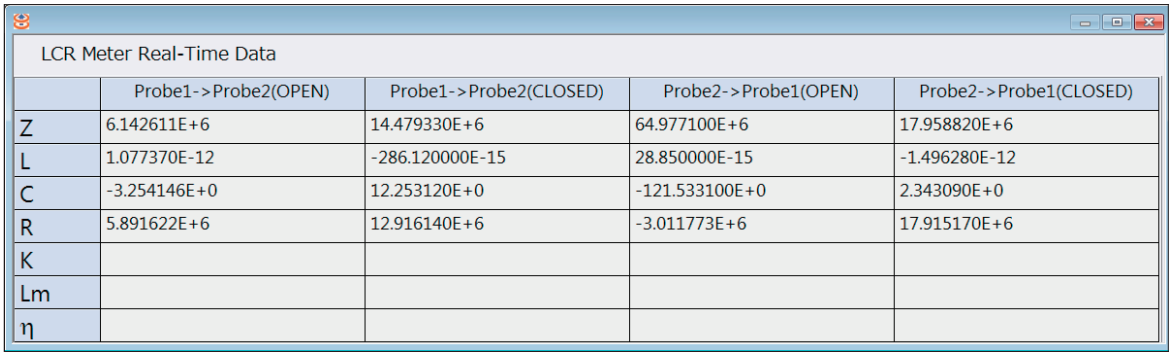
Power Analyzer Real-Time Data

Values measured by a power meter can be checked in real time.



LCR Meter Real-Time Data

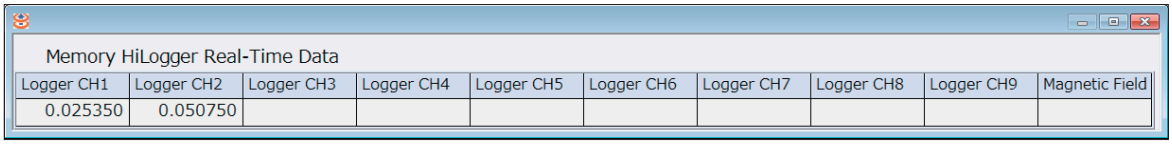
Values measured by an LCR meter can be checked in real time.



	Probe1->Probe2(OPEN)	Probe1->Probe2(CLOSED)	Probe2->Probe1(OPEN)	Probe2->Probe1(CLOSED)
Z	6.142611E+6	14.479330E+6	64.977100E+6	17.958820E+6
L	1.077370E-12	-286.120000E-15	28.850000E-15	-1.496280E-12
C	-3.254146E+0	12.253120E+0	-121.533100E+0	2.343090E+0
R	5.891622E+6	12.916140E+6	-3.011773E+6	17.915170E+6
K				
Lm				
η				

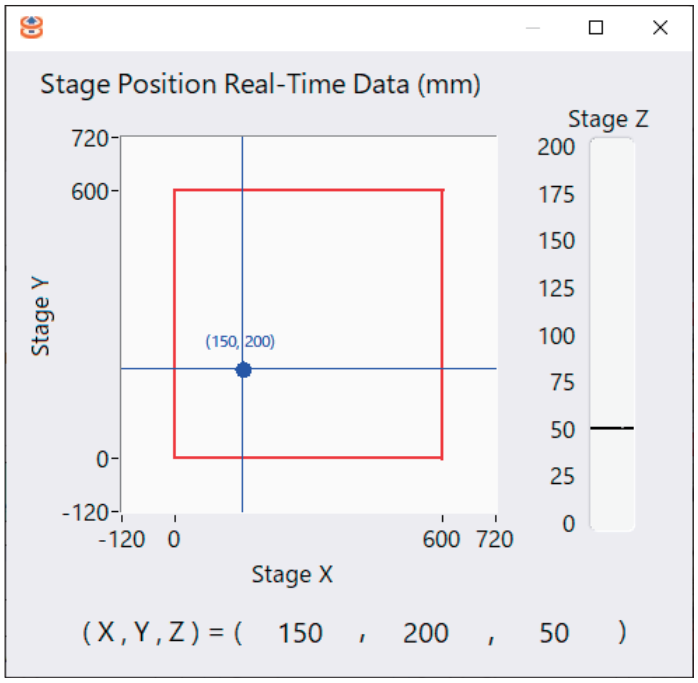
Memory HiLogger Real-Time Data

Values measured by a Memory HiLogger can be checked in real time.



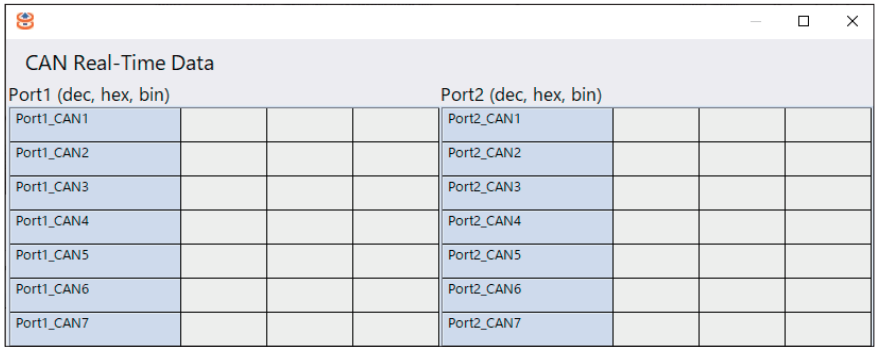
Stage Position Real-Time Data

The present stage coordinates can be checked.



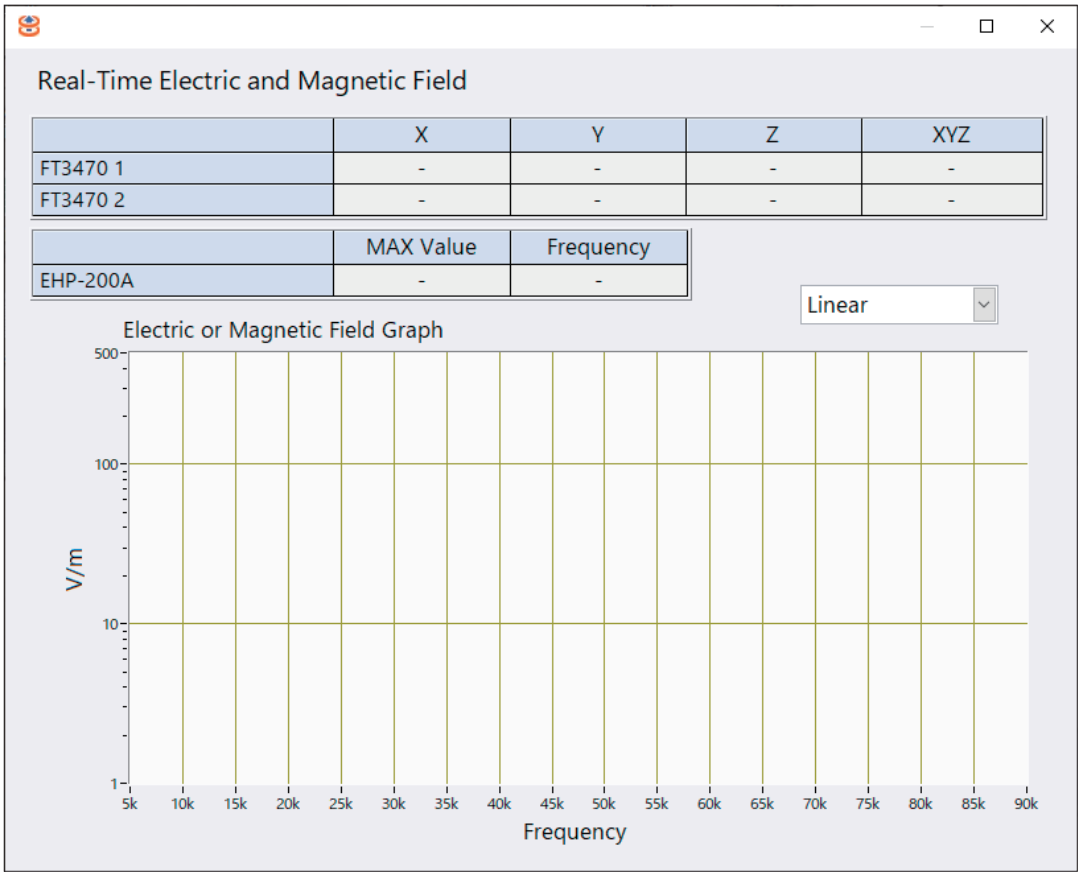
CAN Real-Time Data

CAN measured values can be checked as numerical values in real time.



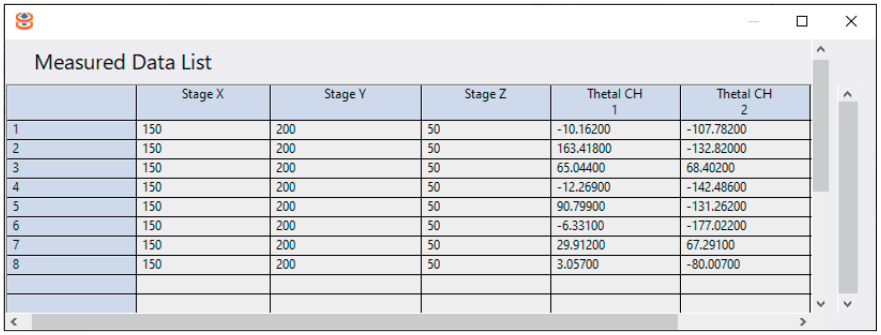
Real-Time Electric and Magnetic Field

Magnetic field measured values can be checked as numerical values (and some graphs) in real time.



Measured Data List

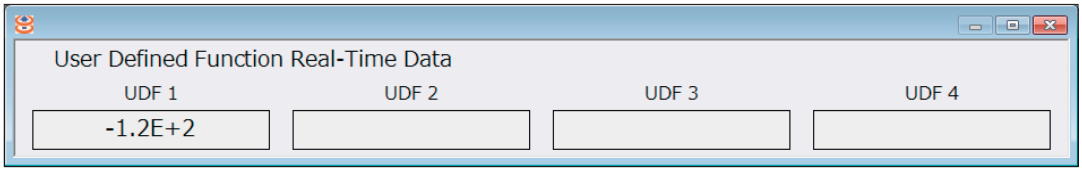
Measured data can be checked in a list.



	Stage X	Stage Y	Stage Z	Thetal CH 1	Thetal CH 2
1	150	200	50	-10.16200	-107.78200
2	150	200	50	163.41800	-132.82000
3	150	200	50	65.04400	68.40200
4	150	200	50	-12.26900	-142.48600
5	150	200	50	90.79900	-131.26200
6	150	200	50	-6.33100	-177.02200
7	150	200	50	29.91200	67.29100
8	150	200	50	3.05700	-80.00700

User Defined Function Real-Time Data

Calculation results can be checked.
A calculation formula must be set in advance (p.65).



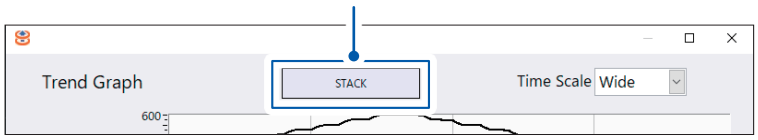
Graph window

Various numerical data can be checked in a graphical or Smith chart format.

Trend graph

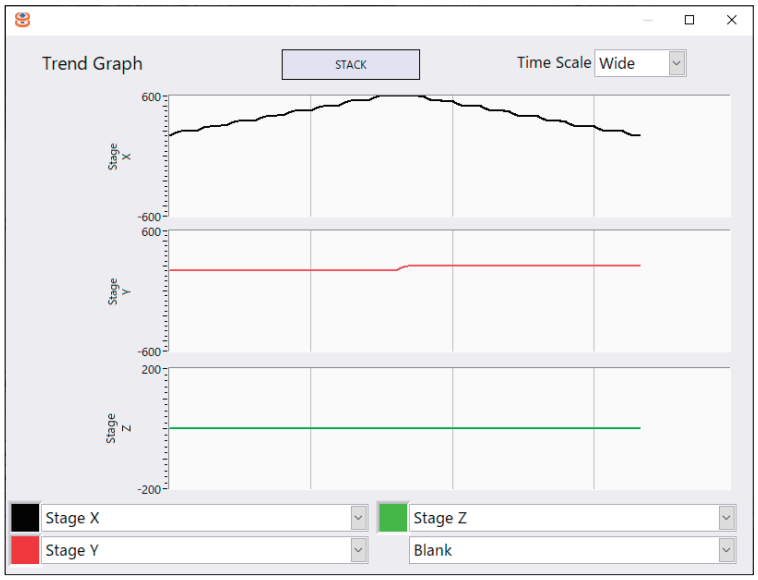
The transition of each measuring instrument can be checked. Two types of trend graphs are shown below.

The type can be switched between stack plot and overlay plot.



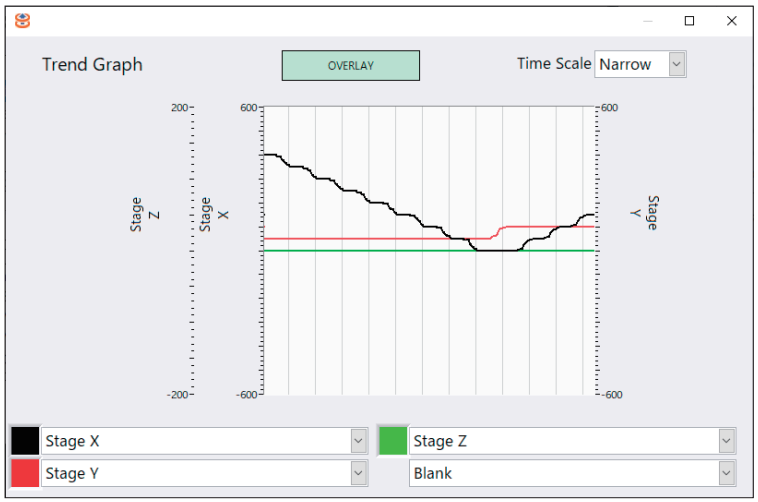
Stack plot

A graph is displayed for each item.



Overlay plot

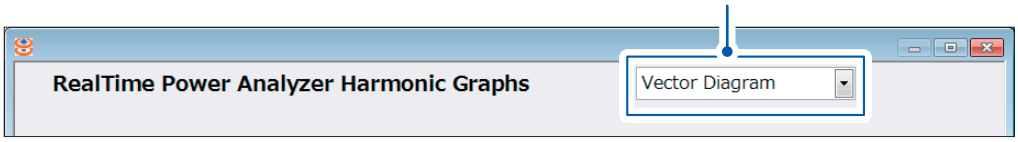
Items are displayed in one graph.



RealTime Power Analyzer Harmonic Graphs

This graph is displayed only when a power meter is used.

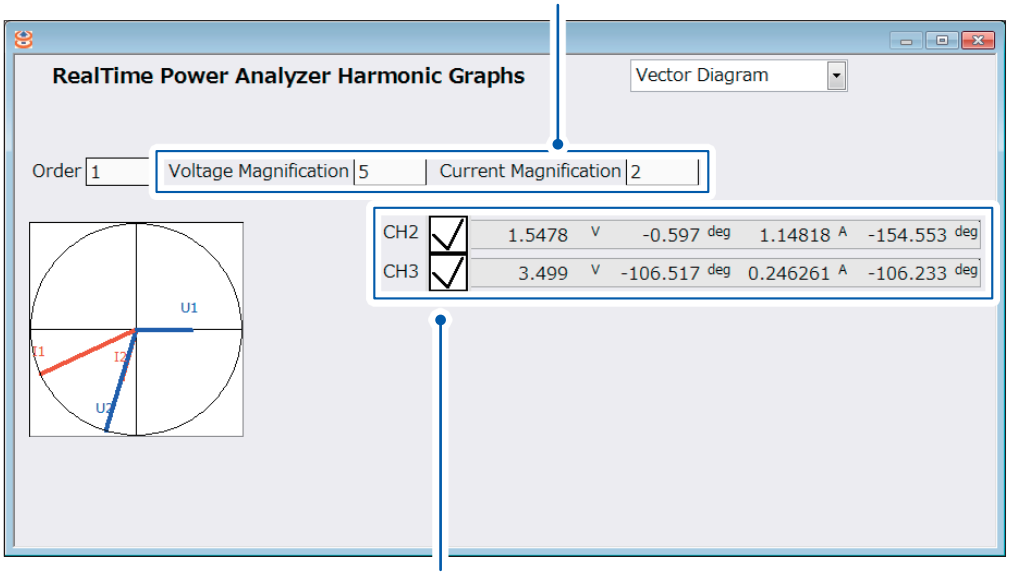
One item can be selected from vector diagram, harmonic graph, and harmonic data.



Vector diagram

Vectors and measured values of voltage (**U**) and current (**I**) can be checked.

If the vector line is short and difficult to see, the magnification can be adjusted so that it is easier to see.

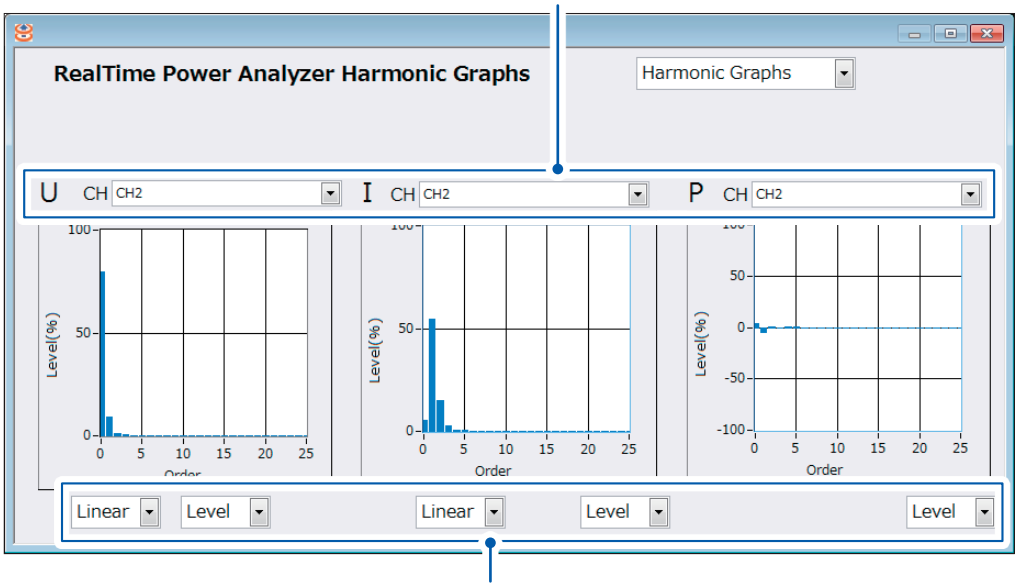


Harmonic voltage, voltage phase, current, and current phase selected in **Order**.

Harmonic graph

Bar graphs of voltage (**U**), current (**I**), and power (**P**) can be checked.

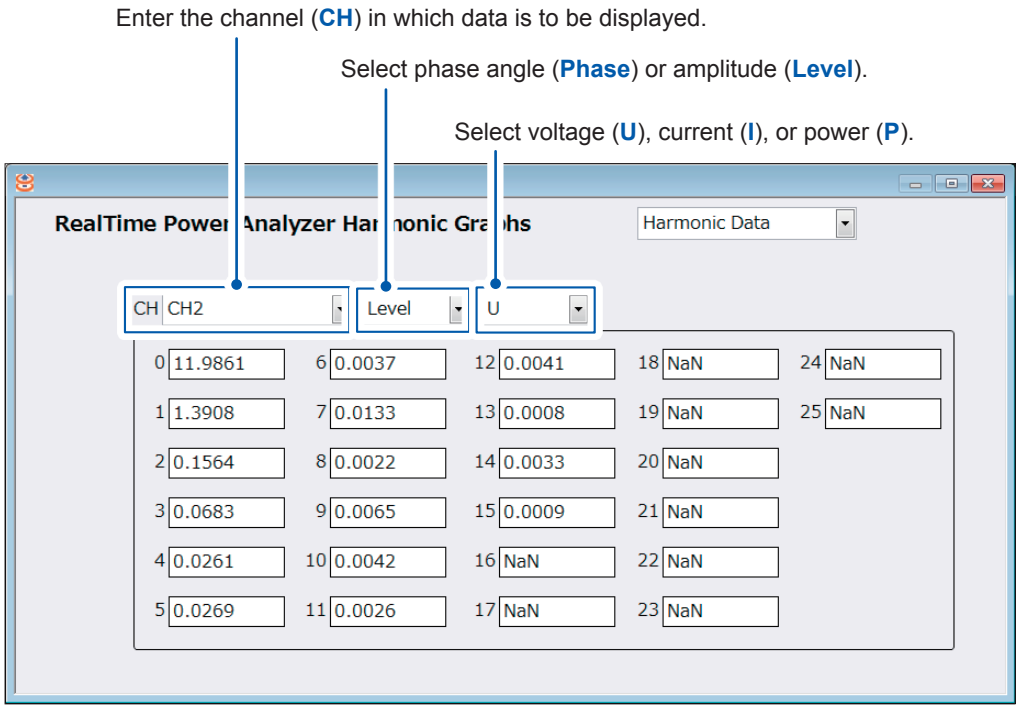
Select the channel (**CH**) to be displayed in the graph.



Right side: Select linear display (**Linear**) or logarithm display (**Log**) (voltage and current only).
Left side: Select phase angle (**Phase**) or amplitude (**Level**).

Harmonic data

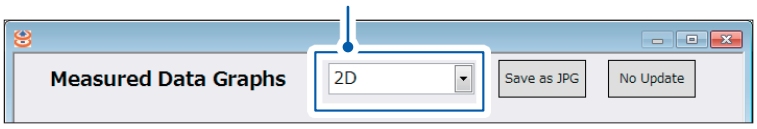
Data 1 to 25 of voltage (**U**), current (**I**), and power (**P**) can be checked.



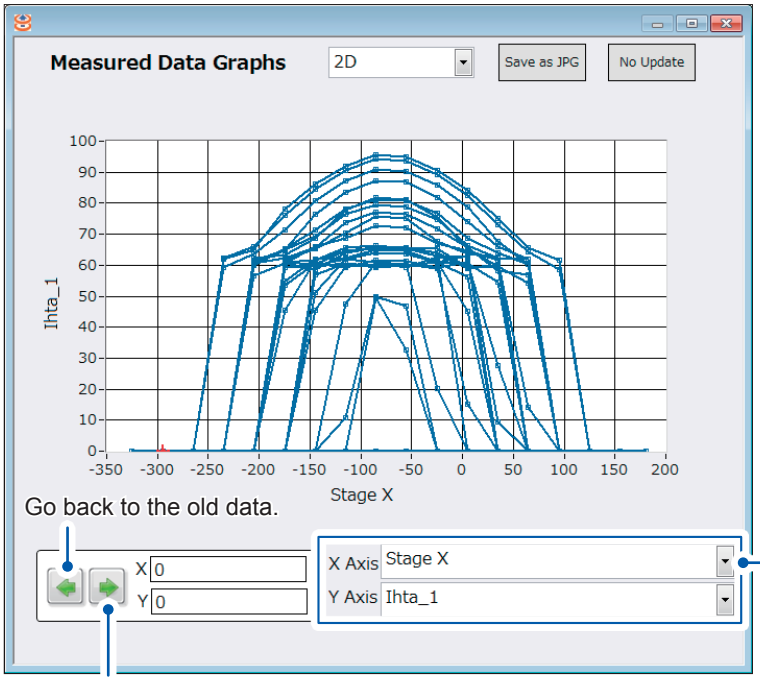
Measured Data Graphs

Measured data can be checked in a graphical format.

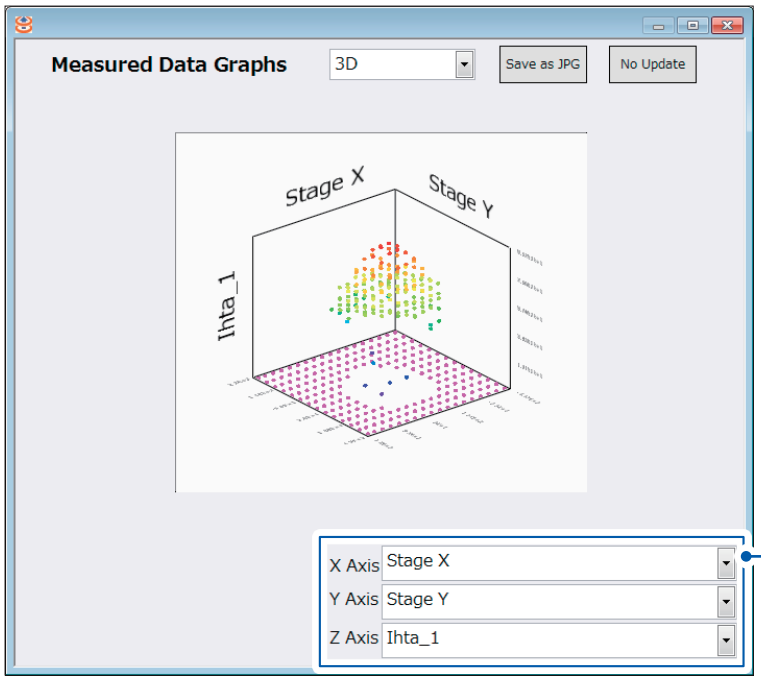
2D: Plot graph of X-axis and Y-axis
3D: Plot graph of X-axis, Y-axis, and Z-axis
4D: Color plot graph of 3 stage axes and one measured value
Smith: Locus of Smith data



2D graph

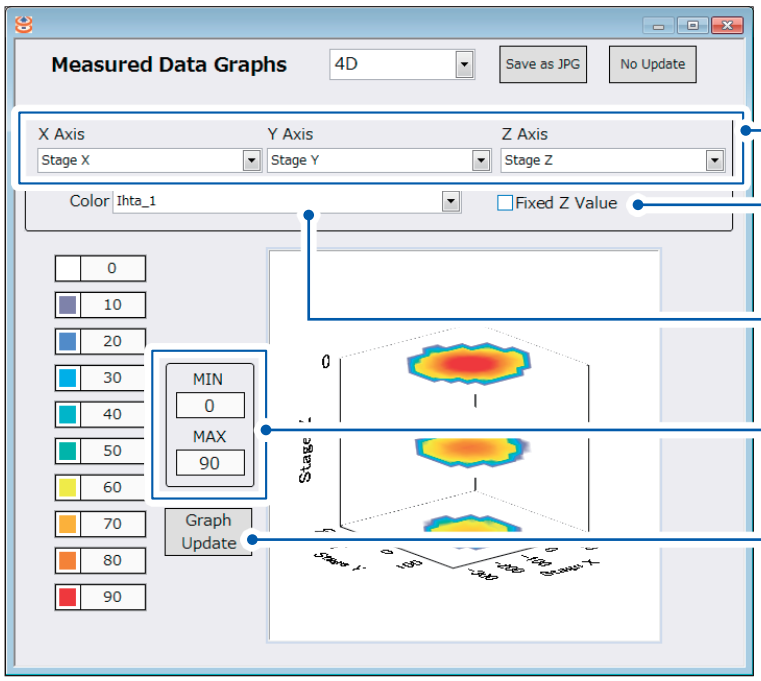


3D graph



The stage axis and measurement item selected here are displayed.

4D graph



Select the stage axes.

When the checkbox is checked, you can select the preset Z-axis value.

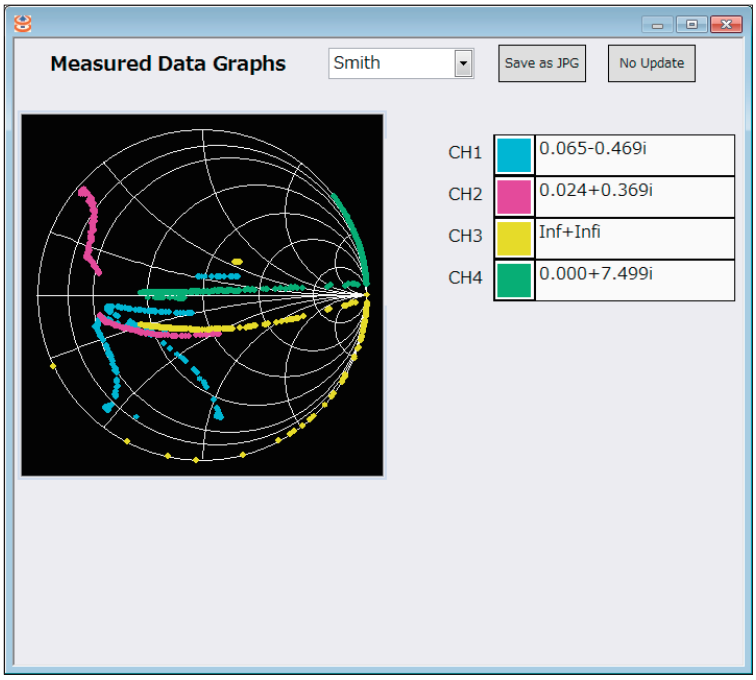
The selected measurement item is displayed.

The set value is divided equally and a color is assigned.

The 4D graph is not automatically updated. Press this button to update the graph.

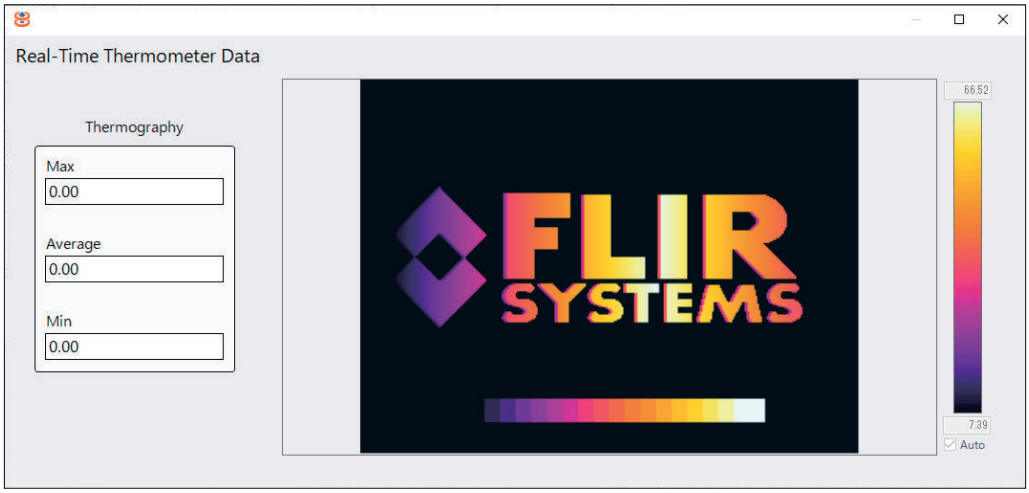
Real time Smith chart

The real axis impedance and imaginary axis impedance on the power transmission side and power receiving side are normalized and can be checked (only when a power meter is used).



Real-Time Thermometer Data

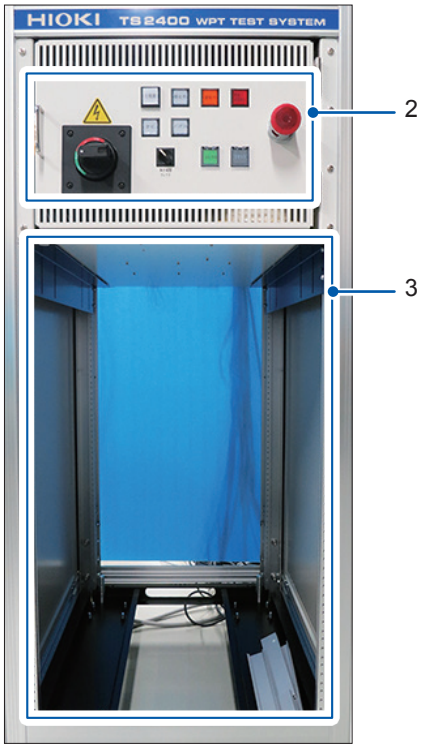
The heat distribution can be displayed as a graph.



2.2 Model Z5017 PLC Rack

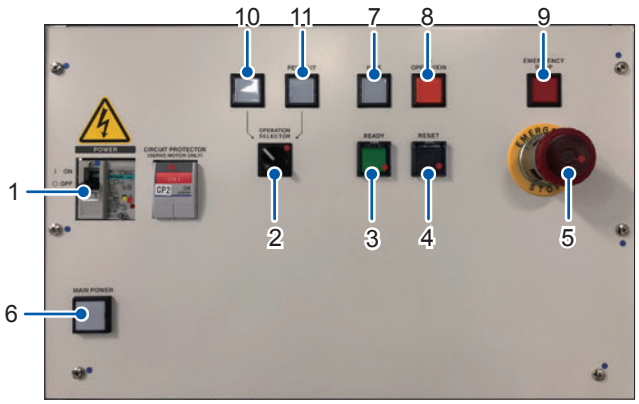
Top

Front



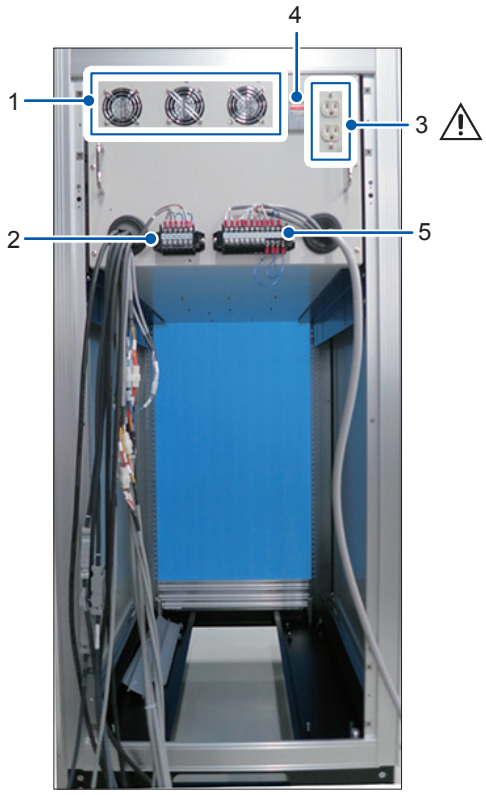
No.	Name and description	
1	**Signal tower**	Indicates the instrument status with blinking colors. Green: Ready for operation Orange: In operation Red: Warning/emergency stop
2	**Front operation panel unit**	Reference: "Front operation panel unit" (p.28)
3	**Measuring instrument and accessory (power, workpiece load, etc.) installation space**	Available space: 14 U (EIA)

Front operation panel unit



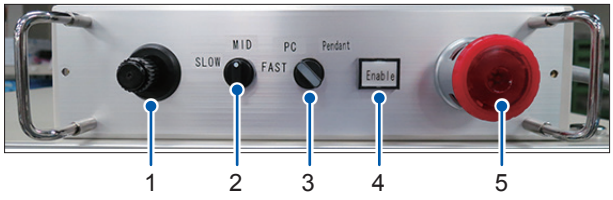
No.	Name and description	
1	**Main breaker**	Switches the main power between **[ON]** and **[OFF]**. It also protects the instrument from over-current. When it is set to **[OPEN]**, the door of the front operation panel unit can be opened.
2	**[OPERATION SELECTOR]**	Switches the power to operate each axis of the stage between PC or pendant. The power selection is enabled only when the selector matches the operation power selector of the pendant unit.
3	**[READY] button**	Pressing this button while it is off feeds the power to the model FT3470-51/-52 drive circuit and prepares the instrument ready for operation. The button lights up when the instrument is ready for operation.
4	**[RESET] button**	Pressing this button after the cause of a warning/emergency stop is resolved with the **[EMERGENCY STOP]** indicator lit cancels the warning and turns off the **[EMERGENCY STOP]** indicator.
5	**[EMERGENCY STOP] button**	Pressing this button during the instrument operation immediately stops the operation of all stage axes.
6	**[MAIN POWER] indicator**	Lights up when the main power is **[ON]**.
7	**[IDLE] indicator**	Lights up when the stage axes stop and the automatic operation program is not executed.
8	**[IN OPERATION] indicator**	Lights up when the stage axes are in automatic operation or manual operation.
9	**[EMERGENCY STOP] indicator**	Lights up when the instrument stops with a warning or when the emergency stop button is pressed.
10	**[PC] indicator**	Lights up when the power to operate the stage axes is set to the PC. It blinks when communication between the PC and PLC is cut off.
11	**[PENDANT] indicator**	Lights up when the power to operate the stage axes is set to pendant.

Rear



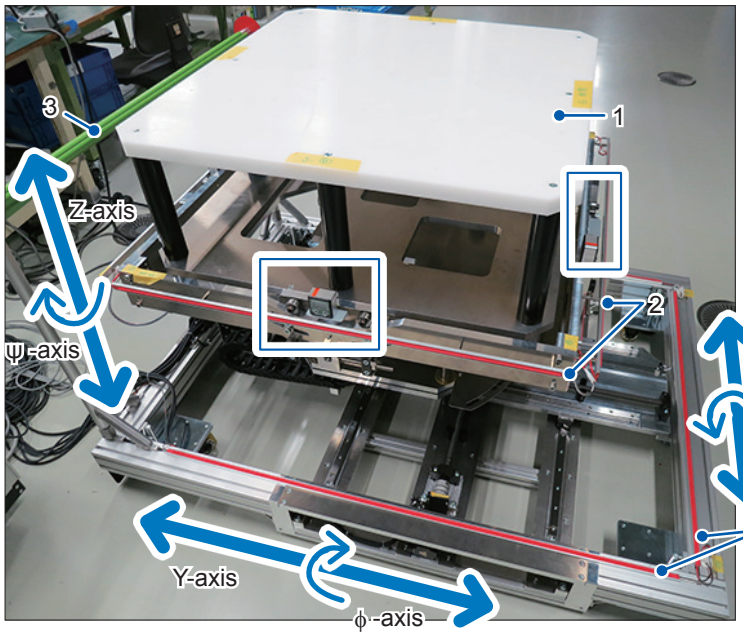
No.	Name and description	
1	**Vent holes**	Do not block the vent holes.
2	**Connection Terminal for Model Z5018**	Connects the model Z5018 Switch Box. Reference: "3.2 Connecting the Z5018 to the Z5017 and LCR Meter" (p.36)
3	**Service outlet**	Outputs 100 V AC to be supplied to external instruments, etc. (Maximum power: 500 VA)
4	**Circuit protector**	For the service outlet (Rating: 5 A)
5	**External I/O terminal**	Reference: "3.3 Connecting an External Control Instrument and the External I/O Terminals of the Instrument" (p.37)

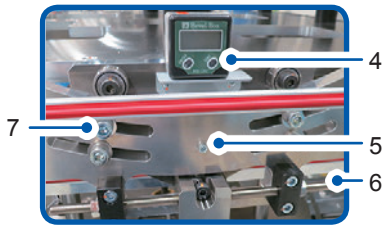
Pendant unit



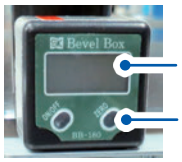
No.	Name and description
1	**Joystick** Moves the stage axes. X-axis and Y-axis movement: Tilt the stick in each direction. Z-axis movement: Turn the knob of the joystick to the left or right. (Left: downward, right: upward)
2	**Jog movement speed selector** Selects the speed of each stage axis for jog movement. **[FAST]**: 100%, **[MID]**: 50%, **[SLOW]**: 20%
3	**Operation authority selector** Switches the power to operate each axis of the stage between **[PC]** and **[Pendant]**. The power selection is enabled only when this selector matches the **[OPERATION SELECTOR]** on the front operation panel unit. If pendant is selected, the built-in indicator lights up.
4	**[Enable] button** Enables the joystick operation only when this button is pressed and lit.
5	**Emergency stop button** Pressing this button during the instrument operation immediately stops the operation of all stage axes.

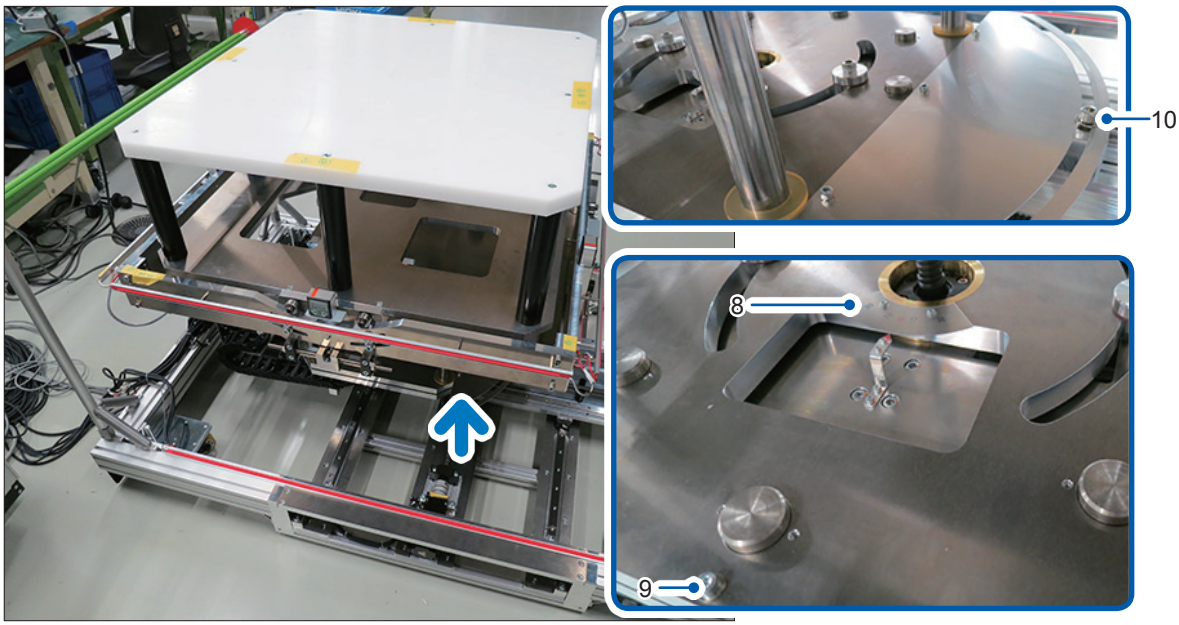
2.3 Model Z5016 WPT Testing Platform



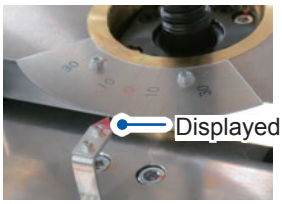


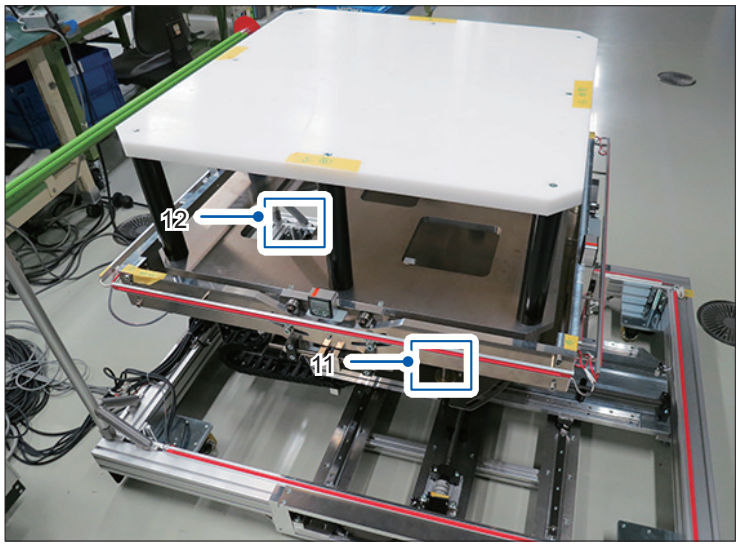
Expanded view of the frame shown in the photo on the left

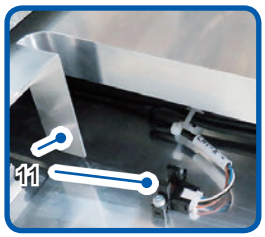
No.	Name and description
1	**Work table** Used to set a workpiece.
2	**Tape switch** Immediately stops the operation of all stage axes when the tape switches come in contact with the operator or foreign objects.
3	**Handle** Hold here for transportation.
4	**θ-axis angle gauge, ϕ-axis angle gauge** Displays the tilt angle of the θ-axis or ϕ-axis. When changing the angle (same for the ϕ-axis): 1. Loosen the lock bolts (M10 × 40). 2. Insert the θ-axis zero set pin into position 5. 3. Press the **[ZERO]** button to adjust the zero point.  The angle is displayed here. **[ZERO]** button 4. Remove the θ-axis zero set pin. 5. Tilt the θ-axis to the desired angle and read the displayed value. 6. Tighten the lock bolts (M10 × 40).
5	**θ-axis zero set pin, ϕ-axis zero set pin** Insert this pin when the θ-axis or the ϕ-axis does not need to be tilted (when setting the axis angle to zero).
6	**θ-axis adjustment bolt, ϕ-axis adjustment bolt** Adjusts the tilt angle of the θ-axis or ϕ-axis.
7	**Lock bolt (4 locations)** Secures the θ-axis or ϕ-axis. Loosen the lock bolts before adjusting the tilt angle and tighten them again after the adjustment is done. Recommended tightening torque: 37 N·m



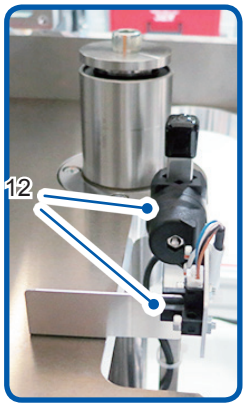
Expanded view of the arrow shown in the photo on the left

No.	Name and description
8	**ψ-axis angle scale** **Displays the tilt angle of the ψ-axis.** When changing the angle: 1. Loosen the lock bolts (M10 × 40). 2. Remove the ψ-axis zero set pin. 3. Tilt the ψ-axis to the desired angle and read the displayed value.  Displayed value where this points to 4. Tighten the lock bolts (M10 × 40).
9	**ψ-axis zero set pin** Insert this pin when the ψ-axis does not need to be tilted (when setting the axis angle to zero).
10	**Lock bolt** Secures the ψ-axis. Loosen the lock bolts before adjusting the tilt angle and tighten them again after the adjustment is done. Recommended tightening torque: 37 N·m



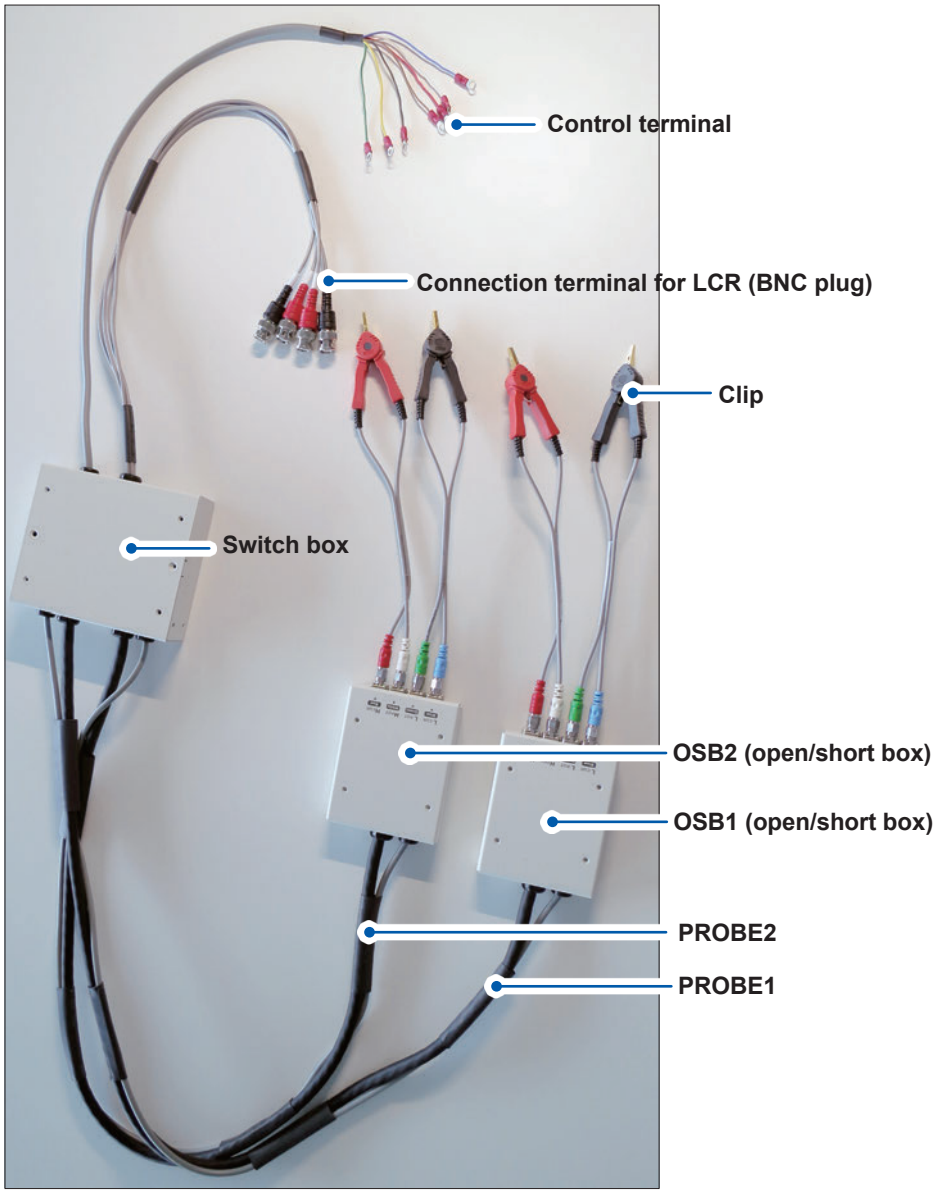


Expanded view of the frame shown in the photo on the left



No.	Name and description
11	**Limit sensor (2 locations each for the X-axis and the Y-axis)** When the limit sensor is activated, a move command from the PC is canceled and any moving axes are stopped. After the axes are stopped, only a move command in the direction opposite from the limit sensor is accepted.
12	**Limit sensor (2 locations for the Z-axis top and bottom)** When the limit sensor is activated, a move command from the PC is canceled and any moving axes are stopped. After the axes are stopped, only a move command in the direction opposite from the limit sensor is accepted. Adjust the installation height of the limit sensor according to the thickness of the workpiece (p.74).

2.4 Model Z5018 Switch Box



3 Preparations

3.1 Connecting the Measuring Instrument and the PC

⚠ CAUTION

When connecting the instrument to your LAN using a LAN cable of more than 30 m or with a cable laid outdoors, take appropriate countermeasures that include installing a surge protector for LANs. Such signal wiring is susceptible to induced lighting, which can cause damage to the instrument/device.

Be sure to read “Connection of the USB terminal” (p.7) in advance.

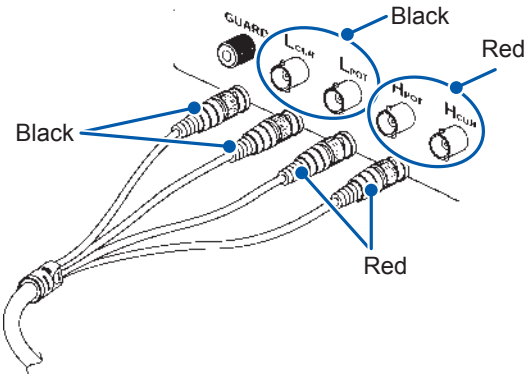
The following procedure is not necessary when the model Z5017 PLC Rack is used.

Connect the measuring instrument and PC according to the following table.
When there is no Ethernet or USB port on the Z5017 side, use a hub as needed.

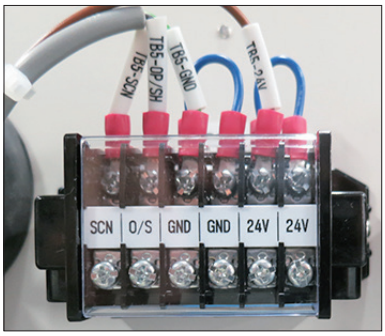
<table>
<tr><th>Model</th><th>Name</th><th>Connection method</th></tr>
<tr><td>PW6001</td><td>Power Analyzer</td><td rowspan="4">Ethernet (LAN connection)
Open the Z5017 front door and connect the LAN cable to any of the following terminals.
 
Hub of the Z5017
For the LAN cable type and LAN connection of the measuring instrument side, see the Instruction Manual that accompanies the measuring instrument.</td></tr>
<tr><td>IM3536</td><td rowspan="2">Impedance Analyzer</td></tr>
<tr><td>IM3570</td></tr>
<tr><td>8423</td><td>Memory HiLogger</td></tr>
<tr><td>FT3470-51
FT3470-52</td><td>Magnetic Field HiTester</td><td rowspan="4">USB2.0
Connect the computer to one of the ports on the USB hub with the included USB cable.
 
Rear side of the Z5015 PC System</td></tr>
<tr><td>EHP-200A</td><td>Electric and Magnetic Field Probe - Analyzer</td></tr>
<tr><td>USB-8502</td><td>CAN Interface Device</td></tr>
<tr><td>FLIR E53</td><td>Optic - Advanced Thermal Camera</td></tr>
</table>

3.2 Connecting the Z5018 to the Z5017 and LCR Meter

1 **Connect the H_{CUR}, H_{POT}, L_{CUR}, and L_{POT} BNC plugs of the Z5018 Switch Box to the corresponding terminals of the LCR meter.**



2 **Connect the control terminals for Z5018 to the Z5018 connection terminals of the Z5017 PLC Rack.**



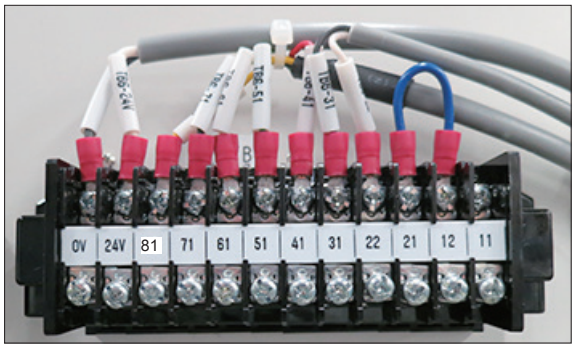
Control terminal cable color	External I/O terminal
White, black	24 V
Red, green	GND
Yellow	Not connected
Brown	SCN
Blue	O/S

3.3 Connecting an External Control Instrument and the External I/O Terminals of the Instrument

Be sure to read “Wire material” (p.6) and “Connection of the power input terminals and external I/O terminals” (p.6) in advance.

This instrument can control any external instruments connected to the external I/O terminals. The following table shows the names and functions of the external I/O terminals.

Wire material: ϕ1.0, 0.8 mm^2 (AWG 18)



Terminal name	Name	Function
11	Safety input (contact) 1	Only when terminals 11 and 12 are shorted, operation preparation and operation can be performed. When they are open, the instrument enters the warning/emergency stop state.
12		
21	Safety input (contact) 2	Only when terminals 21 and 22 are shorted, operation preparation and operation can be performed. When they are open, the instrument enters the warning/emergency stop state.
22		
31	Safety input (PNP)	Only when 24 V DC is input, operation preparation and operation can be performed. When they are open or low level voltage is input, the instrument enters the warning/emergency stop state.
41	Interlock output 1	When the instrument is in the operation preparation or operation state, the output is 0 V. When the instrument is in other states, the output is floating.
51	Interlock output 2	When the instrument is in the operation preparation or operation state, the output is 0 V. When the instrument is in other states, the output is floating.
61	Workpiece load ON/OFF signal output	The software of the instrument can control ON/OFF of the workpiece load. When the workpiece load is ON, the output is 0 V. When the workpiece load is OFF, the output is floating.
71	External output 1 ON/OFF signal	The software of the instrument can control ON/OFF of an external instrument. When the workpiece load is ON, the output is 0 V. When the workpiece load is OFF, the output is floating.
81	External output 2 ON/OFF signal	
24V	24 V DC	Outputs 24 V DC.
0V	0 V DC	Outputs 0 V DC.

3.4 Setting Up the PC (As Needed)

When the model Z5015 PC System is purchased separately or when the model SF2400 WPT Testing Software is to be used on your own PC, the PC needs to be set up.

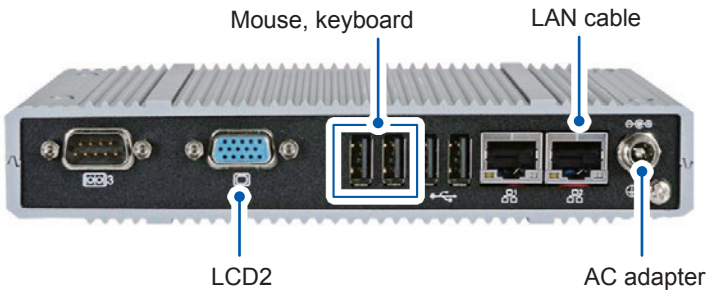
Connection

Be sure to read “Turning on the power” (p.7) in advance.

Connect the following items to the model Z5015 or your PC.
Keyboard, mouse, LCD (liquid crystal display) × 2, LAN cable, and AC adapter

The following is an example of the model Z5015. Use the specified ports. (Due to the boot order setting)

Front side of the model Z5015 PC System



Rear side of the model Z5015 PC System

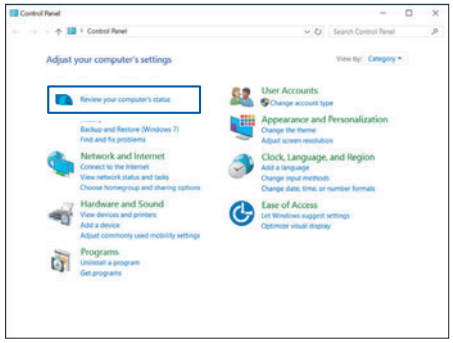
Setting the security

The following description is for Windows 7.

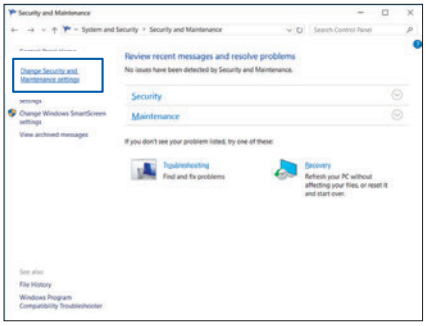
1 **Turn on the power to the LCDs and PC in that order.**

2 **Log onto the PC.**

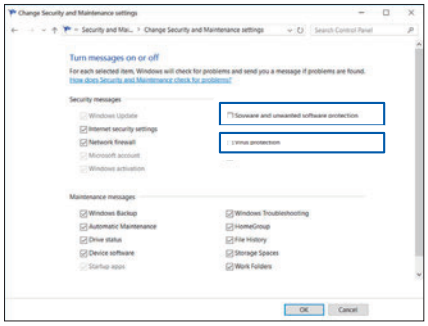
3 **Go to Start, select Control Panel, and then click Review your computer's status.**



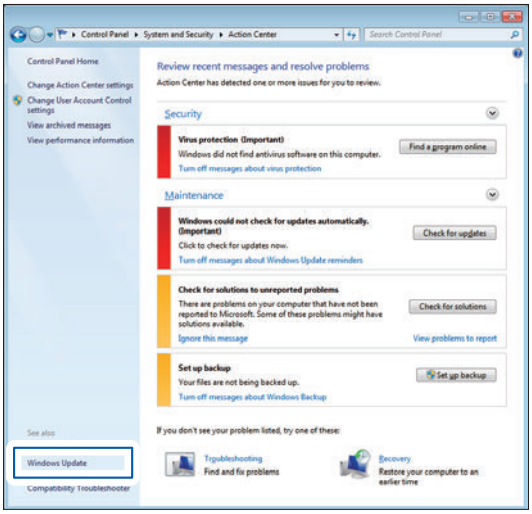
4 **Click Change Action Center settings.**



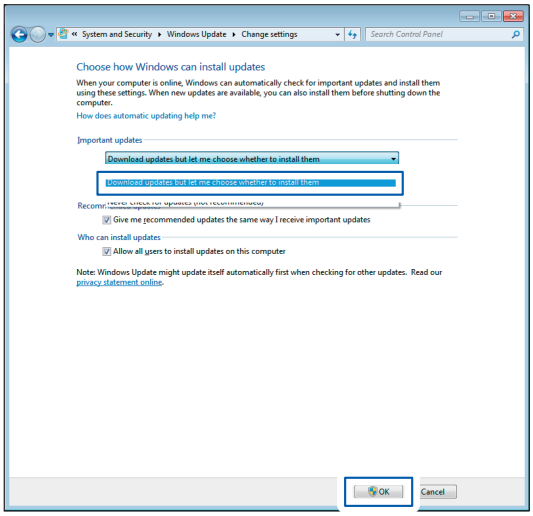
5 **Uncheck the Spyware and unwanted software protection checkbox and the Virus protection checkbox.**



6 **Click Windows Update.**



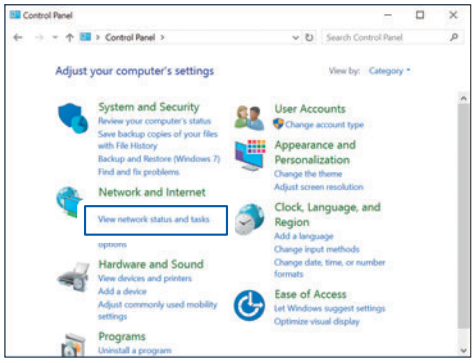
7 **Select Download updates but let me choose whether to install them and click OK.**



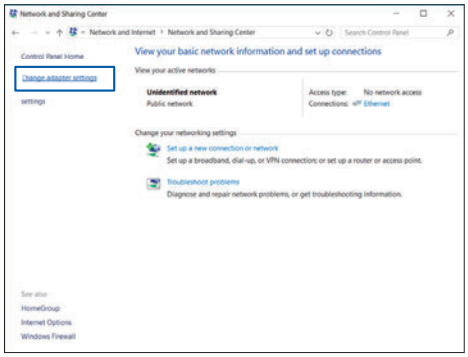
Setting the network

The following description is for Windows 7.

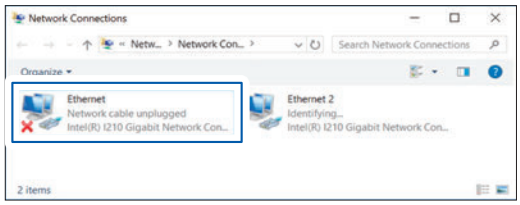
1 **Go to Start, select Control Panel, and click View network status and tasks.**



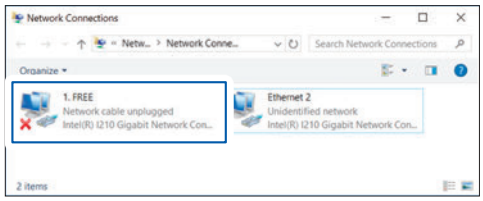
2 **Click Change adapter settings.**



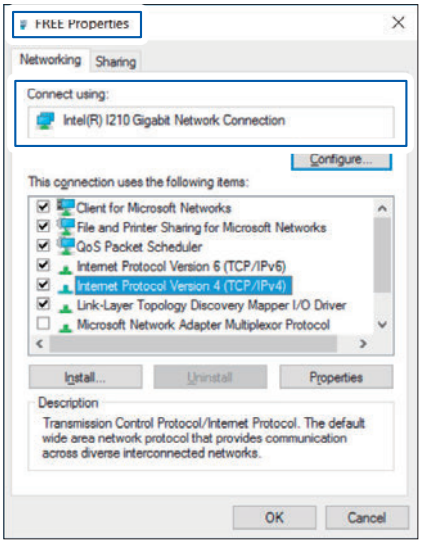
3 **Right-click Ethernet, select Rename, and enter "1.FREE".**



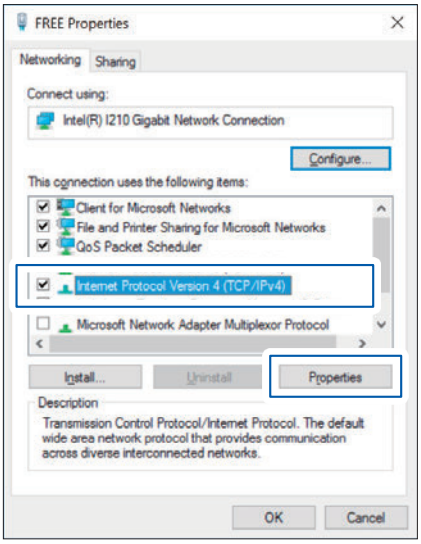
4 **Right-click 1.FREE and select Properties.**



5 **Check the following.**
1: The window title is FREE Properties.
2: Connect using is Intel(R) I210 Gigabit Network Connection.

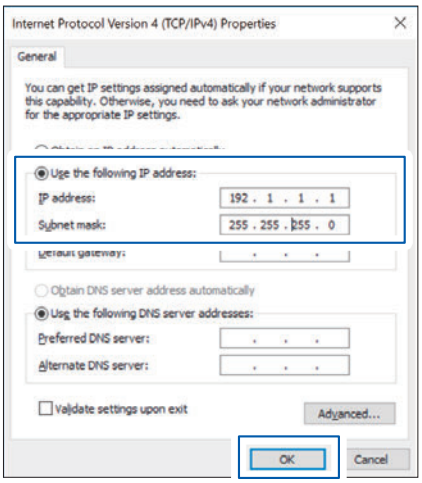


6 **Check the Internet Protocol Version 4 (TCP/IPv4) checkbox and click Properties.**

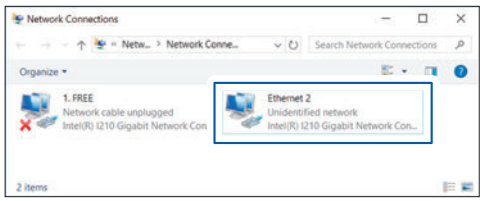


7 Enter the IP address and Subnet mask and click OK.

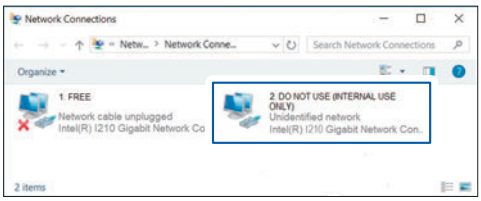
IP address	192. 1. 1. 1
Subnet mask	255. 255. 255. 0



8 Right-click Ethernet 2, select Rename, and enter "2.DO NOT USE (INTERNAL USE ONLY)".

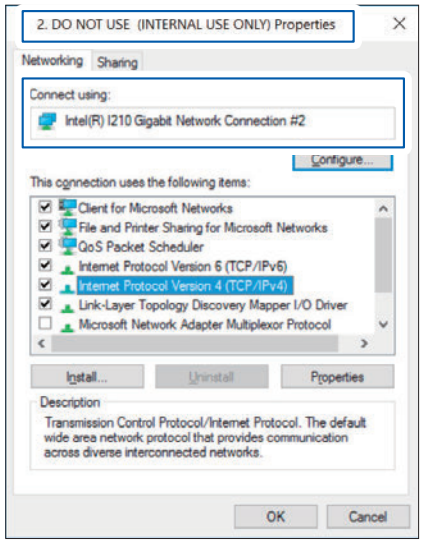


9 Right-click 2.DO NOT USE (INTERNAL USE ONLY) and select Properties.

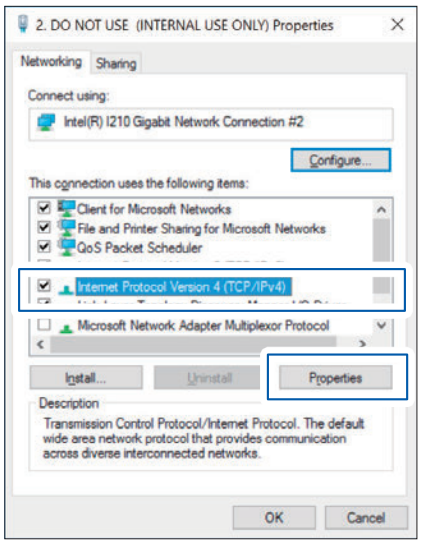


10 Check the following.

1: The window title is 2.DO NOT USE (INTERNAL USE ONLY) Properties.
2: Connect using is Intel(R) I210 Gigabit Network Connection #2.

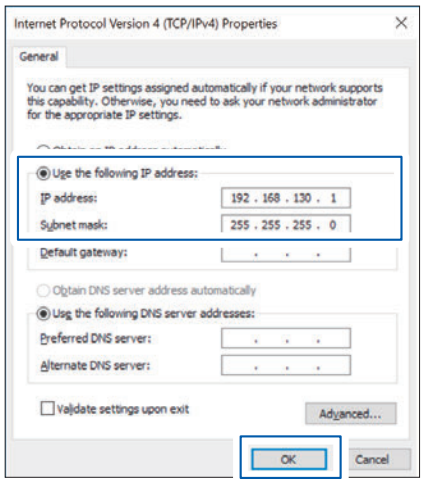


11 **Check the Internet Protocol Version 4 (TCP/IPv4) checkbox and click Properties.**



12 **Enter the IP address and Subnet mask and click OK.**

IP address	192. 168. 130. 1
Subnet mask	255. 255. 255. 0



Changing the BIOS

The following description is for Windows 7.

1 **Turn off the power to the LCDs and PC in that order.**

2 **Turn on the power to the PC. When Press <DEL> or <ESC> to Enter SETUP is displayed, press the [Delete] key on the keyboard.**

The BIOS menu is displayed.

3 **Change the Advanced-NCT6106D Super IO Configuration-Restore AC Power Loss items to Power On.**

4 **Change the Advanced-USB Configuration-EHCI Hand-Off items to Enabled.**

5 **Return to tab selection using the [Esc] key, place the cursor on Save Changes and Reset on the Save & Exit tab, and press the [Enter] key.**

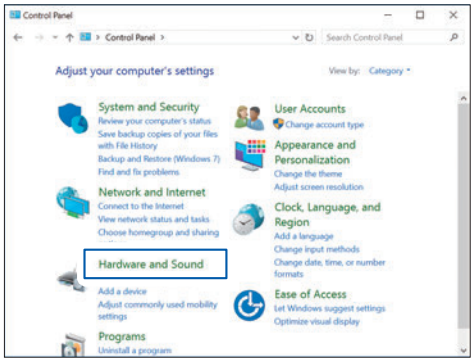
The **Save configuration and reset?** confirmation window appears.

6 **Place the cursor on Yes and press the [Enter] key.**
The PC restarts and Microsoft®Windows® launches.

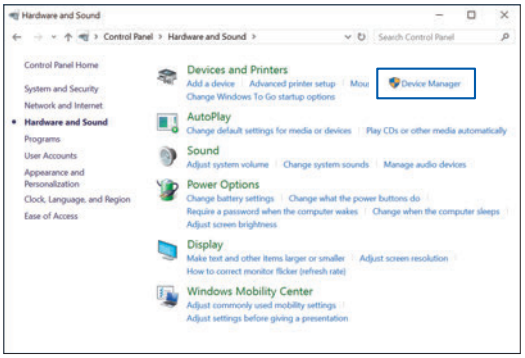
Installing the Model FT3470-51/-52 Magnetic Field HiTester driver

When the model FT3470-51/-52 Magnetic Field HiTester is to be used, the driver needs to be installed manually.
Once the driver is installed, it is automatically recognized after that.

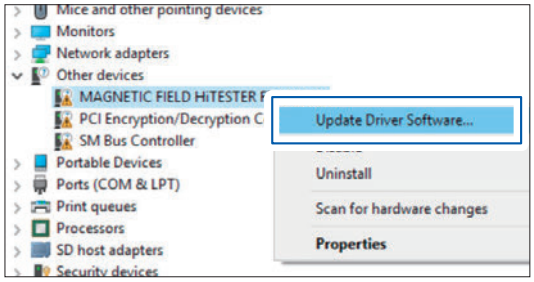
1 **Go to Start, select Control Panel, and then click Hardware and Sound.**



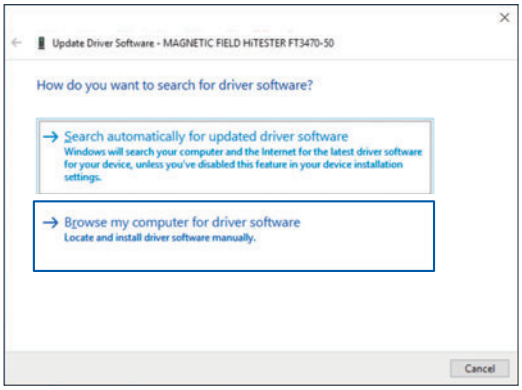
2 **Click Device Manager.**



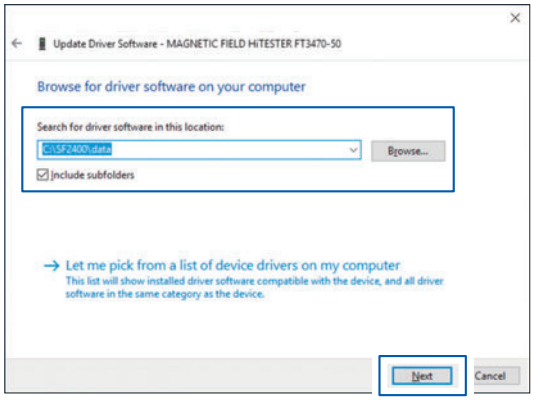
3 **Right-click MAGNETIC FIELD HiTESTER FT3470-50 of Other devices and then click Update Driver Software....**



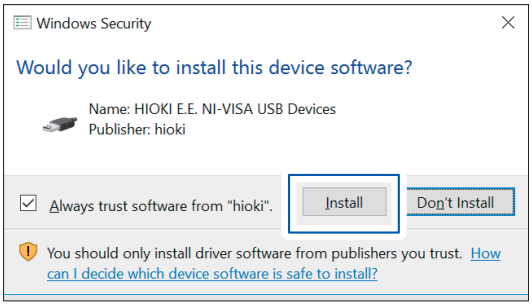
4 **Click Browse my computer for driver software**
Locate and install driver software manually..



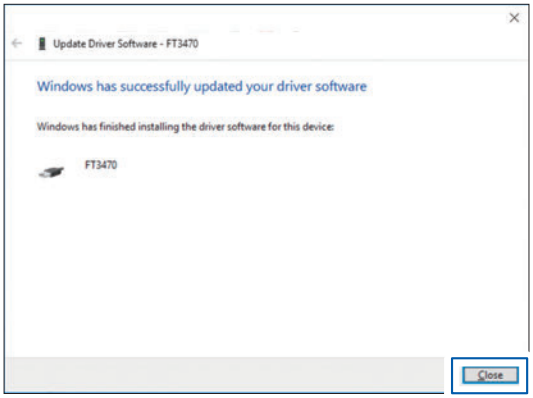
5 **Enter C:\SF2400\data or select the driver from Browse... and click Next.**



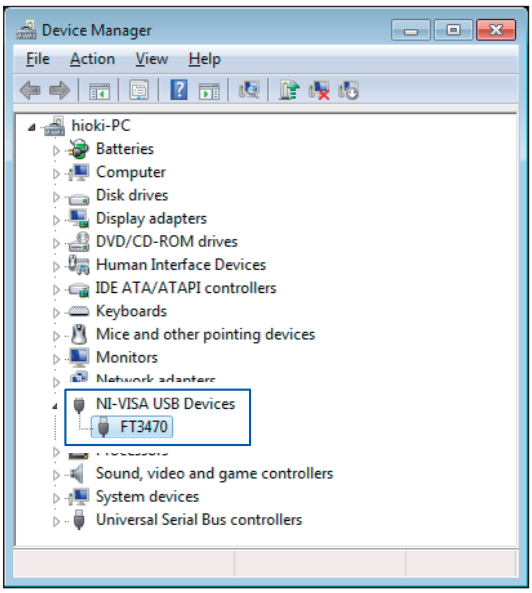
6 **Click Install.**



7 **Click Close and complete the installation.**



8 **In the Device Manager window, check that FT3470 is displayed under NI-VISA USB Devices.**



3.5 Performing Daily/Startup Checks

Before using the instrument, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your authorized Hioki distributor or reseller.

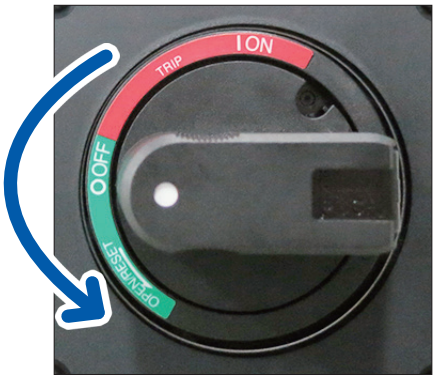
Point/Location	Description	Procedures
Emergency stop button	The emergency stop button operates properly.	Press the emergency stop button and check the following. • The “Emergency stop” dialog box is displayed in the PC window. • The red lamp of the signal tower lights up. • The **[EMERGENCY STOP]** indicator lights up.
Measured value warning and change	The tape switches operate properly.	Touch the tape switches and check the following. • The “Emergency stop” dialog box is displayed in the PC window. • The red lamp of the signal tower lights up. • The **[EMERGENCY STOP]** indicator lights up.
	The measured value warning operates properly when a measured value warning signal is input.	Input a measured value warning signal and check the following. • The “Emergency stop” dialog box is displayed in the PC window. • The red lamp of the signal tower lights up. • The **[EMERGENCY STOP]** indicator lights up.
X-axis and Y-axis	No foreign object or dust is present on the linear guide.	Visually check for any foreign object or dust and remove if any.
	No abnormal noise is generated from the motor, ball screw, or linear guide when the axes move.	Check for any abnormal noise.
Z-axis	Timing belt condition	Check the following visually. • There is no abnormal wear or fraying. • The timing belt is not sagging.
	No foreign object or dust is present on the guide shaft.	Visually check for any foreign object or dust and remove if any.
	No abnormal noise is generated from the motor, ball screw, or linear guide when the axes move.	Check for any abnormal noise by listening.

3.6 Turning On/Off the Instrument

Turning on the power

Be sure to read “Turning on the power” (p.7) in advance.

1 **Switch the main breaker of the model Z5017 PLC Rack to [OPENRESET] and open the door of the front operation panel unit.**



2 **Check that the earth leakage circuit breakers and circuit protector are set to [ON].**

Earth leakage circuit breaker Circuit protector

3 **Close the door and set the main breaker to [ON].**

4 **Turn on the measuring instrument.**

5 **Insert the license key into the USB port of the PC.**
Connect the USB cable provided with the measuring instrument to one of the following three terminals. Connect the mouse and keyboard to the remaining two terminals.

Front side of the model Z5015 PC System

Rear side of the model Z5015 PC System

6 **Turn on the UPS.**

7 **Turn on the monitor.**

8 **Turn on the PC.**
Microsoft®Windows® launches and automatic log-in is performed.

The PC is turned on via the software.
Normally when the UPS power is turned on, the PC power also turns on automatically.
When only the UPS power switch is operated with the motor power on, steps 7 and 8 can be skipped.

Turning off the power

1 **Close the application.**
Select **File** - **Exit** in the menu bar.

2 **Shut down Microsoft®Windows®.**
Click Start of Microsoft®Windows® at the left bottom of the window and click the **Shut down** button.

The PC power turns off after a while.

3 **Turn off the UPS power.**

4 **Turn off the measuring instrument.**

5 **Set the main breaker to [OFF].**

3.7 Setting Communication between the Measuring Instrument and the PC

Set the IP address and subnet mask to establish communication between the measuring instrument and the PC.
For the procedure to set the measuring instrument, see the Instruction Manual that accompanies the measuring instrument.

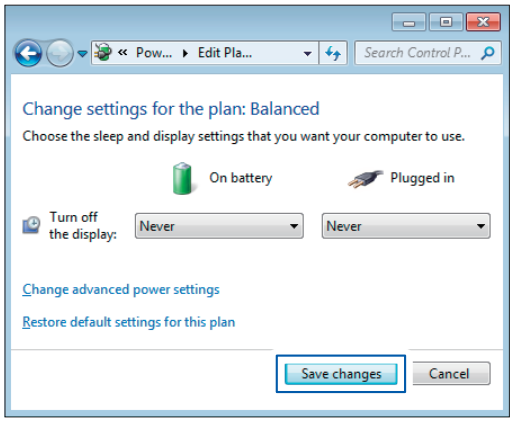
Instrument	IP address	Subnet mask	Port No.
PW6001 (First instrument)	192.168.130.2	255.255.255.0	–
PW6001 (Second instrument)	192.168.130.5	255.255.255.0	–
LCR Meter	192.168.130.3	255.255.255.0	3570
8423	192.168.130.6	255.255.255.0	–

Setting the PC

Communication with the measuring instrument is cut off if the PC enters sleep or screensaver mode or it turns off when data is acquired with the instrument connected.
Check the sleep and screensaver mode settings.

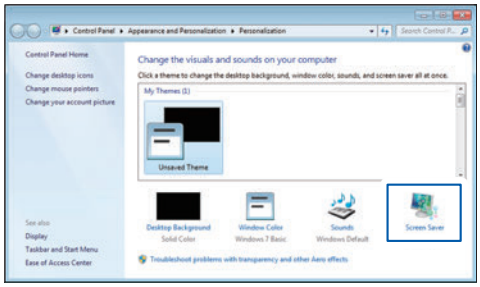
1 **Click Control Panel - Hardware and Sound, Power Options, and then Change plan settings.**

2 **Set the items according to the following window and click Save changes.**

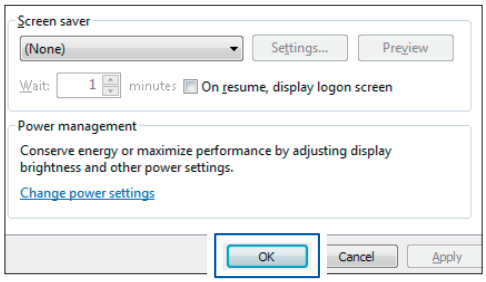


3 **Right-click the window and click Personalization.**

4 **Click Screen Saver.**



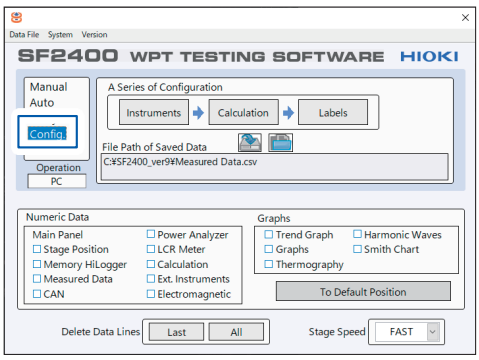
5 **Set the items according to the following window and click OK.**



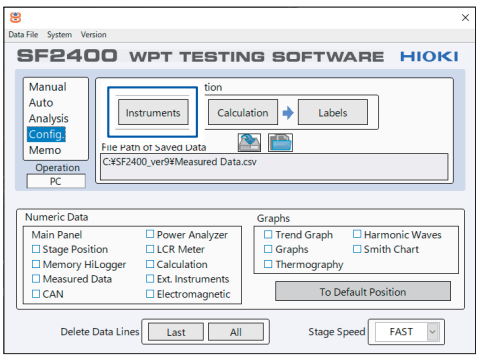
3.8 Determining the Home Position of the Stage Coordinates

Set the home position (X: 0, Y: 0, and Z: 0) of the stage coordinates.

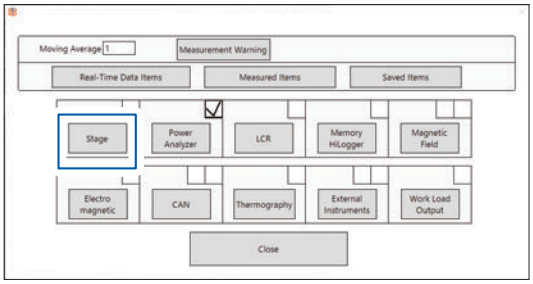
1 Click Config. on the main window.



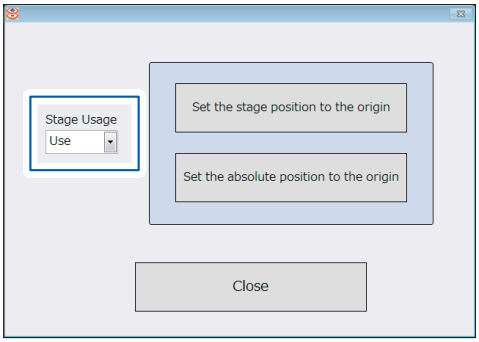
2 Click Instruments.



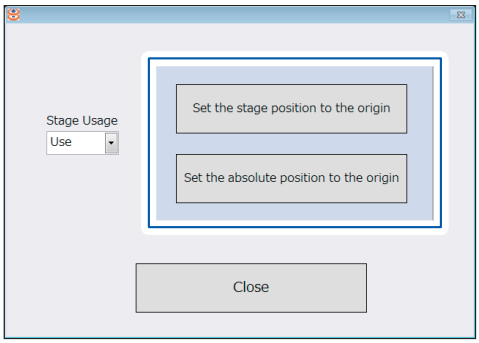
3 Check Stage.



4 Click and select Use.

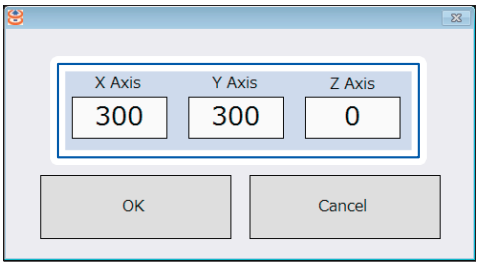


5 Select either of the settings.



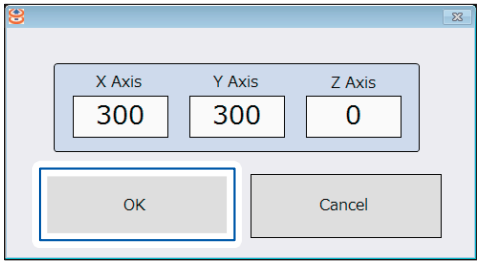
Set the stage position to the origin	It is necessary to move the work table to the coordinates that are to be the home position of the stage coordinates in advance (p.70).
Set the absolute position to the origin	Proceed to the next step.

6 Enter coordinates for the home positions.

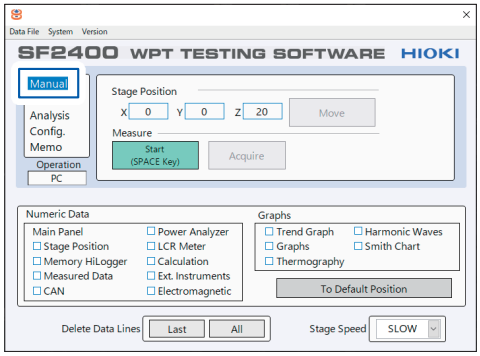


Enter absolute coordinates (mechanical coordinates of each axis).

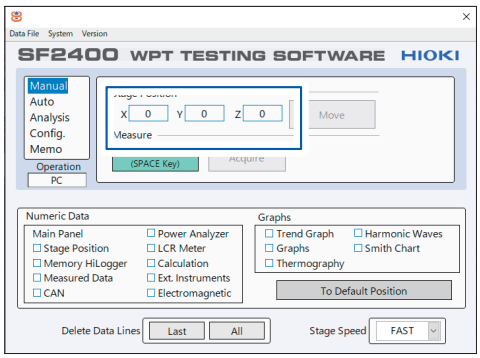
7 Click OK.



8 Click Auto on the main window.



9 Check that the coordinates for Stage Position are 0.



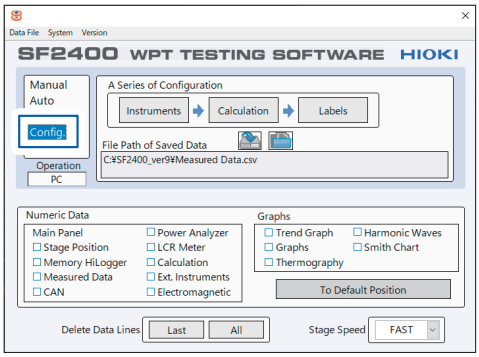
The angle of the θ-axis, ϕ-axis, and Ψ-axis can be manually adjusted (p.31, p.32).

3.9 Setting the Measuring Instrument

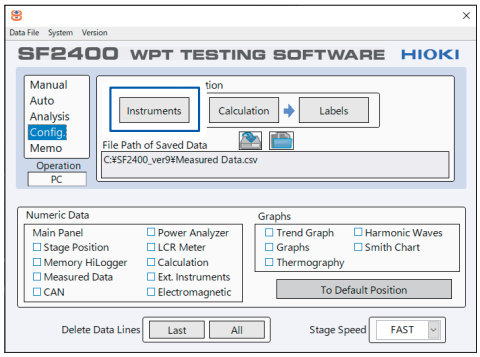
Set the measuring instrument to be used.
Loading the settings of the measuring instrument or checking the present settings of the measuring instrument cannot be performed.
For the description of each setting item, see the Instruction Manual that accompanies the measuring instrument.

Setting the power meter (When measuring a power efficiency)

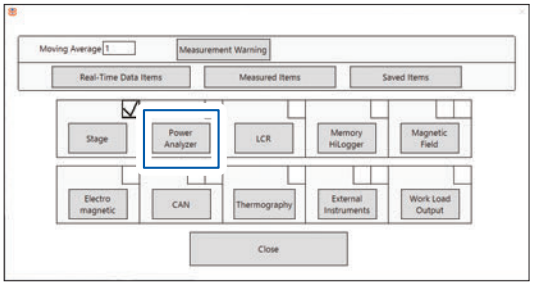
1 **Click Config. on the main window.**



2 **Click Instruments.**



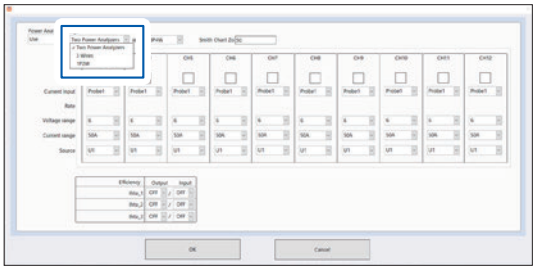
3 **Click Power Analyzer.**



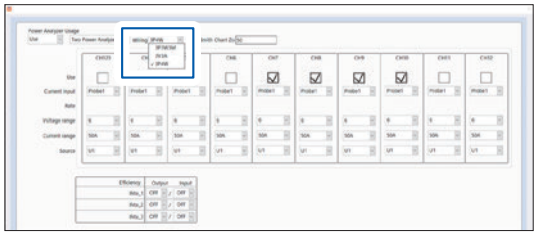
4 **Click and select Use.**

The LCR meter and power meter cannot be used at the same time.
When **Use** is selected for the power meter setting, the ☑ of the channel checkboxes used for the LCR setting are automatically unchecked and measurement is disabled.

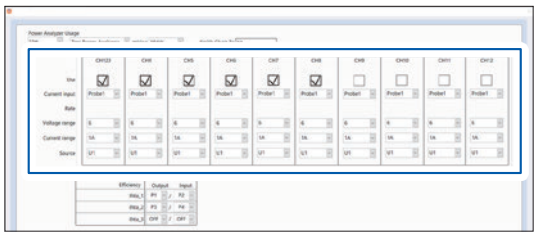
5 **Select whether you wish to use one or two PW6001 instructments.**



6 **Select the power meter's wiring type.**

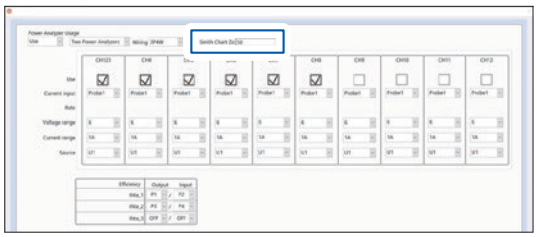


7 Check (☑) the checkboxes of the channels to be used and click and select each item.

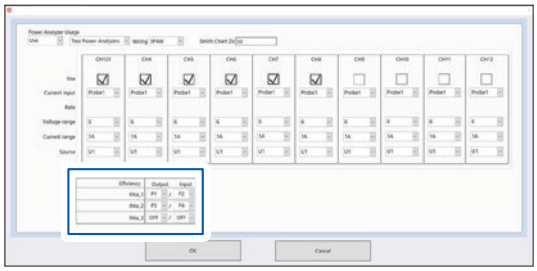


- The power meter data is acquired and displayed in the numerical data window (p.18) and the graph window (p.21).
- The power meter and LCR meter cannot be used at the same time. When the channel checkboxes are checked (☑) for the power meter setting, the LCR setting is automatically changed to **Disuse**.

8 Enter a Zo value to be used in the Smith chart.

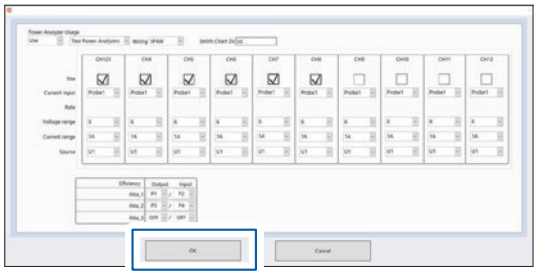


9 Select the efficiency input and output.



The CH1 power is displayed as P1 and the CH2 power as P2. Specify the power of the channel for which the efficiency is to be calculated.
The efficiency is calculated by division of the power.

10 Click OK.

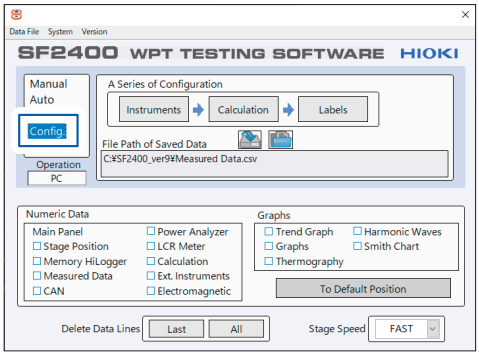


The information is sent to the power meter and the settings are applied.

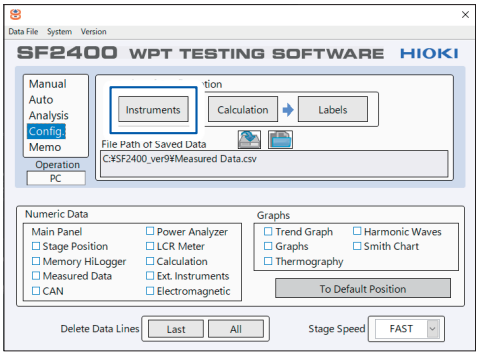
When measurement is started, the measurement results of the power meter can be checked in the numerical data window (p.18) and the graph window (p.21).

Setting the LCR meter (When measuring a coupling coefficient)

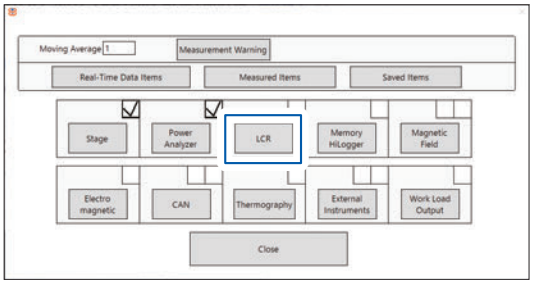
1 Click Config. on the main window.



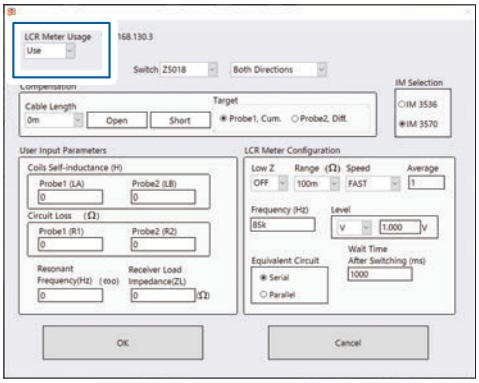
2 Click Instruments.



3 Click LCR.

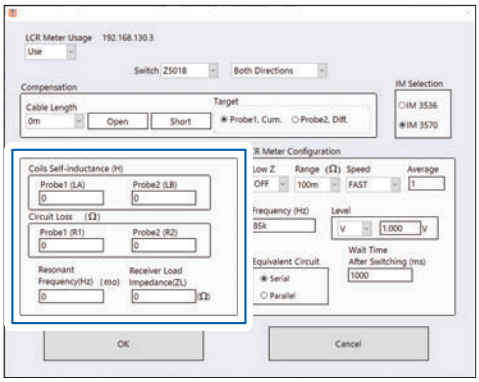


4 Click and select Use.



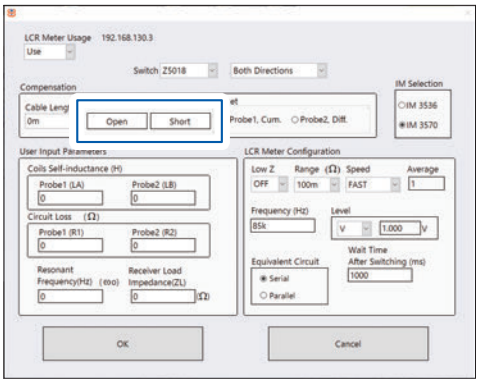
The LCR meter and power meter cannot be used at the same time.
When **Use** is selected for the LCR meter setting, the check (☑) of the channel checkboxes used for the power meter setting are automatically unchecked and measurement is disabled.

5 Enter a value in each item.

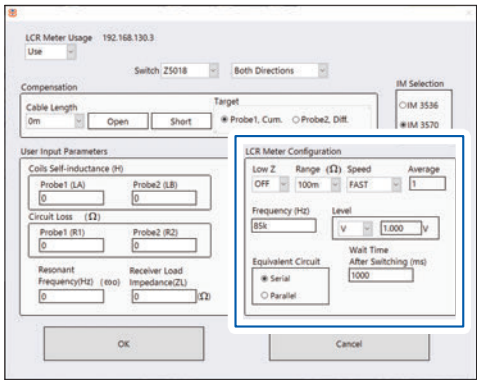


These parameters are used for calculation along with the data acquired from the LCR meter.

6 Click and select Open or Short.

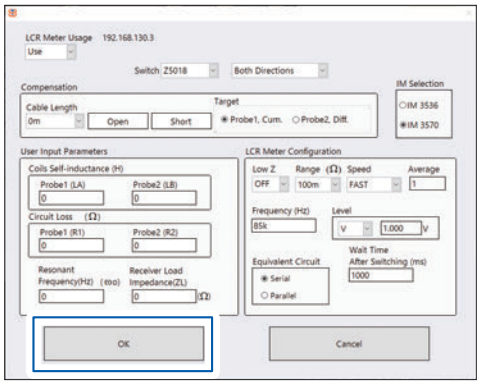


7 Enter a value in Frequency and Wait, and click and select other items.



The **Low Z**, **Frequency**, and **Equivalent Circuit** settings are reflected in the LCR meter.
The setting in **Switch** specifies whether Probe 1 or Probe 2 is to be used as a reference for the model Z5018 Switch Box (p. 34).
For **Wait**, enter a time period until the measured value is stabilized.

8 Click OK.

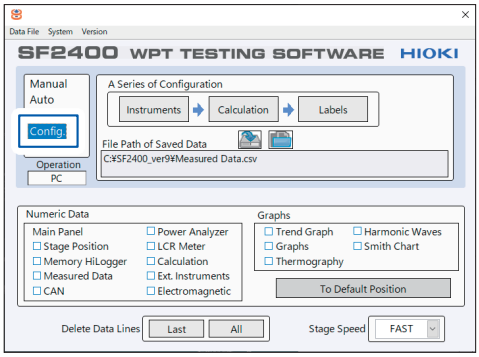


The information is sent to the LCR meter and the settings are applied.

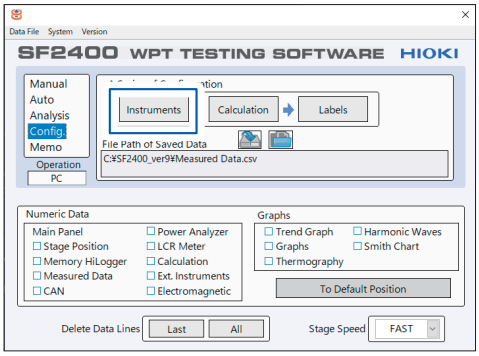
When measurement is started, the measurement results of the LCR meter can be checked in the numerical data window (p. 18).

Setting the Memory HiLogger (When measuring voltage and temperature)

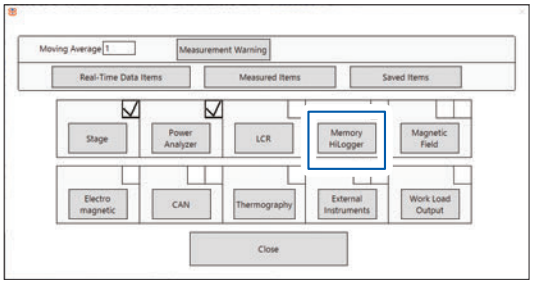
1 Click Config. on the main window.



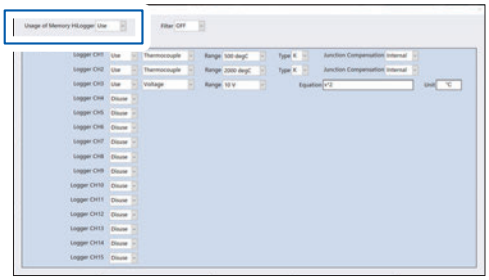
2 Click Instruments.



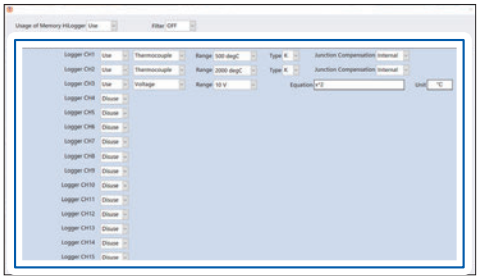
3 Click Memory HiLogger.



4 Click and select Use.

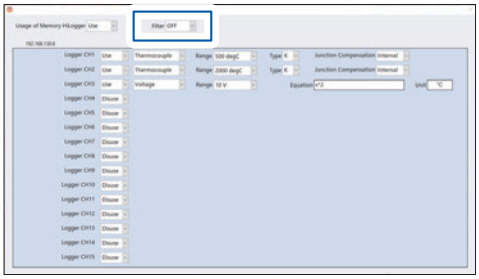


5 Click and select each item.

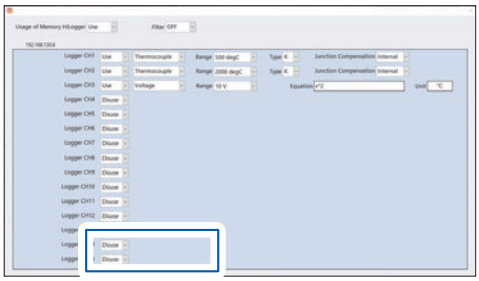


When the voltage is to be measured, a calculation formula can be entered.
Example: When a value that is double the measured value is to be displayed in the window, enter **x*2** (x is in lower case character).

6 Click and select Filter.



7 Click OK.

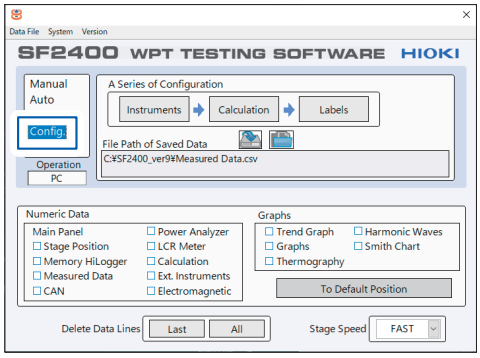


The information is sent to the Memory HiLogger and the settings are applied.

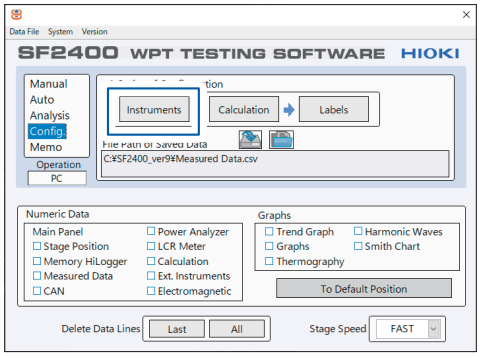
When measurement is started, the measurement results can be checked in the numerical data window (p. 18).

Setting the Magnetic Field HiTester (When measuring a field intensity)

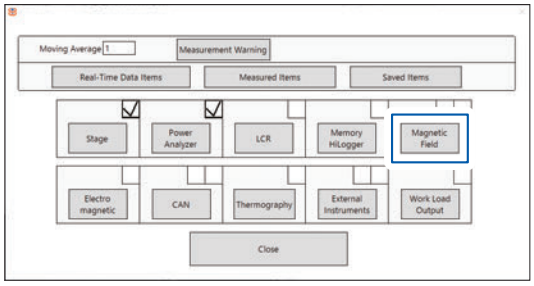
1 Click Config. on the main window.



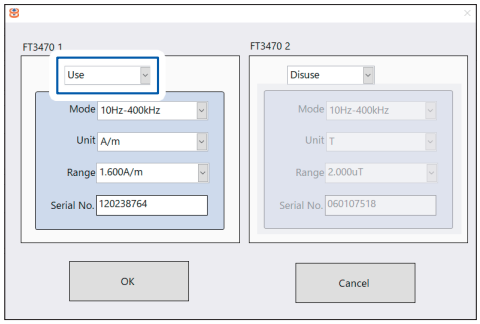
2 Click Instruments.



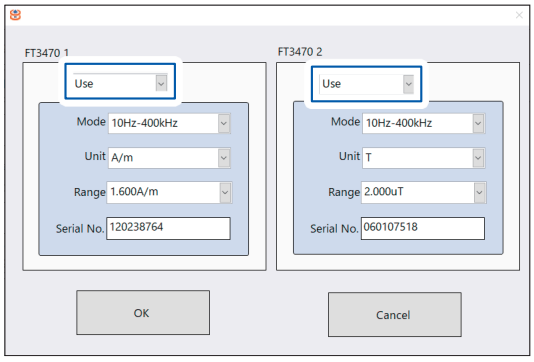
3 Click Magnetic Field.



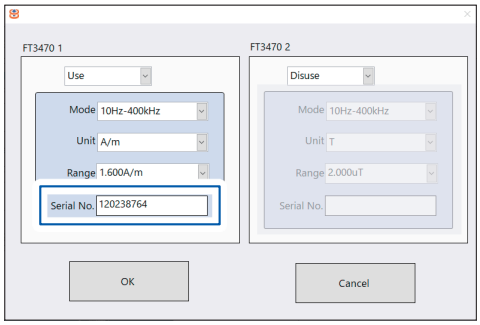
4 Click and select Use.



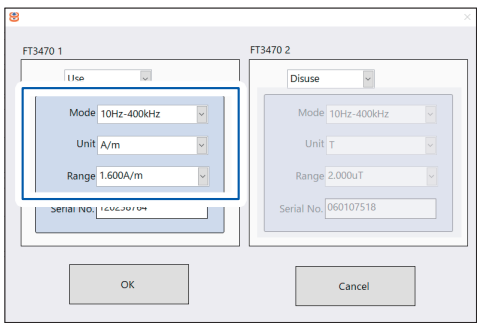
5 Select whether to use each of the two possible magnetic field measuring instruments.



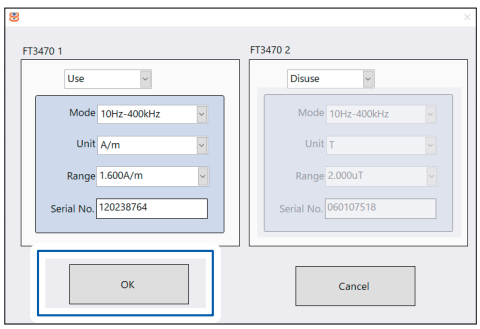
6 To connect a magnetic field measuring instrument, enter its serial number. (The serial number can be found on the back of the instrument.)



7 Click and select each item.



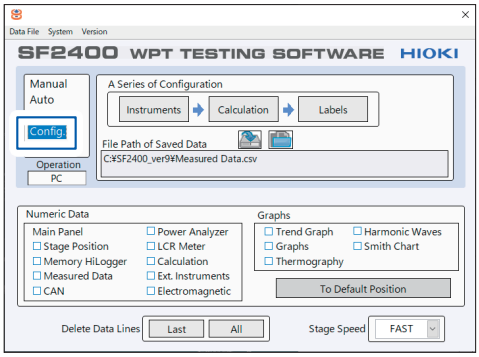
8 Click OK.



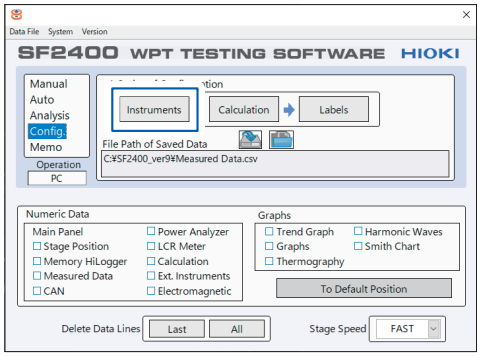
The information is sent to the Magnetic Field HiTester and the settings are applied.

Setting the Electromagnetic Field HiTester

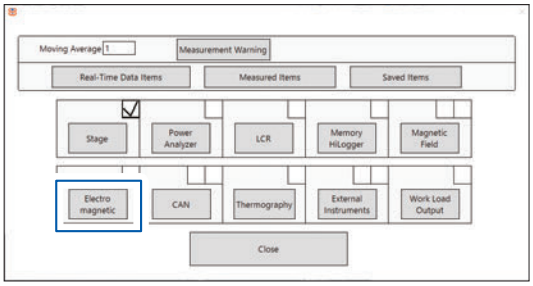
1 Click Config. on the main window.



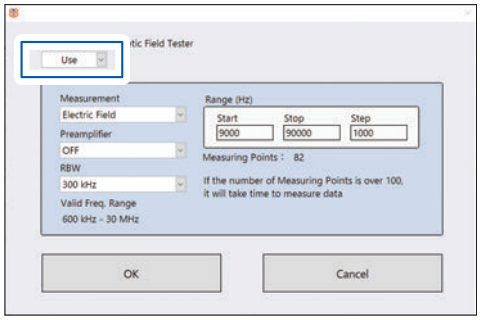
2 Click Instruments.



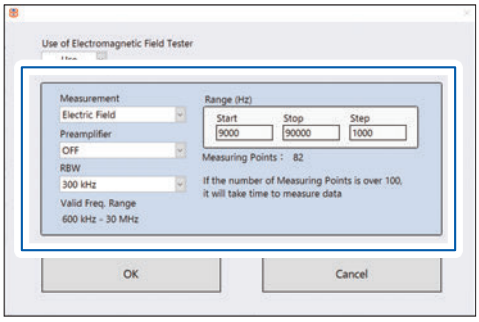
3 Click Electro magnetic.



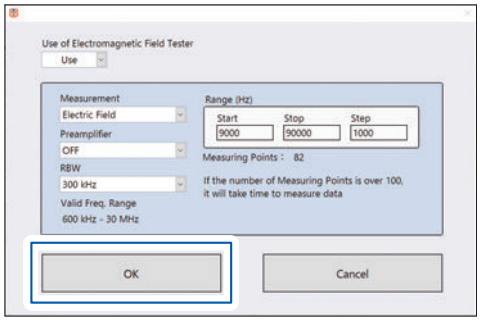
4 Click and select Use.



5 Click and select each item.

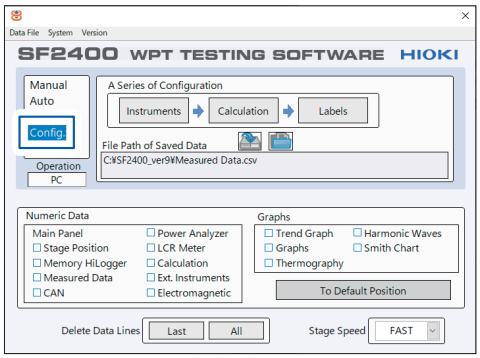


6 Click OK.

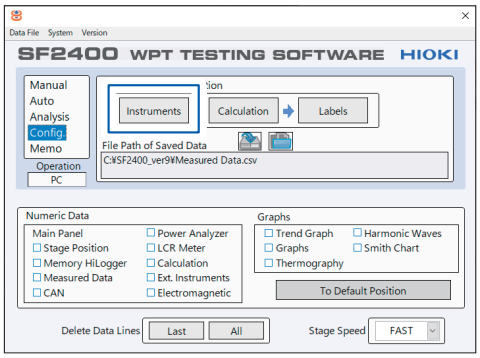


Setting the CAN

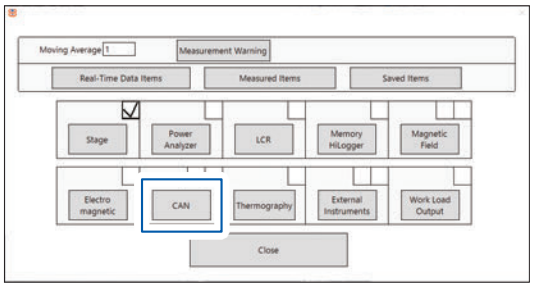
1 Click Config. on the main window.



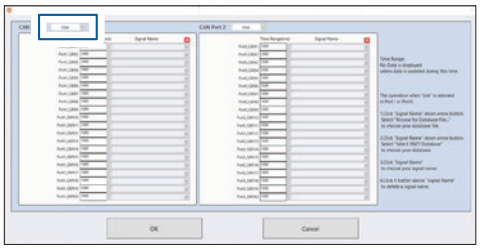
2 Click Instruments.



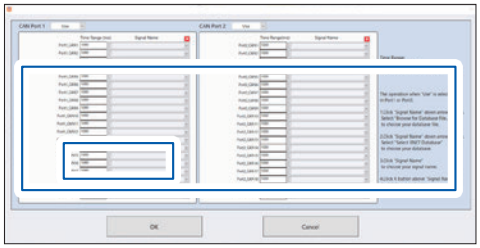
3 Click CAN.



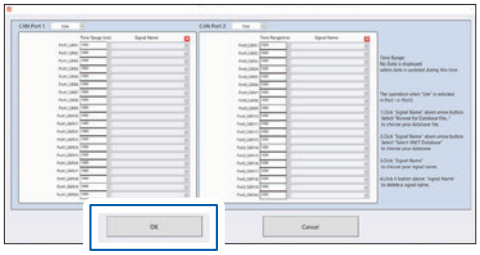
4 Click and select Use.



5 Click and select each item.

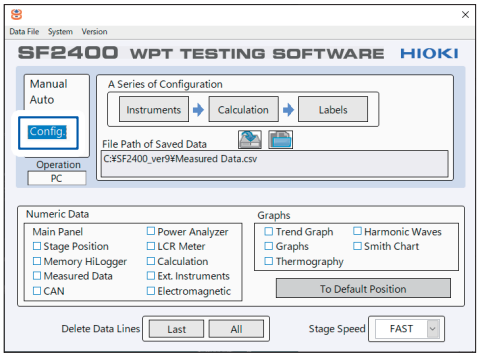


6 Click OK.

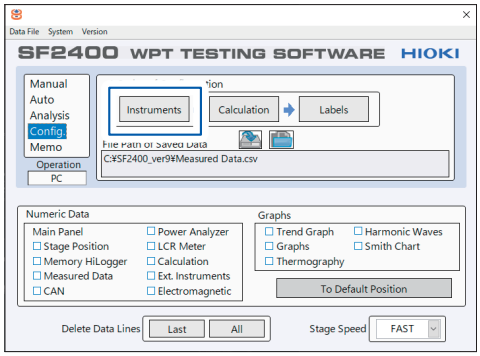


Setting the Thermography

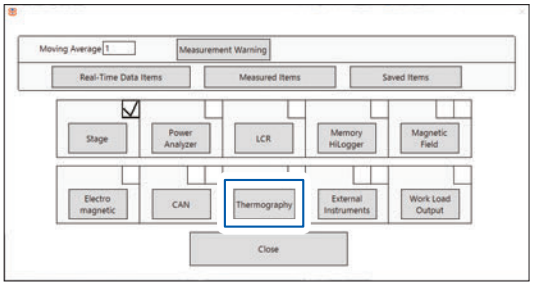
1 Click **Config.** on the main window.



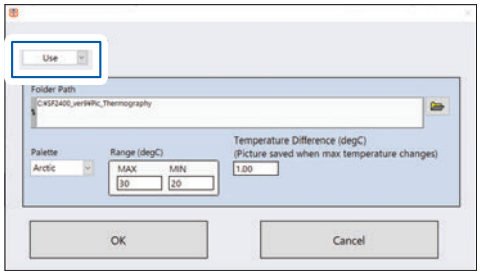
2 Click **Instruments**.



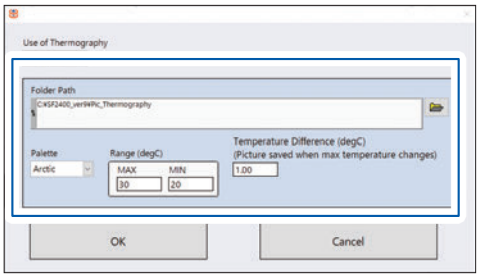
3 Click **Thermography**.



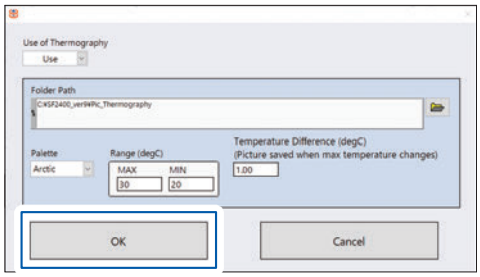
4 Click and select **Use**.



5 Click and select each item.



6 Click **OK**.

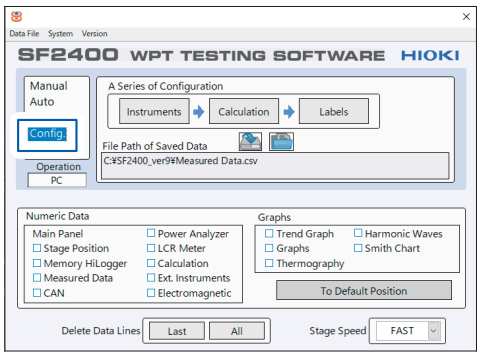


3.10 External Output and Workpiece Load

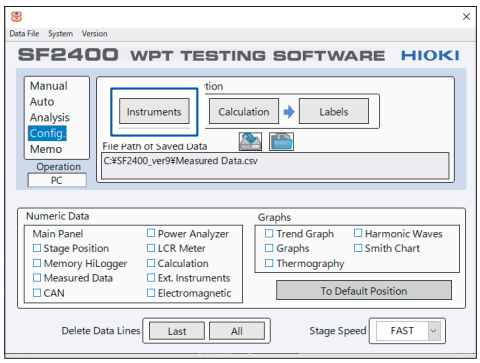
Specify the following settings when controlling external output (2 channels) and workpiece load connected to the external I/O terminals from the PC.

Setting the External Instruments

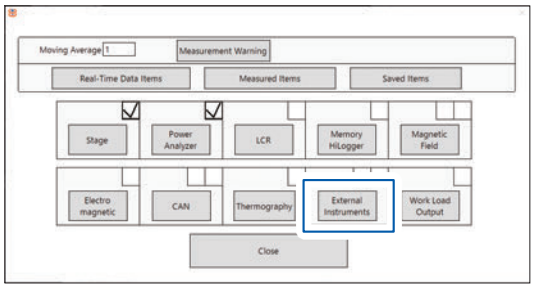
1 **Click Config. on the main window.**



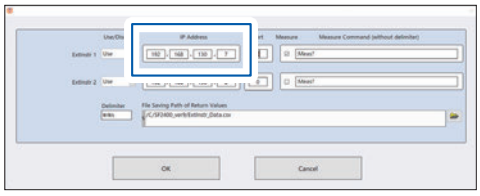
2 **Click Instruments.**



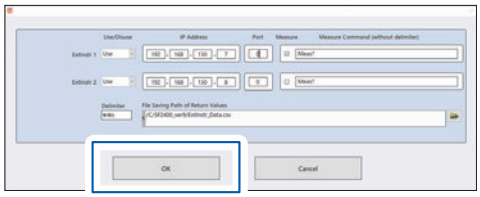
3 **Click External Instruments.**



4 **Set the external instruments' IP addresses.**

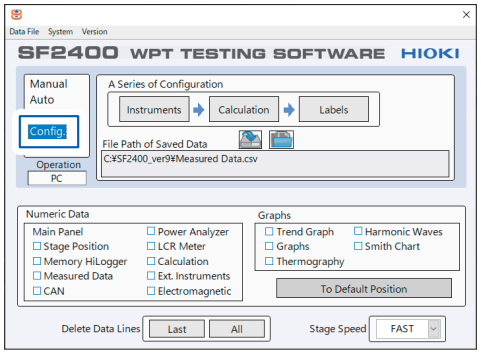


5 **Click OK.**

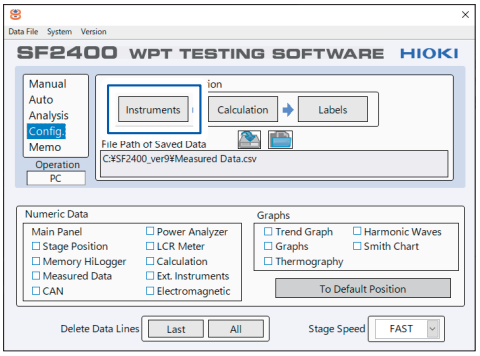


Setting the Work Load

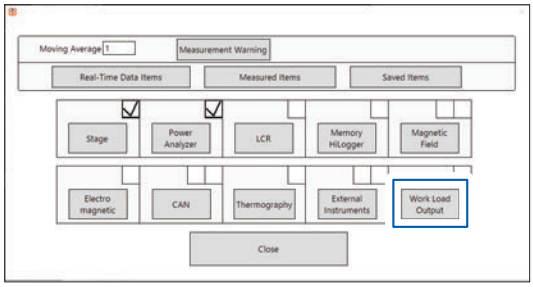
1 **Click Config. on the main window.**



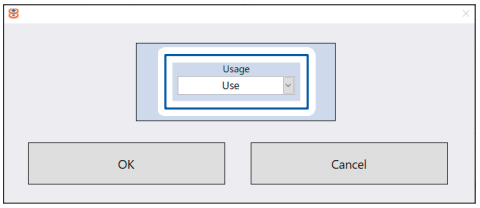
2 **Click Instruments.**



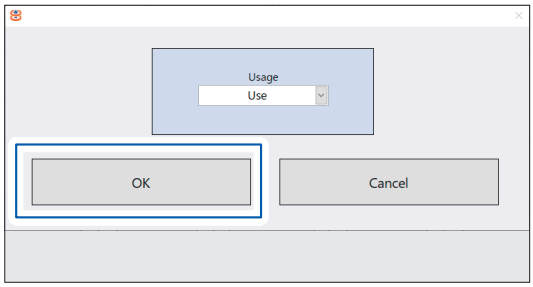
3 **Click Work Load Output.**



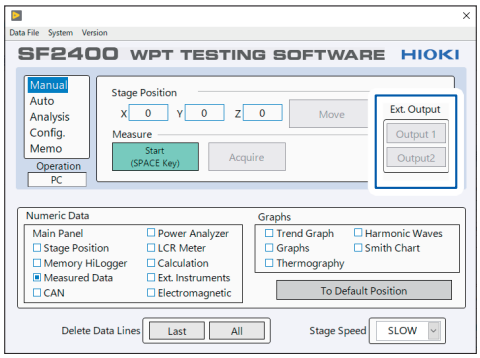
4 **Click and select Use.**



5 **Click OK.**



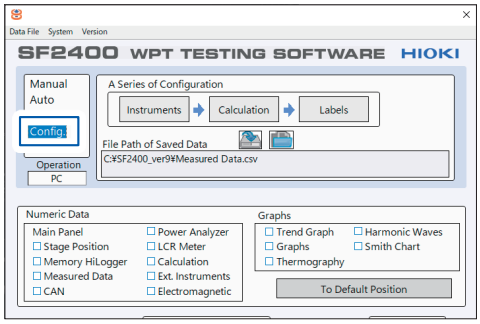
For manual measurement (p.75), the item to be externally controlled is displayed.



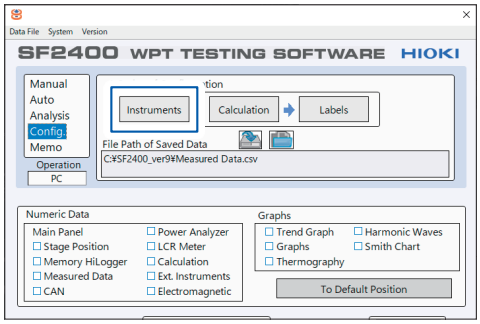
3.11 Setting the Measured Value Warning

The measured value warning is a function to stop the instrument for safety when a value outside the specified range is acquired from the instrument.

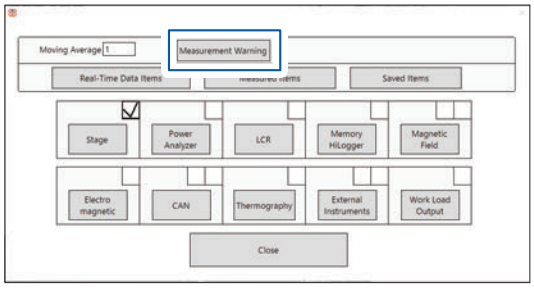
1 **Click Config. on the main window.**



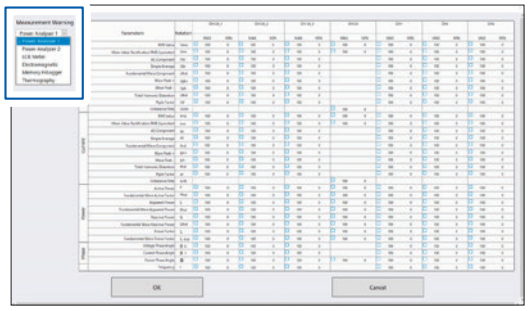
2 **Click Instruments.**



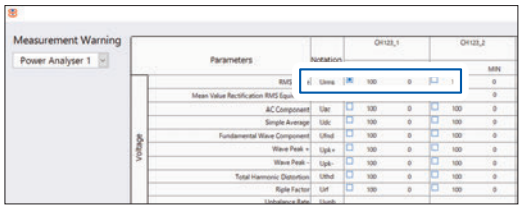
3 **Click Measurement Warning.**



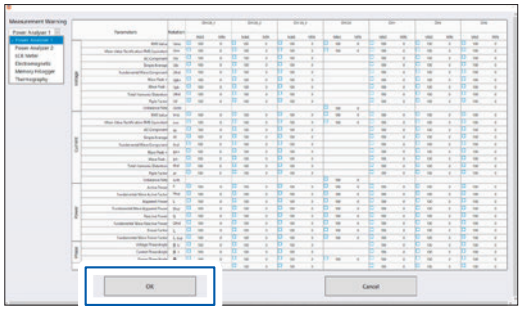
4 **Click and select the stage or measuring instrument.**



5 **Select the item to be monitored by the measured value warning and enter the upper/lower limit values.**

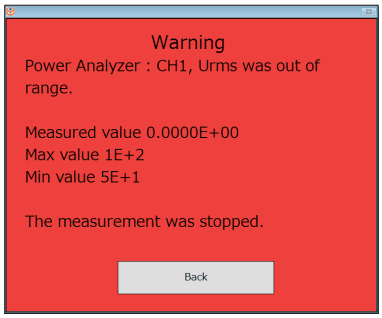


6 **Click OK.**



The measured value is checked to see whether it is in the upper/lower limit range every time a measurement is performed.

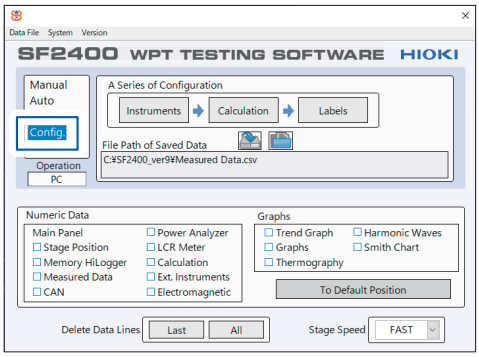
When the value is outside of the range, a warning window appears.
When manual measurement is performed, the measurement is continued. When automatic measurement is performed, it is switched to manual measurement.



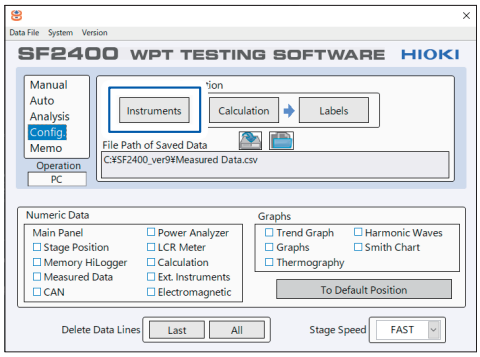
3.12 Setting Data Items to be Saved

The measurement data items to be saved in the PC can be selected.

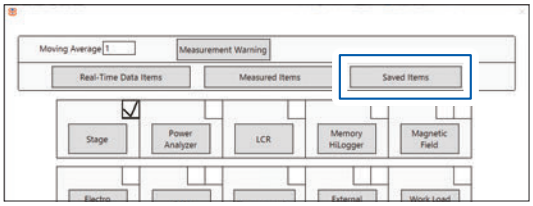
1 Click Config. on the main window.



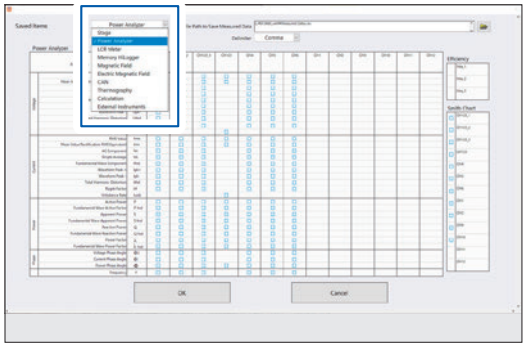
2 Click Instruments.



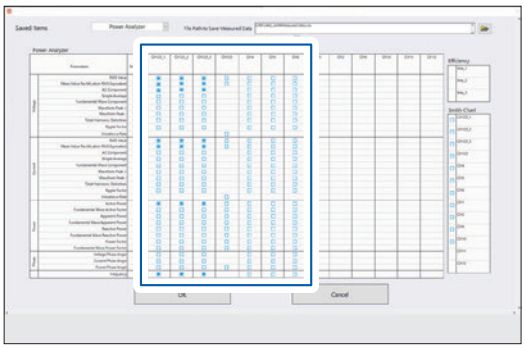
3 Click Saved Items.



4 Select an instruments to be saved.

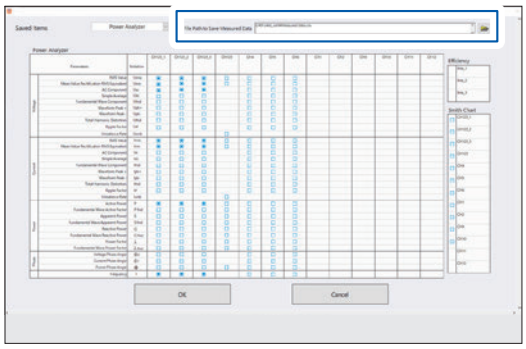


5 Select an item (items) to be saved.

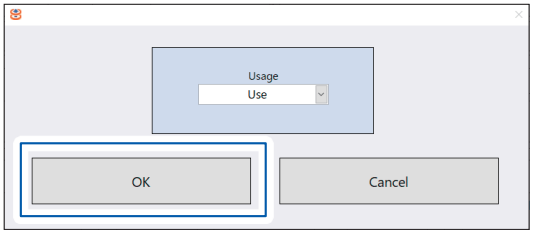


Checkboxes (☐) are displayed only for the items of the connected instrument.

6 Click the folder icon and select the CSV format file of the saving destination.



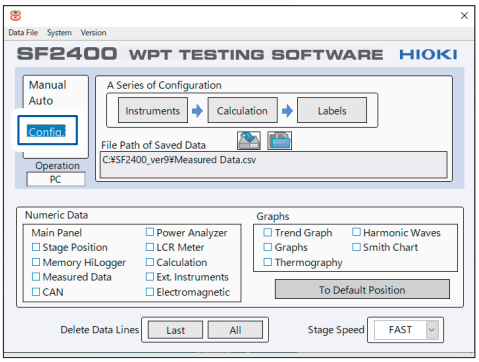
7 Click OK.



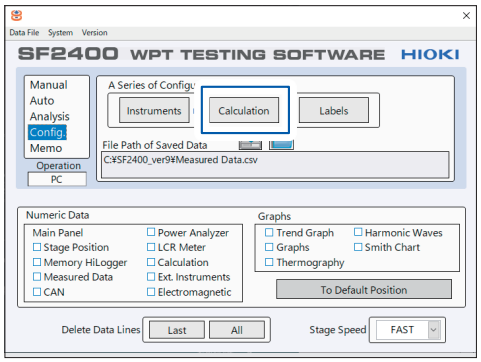
3.13 Setting the Calculation Formula

When a calculation formula is set, the measured value is automatically calculated during measurement and the calculation result is displayed in the **User Defined Function Real-Time Data** window.

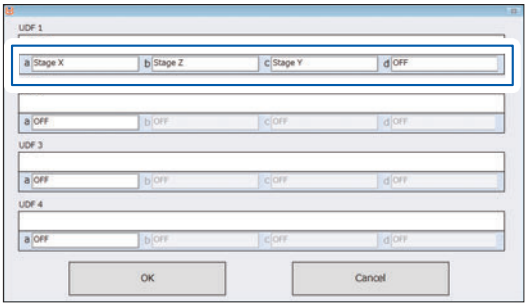
1 Click Config. on the main window.



2 Click Calculation.

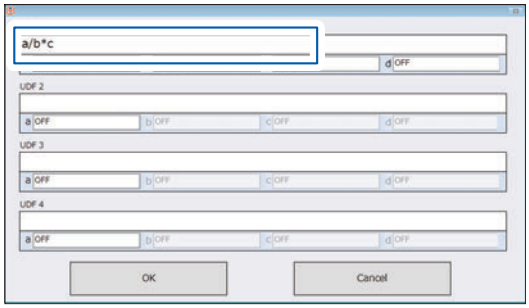


3 Click and select the calculation parameter.



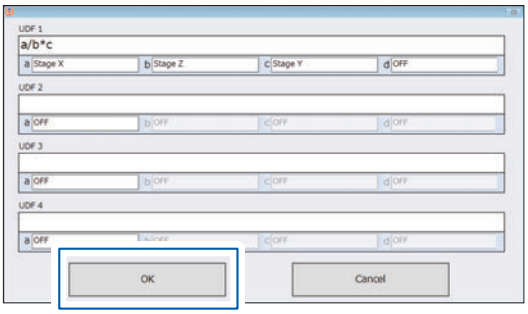
When the use of the stage is selected (p.50) for **Instruments**, the stage items are displayed. For the model PW6001, LCR meter, and Memory HiLogger, the items checked in **Real-Time Data Items** (p.68) can also be selected.

4 Enter a calculation formula.

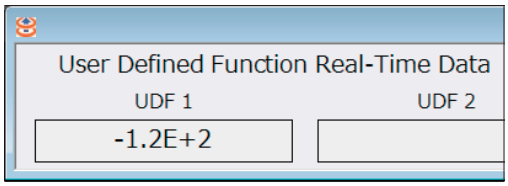


Reference: “Functions” (p.66)

5 Click OK.



When an invalid calculation formula is entered, an error is displayed.
Correct the calculation formula and then click **OK**.



The calculation result is displayed in the **User Defined Function Real-Time Data** window.

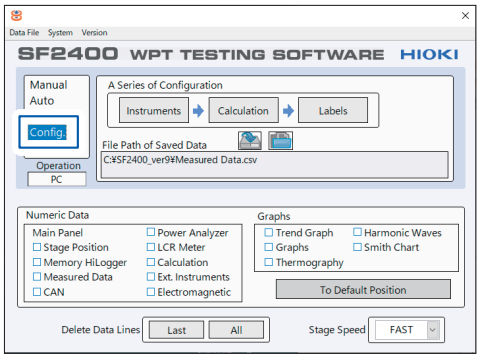
Functions

Function	Explanation
abs(x)	Absolute value: Returns an absolute value of x.
acos(x)	Inverse Cosine: Calculates an arc cosine of x in radians.
acosh(x)	Inverse Hyperbolic Cosine: Calculates a hyperbolic inverse cosine of x.
asin(x)	Inverse Sine: Calculates an arc sine of x in radians.
asinh(x)	Inverse Hyperbolic Sine: Calculates a hyperbolic inverse sine of x.
atan(x)	Inverse Tangent: Calculates an arc tangent of x in radians.
atan2(y,x)	Inverse Tangent (2 Input): Calculates an arc tangent of x/y in radians.
atanh(x)	Inverse Hyperbolic Tangent: Calculates a hyperbolic arc tangent of x.
ceil(x)	Rounding up to an integer: Rounds up x to the next greater integer (smallest integer x).
cos(x)	Cosine: Calculates a cosine value of x. The unit of x is radians.
cosh(x)	Hyperbolic Cosine: Calculates a hyperbolic inverse cosine of x.
cot(x)	Cotangent: Calculates a cotangent of x (1/tan (x)). The unit of x is radians.
csc(x)	Cosecant: Calculates a cosecant of x (1/sin (x)). The unit of x is radians.
exp(x)	Exponent: Calculates a value of e to the xth power.
expm1(x)	Exponent function: Subtracts 1 from (Arg) - 1 e to the xth ((e^x) - 1).
floor(x)	Rounding down to an integer: Rounds down x to the next smaller integer (greatest integer x).
getexp(x)	Mantissa & exponent: Returns an exponent of x.
getman(x)	Mantissa & exponent: Returns a mantissa of x.
int(x)	Rounding down to a closest value: Rounds down - x to the closest integer.
intrz(x)	Rounds down - x to the integer closest to the value between x and 0.
ln(x)	Logarithm natural: Calculates a logarithm natural of x with e as a base.
lnp1(x)	Logarithm natural: Calculates a logarithm natural of (Arg +1) (x + 1).
log(x)	Common logarithm: Calculates a logarithm of x with 10 as a base.
log2(x)	Logarithm of base 2: Calculates a logarithm of 2 as a base.
max(x,y)	Maximum and minimum: Returns the larger value of maximum and minimum x and y.
min(x,y)	Maximum and minimum: Returns the smaller value of maximum and minimum x and y.
mod(x,y)	Quotient & remainder: Calculates the remainder of x/y when the quotient is rounded toward the negative infinity.
x^y	x to the Yth power: Calculates x to the yth power.
rand( )	Random number (0 - 1): Generates a floating decimal point between random numbers 0 and 1 exclusively.
rem(x,y)	Quotient & remainder: Calculates the remainder of x/y when rounding down the quotient to the closest integer.
sec(x)	Secant: Calculates a secant of x. The unit of x is radians (1/cos (x)).
sign(x)	Sign: Returns 1 when x is larger than 0, returns 0 when x is equal to 0, and return -1 when x is smaller than 0.
sin(x)	Sine: Calculates a sine value of x. The unit of x is radians.
sinc(x)	Sinc: Calculates a sine value (sin (x)/x) by dividing sine of x by x. The unit of x is radians.
sinh(x)	Hyperbolic Sine. Calculates a hyperbolic inverse sine of x.
sizeOfDim(ary,di)	Returns the size of the specified “di” dimension to the arrangement ary.
sqrt(x)	Square root: Calculates a square root of x.
tan(x)	Tangent: Calculates a sine value of x. The unit of x is radians.
tanh(x)	Hyperbolic Tangent: Calculates a hyperbolic arc tangent of x.

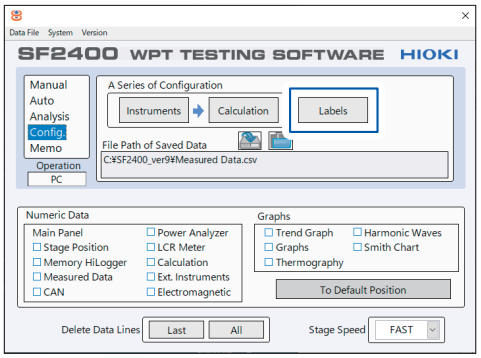
3.14 Setting Labels

The stage, measuring instrument, and calculation can be labeled.

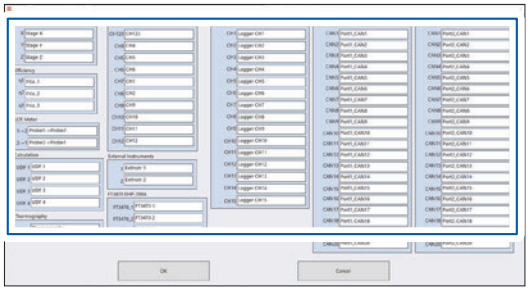
1 Click Config. on the main window.



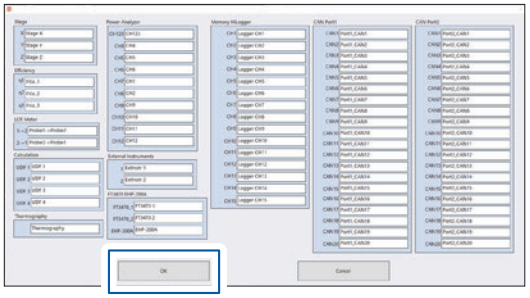
2 Click Labels.



3 Enter a desired name.



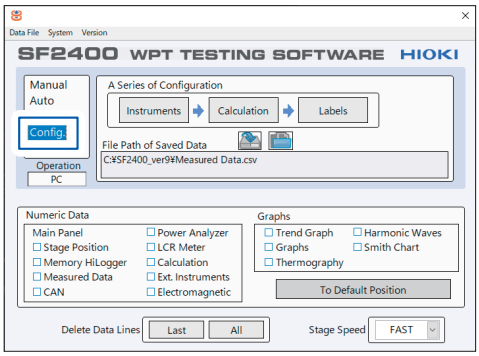
4 Click OK.



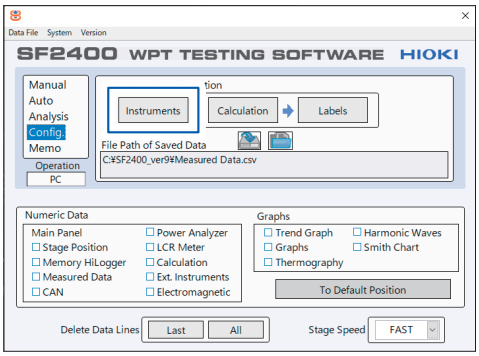
3.15 Setting Real Time Data Display Items

When measurement is started, data is always acquired from the instrument or stage. If all measurement data are displayed, the number of data becomes significantly large.
It is possible to set to display only the desired data.

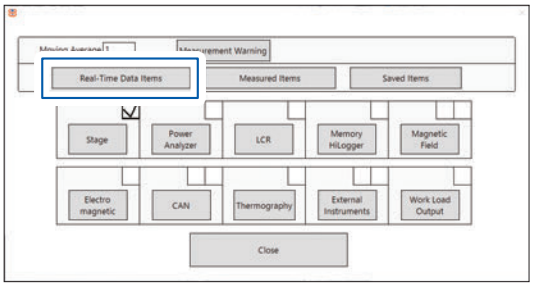
1 Click Config. on the main window.



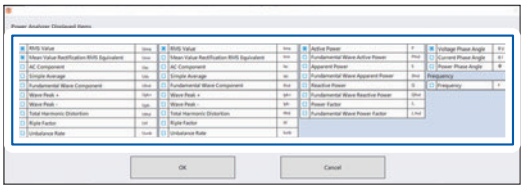
2 Click Instruments.



3 Click Real-Time Data Items.

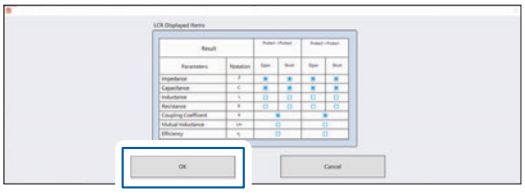


4 (When the power meter is enabled) Select an item (items) to be displayed.



5 (When the LCR meter is enabled) Select an item (items) to be displayed.

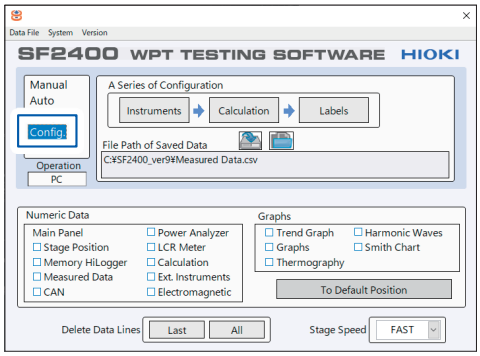
6 Click OK.



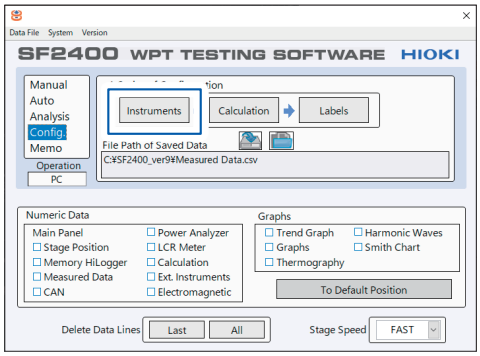
3.16 Measured Data Display Items

The items checked here are displayed in the measured data list when **Acquire** is clicked in manual measurement and a measurement sequence is executed in automatic measurement.

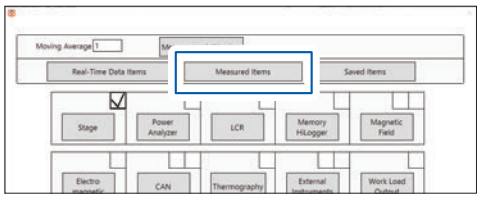
1 Click Config. on the main window.



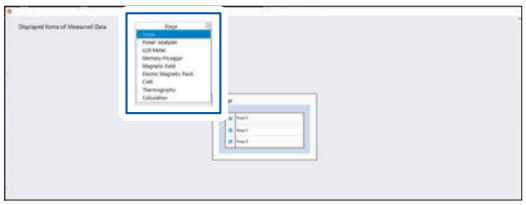
2 Click Instruments.



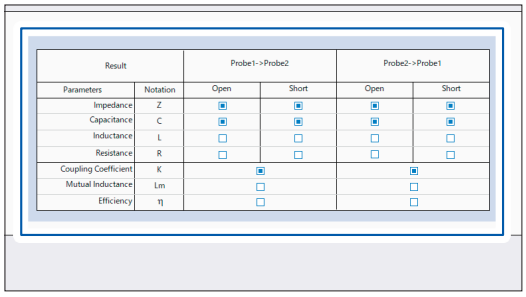
3 Click Measured Items.



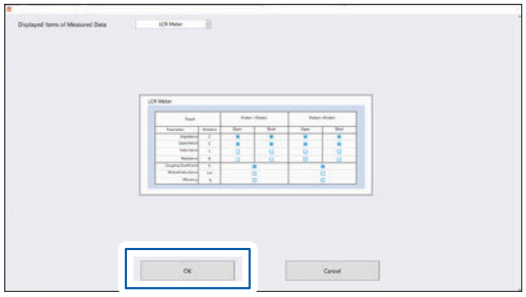
4 Select an instrument to be displayed.



5 Check an item (items) to be displayed in the measured data list.



6 Click OK.



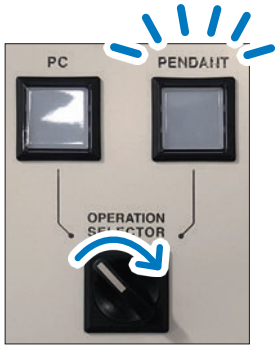
3.17 Positioning a Workpiece

Move the work table using the model Z5017 PLC Rack pendant so that a workpiece can be easily set and secure the workpiece.

⚠ CAUTION

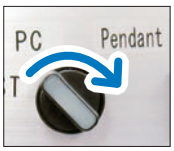
Be sure to secure a workpiece to the work table.
If the workpiece is not completely secured, it will fall when the work table accelerates/decelerates, which may damage the workpiece or the instrument.

1 Switch the [OPERATION SELECTOR] on the front of the model Z5017 to [PENDANT].



The [PENDANT] indicator lights up.

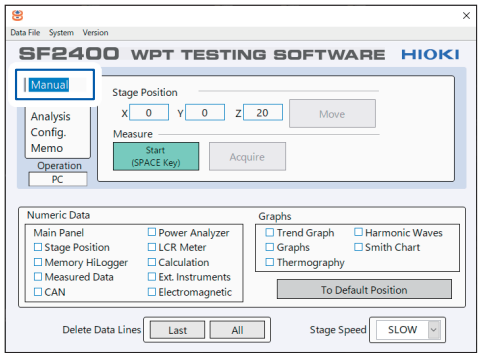
2 Switch the operation authority selector on the pendant to [Pendant].



The operation authority selector on the pendant lights up.

Only when the selectors of the model Z5017 and pendant match, the work table can be moved using the selected PC or pendant.

3 Click Manual on the main window.



While checking the coordinates under **Stage Position**, perform the following operation.

4 Press the [Enable] button on the pendant (lit) and move the work table using the joystick.

Joystick

Joystick operation

X-axis and Y-axis movement: Tilt the stick in each direction.
Z-axis movement: Turn the knob of the joystick to left or right. (Left: Downward, right: upward)

5 Secure a workpiece to the work table.

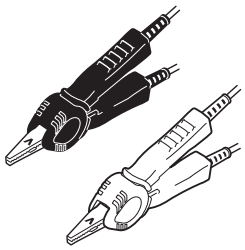
3.18 Connecting the Measuring Instrument and a Workpiece

When measuring a coupling coefficient

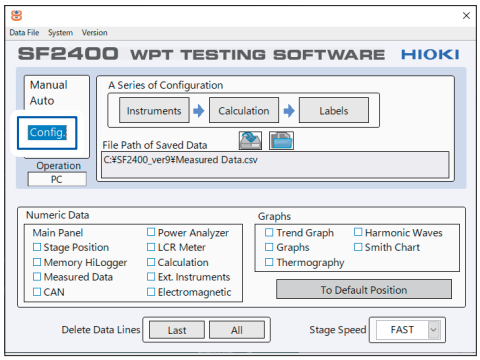
Connect the LCR meter (Model IM3570 Impedance Analyzer or IM3536 LCR Meter) and a workpiece. The LCR meter must be set in advance (p. 54).

1. Executing open correction

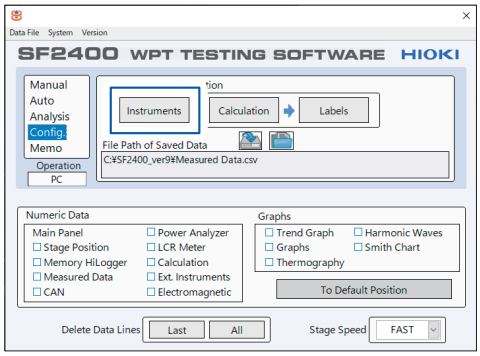
1 **Open HIGH and LOW of the model Z5018 Switch Box clips.**
(Adjust the distance between HIGH and LOW based on the width of a workpiece.)



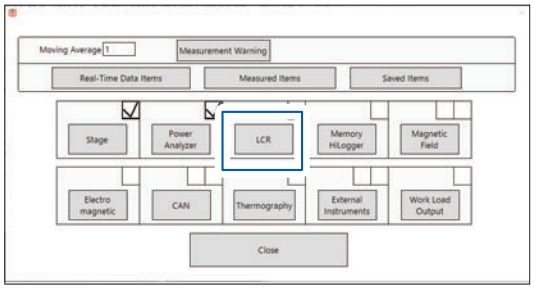
2 **Click Config. on the main window.**



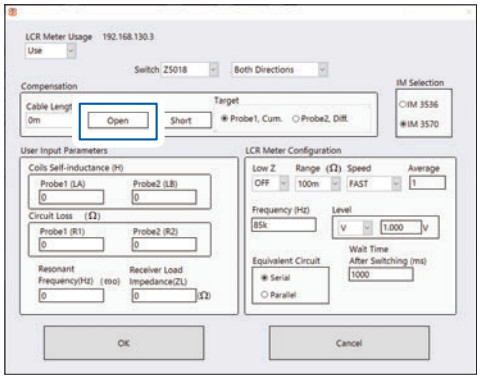
3 **Click Instruments.**



4 **Click LCR.**

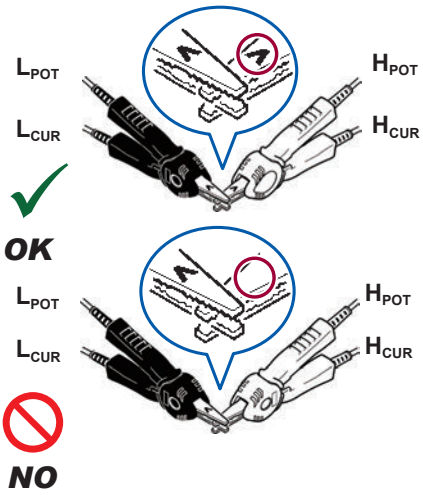


5 **Click Open.**

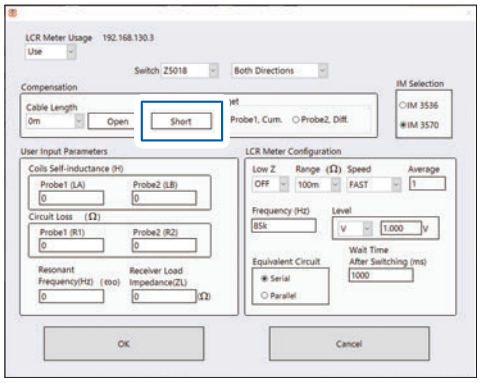


2. Executing short correction and connect a workpiece

1 **Align the V marking on the model Z5018 Switch Box clips and short the tip.**



2 **Click Short.**



3 **Secure the workpiece to the work table.**

4 **Connect the Z5018 clips to OSB1 and OSB2.**

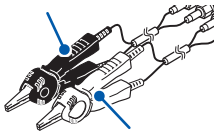
L_{CUR}: Blue, L_{POT}: Green, H_{POT}: White, H_{CUR}: Red

5 **Connect the Z5018 clips to the transmission side and reception side coils.**

PROBE 1: Transmission side

PROBE 2: Reception side

Black clip



Red clip

3. Executing load correction

Execute open correction and short correction and connect a workpiece to the model Z5018 Switch Box before executing load correction.
As open correction and short correction are performed, panels of panel name **1** and **2** are created in the LCR meter.

Panel name	Description
1	Probe 1 correction data
2	Probe 2 correction data

For the procedure to load and save the panels, see the Instruction Manual that accompanies the LCR meter.

1 **Load panel 1.**

2 **Executing load correction.**

3 **Save panel 1.**

4 **Load panel 2.**

5 **Executing load correction.**

6 **Save panel 2.**

When measuring a power efficiency and other items

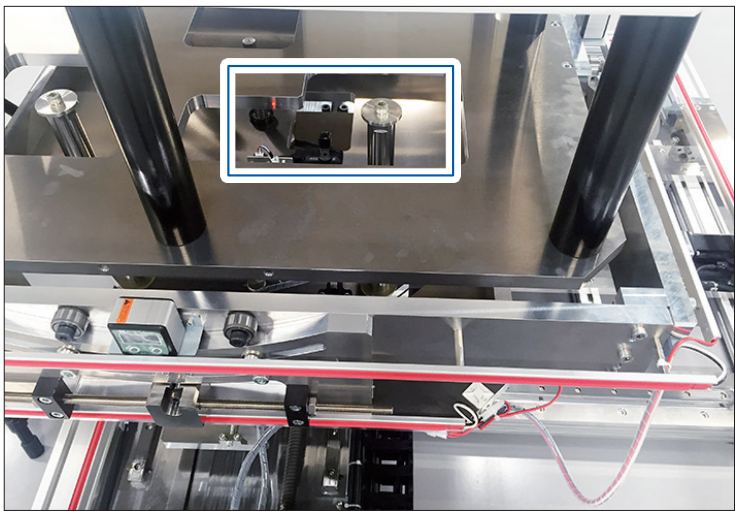
Connect or install each optional measuring instrument to the measurement point of a workpiece. For the connection and installation, see the instruction Manual that accompanies each measuring instrument.

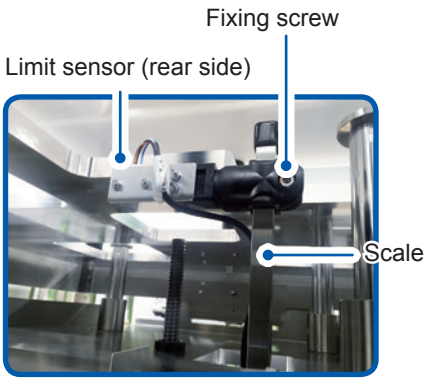
Options		Measurement item
☐ **PW6001**	**Power Analyzer**	Current, voltage, active power, frequency, voltage/current/power phase, power factor, and efficiency
☐ **8423**	**Memory HiLogger**	Voltage and temperature
☐ **FT3470-51/-52**	**Magnetic Field HiTester**	Field intensity
☐ **EHP-200A**	**Electric and Magnetic Field Probe - Analyzer**	Electric field intensity, field intensity
☐ **USB-8502**	**CAN Interface Device**	CAN communication
☐ **FLIR E53**	**Optic - Advanced Thermal Camera**	Temperature

3.19 Determining the Z-Axis Limit Sensor Position

Adjust the position of the Z-axis limit sensor according to the thickness of a workpiece to be measured.
When the X-axis, Y-axis, or Z-axis limit sensor is activated, a move command from the PC is canceled and any moving axes are stopped.
After the axes are stopped, only a move command in the direction opposite from the limit sensor is accepted.

Although the X-axis and Y-axis limit sensor positions are fixed, the Z-axis limit sensor position can be adjusted. With consideration of the workpiece thickness and the distance between the axis and the reception coil, adjust the Z-axis limit sensor height so that there is no interference with the stage or a workpiece.
(It is set at the upper limit of the stroke range at the time of shipment.)





Expanded view of the frame shown in the photo on the left

Required items:

Hexagonal wrench

1 **Loosen the fixing screw using a hexagonal wrench.**

2 **Adjust the limit sensor height referring to the scale.**

3 **Tighten the fixing screw using the hexagonal wrench.**

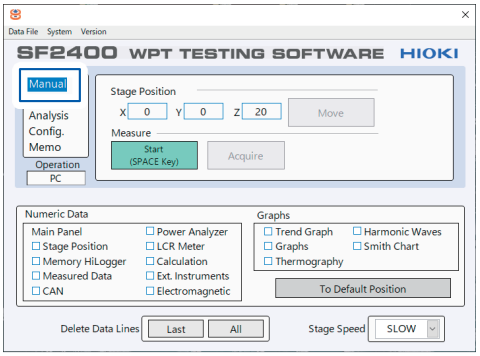
4 Measurement

There are two measurement types, manual measurement and automatic measurement.

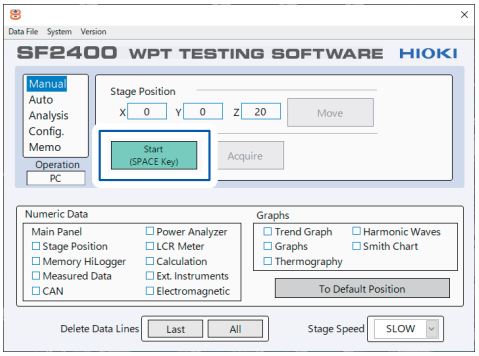
4.1 Manual measurement

Manually move the stage to specified coordinates and import data.

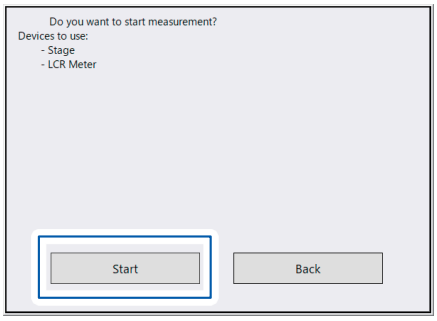
1 Click Manual on the main window.



2 Click Start.

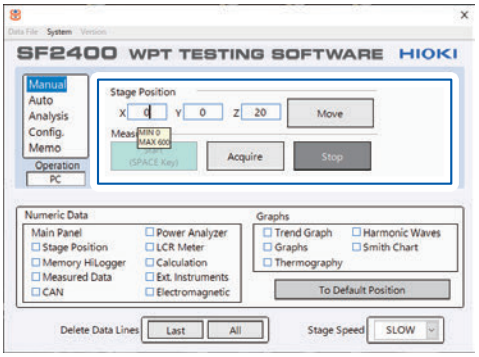


3 Click Start.



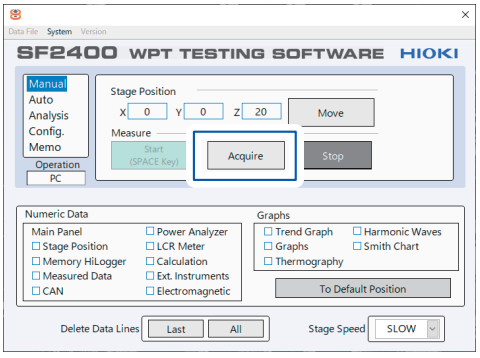
As the instrument to be used is displayed, check it before starting measurement.
If the displayed instrument is wrong, change the setting.
Reference: “3.9 Setting the Measuring Instrument” (p. 52)

4 Enter coordinates and click Move.

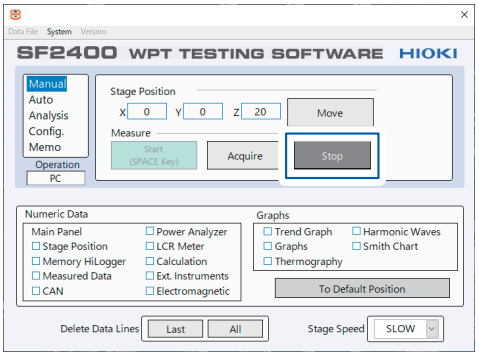


When the cursor is placed over the **Stage Position** cell, the input range (maximum (**MAX**) and minimum (**MIN**)) is displayed. If values that are not in the range are entered, they are automatically set to values within the range. (Example: Even when **110** is entered, **100** is set.)
The coordinates during movement can be checked in the **Stage Position Real-Time Data** window (p. 19).

5 Click Acquire.



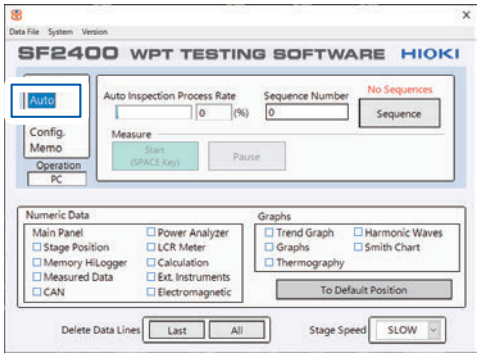
6 Click Stop.



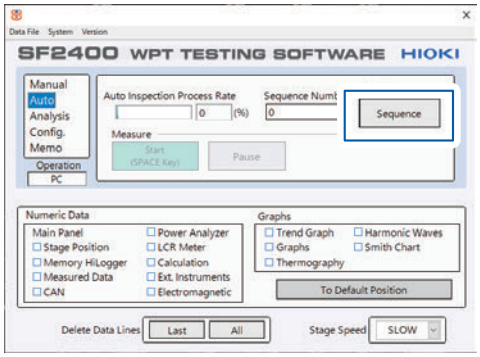
4.2 Automatic measurement

The stage is moved and data is imported according to the preset settings and order (sequence).

1 **Click Auto on the main window.**

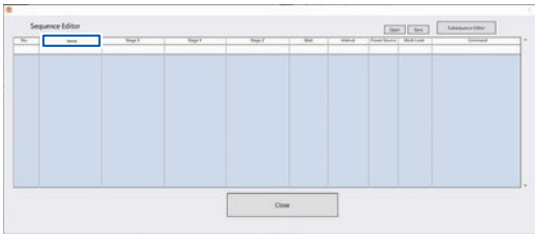


2 **Click Sequence.**

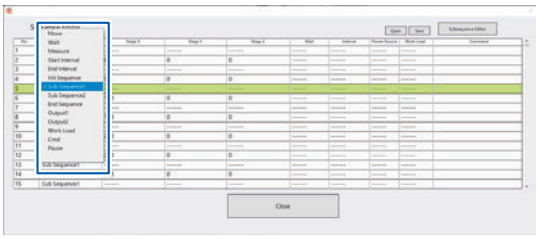


The script window (window to set the measurement order) appears.

3 **Click the cell of Items.**



4 **Select an item.**
(Reference: “Main sequence item list” (p.77))

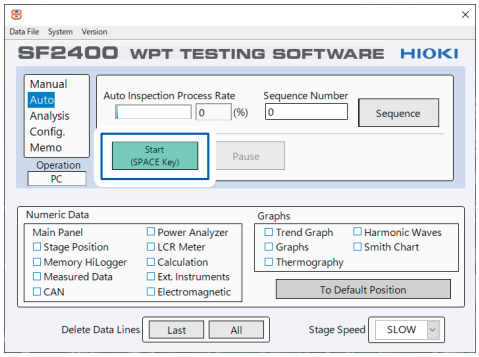


5 **Repeat step 3 and 4 and select all required items.**

6 **Set the details of each item.**
(Reference: “Main sequence item list” (p.77))

7 **Click Close.**

8 **Click Start on the main window.**



When all the main sequence items are completed, 100% is displayed under **Auto Inspection Process Rate**.

When ending measurement

Click **Stop**.

When pausing measurement

Cick **Pause**. Click **Start** to resume measurement.

Main sequence item list

Item	Explanation	Detail setting item
Move	Moves the stage to the specified coordinates.	Coordinate values (**X**, **Y**, **Z**)
Wait	Stands by for the specified time.	**Wait**
Measure	Imports data.	–
Start Interval	Imports data at the specified intervals.	**Interval**
End Interval	Ends interval measurement.	
Init Sequence	Executes the items set in **Subsequence Editor**. Reference: “Creating a sub-sequence” (p.78)	–
Sub Sequence1		
Sub Sequence2		
End Sequence		
Output1_ON_OFF	Turns ON/OFF external output 1 of the external I/O terminal (71).	
Output2_ON_OFF	Turns ON/OFF external output 2 of the external I/O terminal (81).	
Workpiece load_ON_OFF	Turns ON/OFF the workpiece load of the external I/O terminal (61).	
Cmd_Write_Query_Read	Writes commands to, sends queries to, and reads information from external instruments 1 and 2.	
Pause	Pauses operation.	

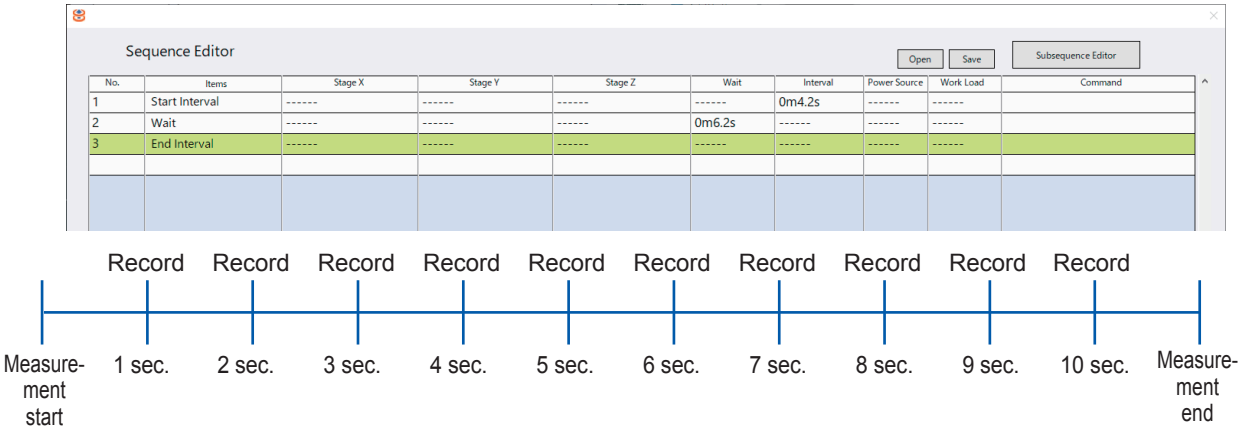
The main sequence can be saved and deleted from the menu displayed when the right button of the mouse is clicked.

Delete All Lines	Deletes all specified items and specifies settings from the beginning.
Open	Loads a saved script.
Save	Saves the present script in a tab-delimited file.
Delete Current Line	Deletes the information in the row selected by the mouse.
Insert a Line	Adds a row above the row selected by the mouse.
Batch Input	Adds the main sequence items at the same time. This is a useful function when many items are to be set. Reference: “Adding movement steps at the same time” (p.80)

Interval measurement

Continuous measurement performed at specified intervals is called “interval measurement”.
The standby time between the start and the completion of interval measurement is set.

Example: Performing continuous measurement at intervals of 1 second for 10 seconds.



Creating a sub-sequence

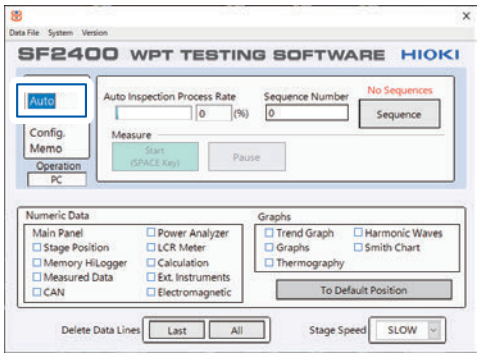
Sub-sequence

A sub-sequence is a group of multiple sequences and is used in the main sequence. Four types of sub-sequences are shown below.

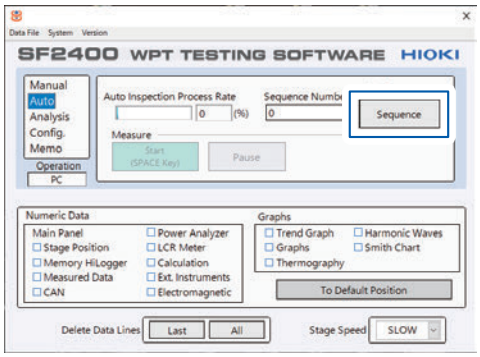
Init Sequence	Used at the start of the main sequence.
Sub Sequence 1	Used in the middle of the sequence.
Sub Sequence 2	Used in the middle of the sequence.
End Sequence	Used at the end of the main sequence.

Two types of sub-sequences can be saved. The initial and end scripts are also set.

1 **Click Auto on the main window.**

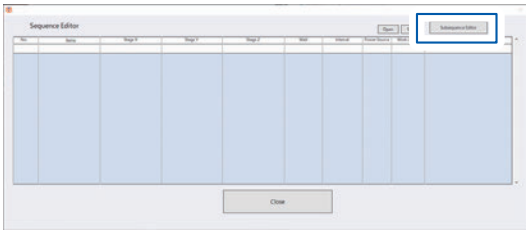


2 **Click Sequence.**



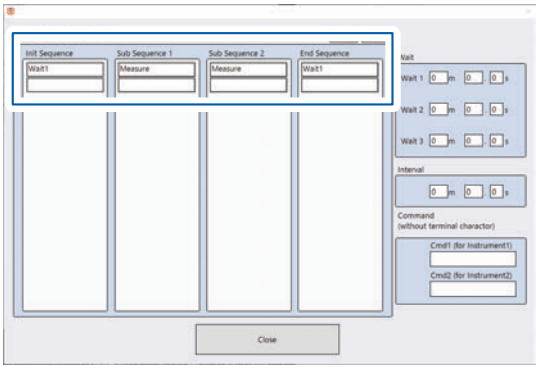
The script window (window to set the measurement order) appears.

3 **Click Subsequence Editor.**



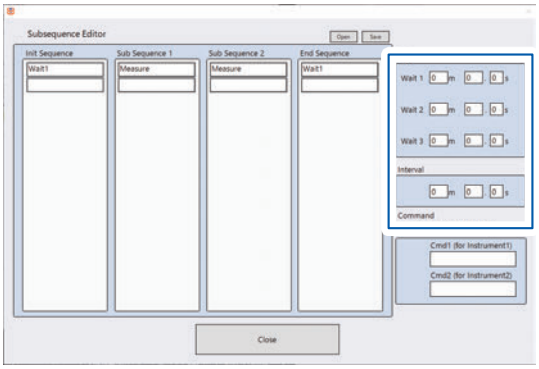
4 **Click Init Sequence, Sub Sequence 1, Sub Sequence 2, and End Sequence and select items.**

Reference: “Sub-sequence item list” (p.79)

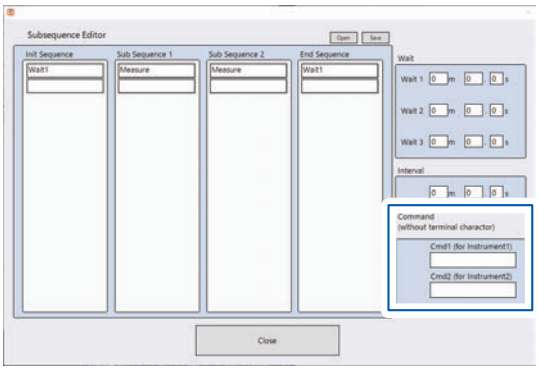


5 **Set the standby time and interval.**

(When the standby or interval measurement is selected in step 2)



6 Enter the command you wish to send to the external device being controlled.



7 **Click Close.**

Sub-sequence item list

Item	Explanation	Detail setting item
Wait	Stands by for the specified time.	Wait
Measure	Imports data.	–
Start Interval	Imports data at the specified intervals.	Interval
End Interval	Ends interval measurement.	
Output1_ON_OFF	Turns ON/OFF external output 1 of the external I/O terminal (71).	
Output 2_ON_OFF	Turns ON/OFF external output 2 of the external I/O terminal (81).	
Workpiece load_ON_OFF	Turns ON/OFF the workpiece load of the external I/O terminal (61).	
Cmd_Write_Query_Read	Writes commands to, sends queries to, and reads information from external instruments 1 and 2.	
Pause	Pauses operation.	

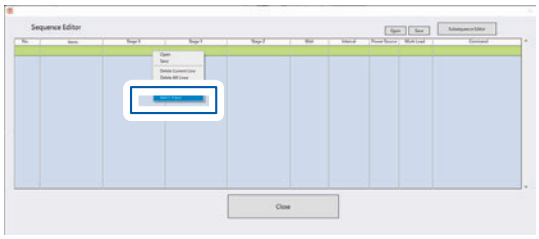
The sub-sequence can be saved and deleted from the menu displayed when the right button of the mouse is clicked.

Delete Last Line	Deletes the last row.
Default Values	Initializes the sub-sequence. By default, standby 1 is set for the initial sequence and end sequence and measurement is set for sub-sequence 1 and sub-sequence 2.
Save	Saves the present sequence in a tab-delimited file. Specify a folder and enter a file name to save the file.
Open	Opens the file selection dialog box. Select and load the selected sequence file.

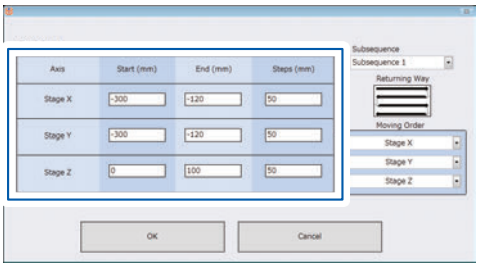
Adding movement steps at the same time

When the number of movement steps increases, it takes more time to set them. The move positions and step positions can be automatically set all together using the batch addition function. It is only necessary to enter the start and end positions and step interval of each axis.

1 **Right-click an item and select Batch Input.**

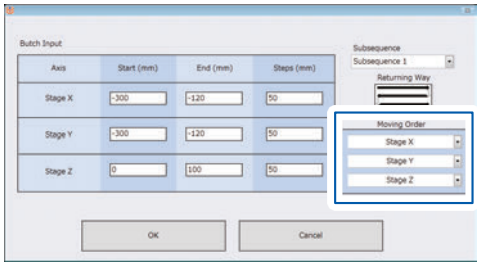


2 **Enter values in Start, End, and Steps for X, Y, and Z.**

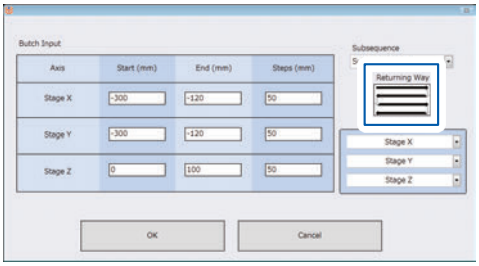


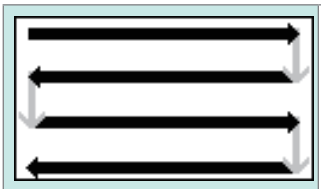
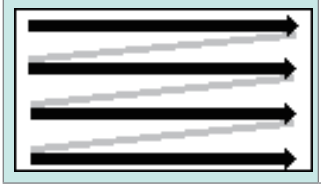
Steps: Step size of the movement interval (When the X-axis is set as shown above, the stage moves from the 0 mm position to the 10 mm position on the X-axis in increments of 1 mm.)

3 **Click and select Moving Order.**

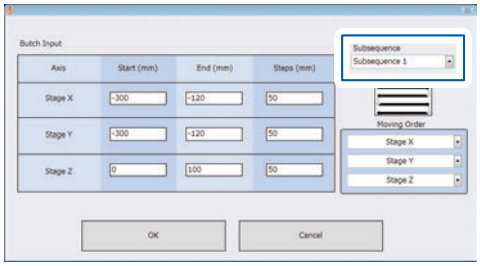


4 **Click and select the stage motion.**

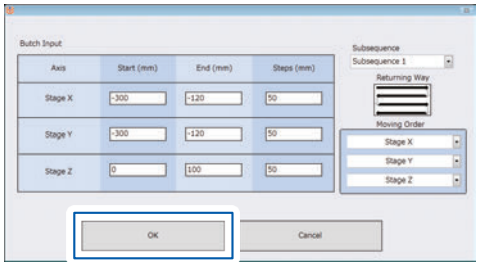


	When the stage moves to the end of one axis and is retained at the end position, another axis starts moving.
	When the axis moves to the end, it moves to the start position with another axis.

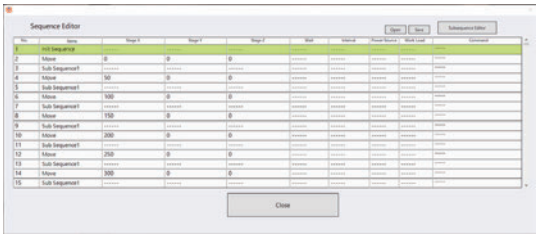
5 **Click and select Subsequence.**



6 **Click OK.**



The **Move** and the selected **Sub Sequence** are set alternately.



4

5 Specifications

5.1 Model TS2400 WPT Test System

General Specifications

The configuration and options (standard measuring instruments) of this product are selected from the following 6 patterns, A to F.

✓: Yes, –: No

	Model	Name	Description	Configuration pattern					
				A	B	C	D	E	F
TS2400	SF2400	WPT Testing Software	Measurement and control PC application	–	–	–	–	–	✓
	Z5015	PC System	PC, peripherals and model SF2400 WPT Testing Software	✓	✓	✓	✓	✓	–
	Z5016	WPT Testing Platform	Workpiece positioning stage	✓	✓	✓	✓	–	–
	Z5017	PLC Rack	• Stage control instrument • Above instrument and measuring instrument storage rack	✓	✓	✓	✓	–	–
	Z5018	Switch Box	Switches transmission/ reception coil connection.	✓	✓	–	–	–	–
	Z5025	WPT Vehicle Assembly Mount	Secondary-side coil positioning turret	✓	–	✓	–	–	–
Options	PW6001 *3	Power Analyzer	–	✓*1					
	IM3536	LCR Meter	–	✓*1					
	IM3570	Impedance Analyzer							
	8423	Memory HiLogger	–	✓*1					
	FT3470-51/ -52	Magnetic Field HiTester	–	✓*2					
	EHP-200A	Electric and Magnetic Field Probe - Analyzer	–	✓*2					
	USB-8502	CAN Interface Device	–	✓*2					
	FLIR E53	Optic - Advanced Thermal Camera	–	✓*2					

*1: Connected using LAN
*2: Connected using USB
*3: Compatible with PW6001-01/-02/-03/-04/-05/-06/-11/-12/-13/-14/-15/-16.

5.2 Model SF2400 WPT Testing Software

General Specifications

License key authentication method	Authentication by license key 1 dongle per 1 license
License configuration	Any number can be installed on PCs. When the license key is not inserted: Cannot be connected to optional measuring instruments, Z5017 PLC Rack, and Z5016 WPT Testing Platform.
Distribution	Preinstalled on the Z5015 PC System. The latest version can be downloaded from our website.
Operating environment PC specifications	Operation guaranteed only on the Z5015 PC System. When it is to be used on other computers, the following specifications are recommended. OS: Windows 7 and 10, 32 bits or 64 bits Main memory: 4 GB or more CPU: Clock frequency 1.9 GHz or more and 4 cores/4 threads or more Storage: SSD 64 GB or more Display: Screen resolution 1920 × 1080 or more, 2 displays (dual-display environment)
Network connection	Not available, use standalone only
Accessories	Reference: "Accessories" (p.3)

Function Specifications

(1) Data collection and control items

Model	Name	Control item	Data collection and calculation item
PW6001	Power Analyzer	Current/voltage range, synchronized source, and efficiency calculation setting	Select from the PW6001 measurement parameters (maximum 180).
IM3570 (IM3536)	Impedance Analyzer (LCR Meter)	Measurement range and measurement frequency	Inductance, capacity, DC resistance, and impedance
8423	Memory HiLogger	Measurement range	Voltage and temperature
FT3470-51/-52	Magnetic Field HiTester	Measurement range	Magnetic flux density
EHP-200A	Electric and Magnetic Field Probe - Analyzer	Measurement range	Electric flux density, magnetic flux density
USB-8502	CAN Interface Device	Communication setting	–
FLIR E53	Optic - Advanced Thermal Camera	Measurement range	Heat distribution
Z5016[*1]	WPT Testing Platform	Axis position and axis movement speed	Present axis coordinates
Z5018[*1]	Switch Box	Switching the connection system of power transmission/reception workpiece. 1. Switching between transmission workpiece and reception workpiece for connection. 2. Reception side short circuit/open	–
External control	Workpiece load equipment [*1]	ON/OFF	–

Model	Name	Control item	Data collection and calculation item
External control	Workpiece power supply *1	ON/OFF [Interlock operation condition 1. or 2.] 1. The workpiece load is OFF. 2. The measured value is over the specified threshold value.	–

*1: Control via the Z5017 PLC Rack
Similar measuring instruments other than shown above can be fabricated as special orders. However, only compatible measurements are available.

Calculation Items

Item	Character	Input parameter			Calculation formula
		Item		Character	
Coupling coefficient	K	Transmission coil inductance	When the reception coil end is open	L_o	$K=\sqrt{1-\frac{L_S}{L_o}}$
			When the reception coil end is shorted	L_S	
Mutual inductance (calculated value)	$L_{m\,cal}$	Transmission/ reception coil self-inductance	Transmission side	L_A	$L_{m\,cal}=K\sqrt{L_A L_B}$
			Reception side	L_B	
Efficiency (calculated value)	η_{cal}	Resonance frequency *1		ω_0	$\eta_{cal}=\frac{(\omega_0 L_{m\,cal})^2 Z_L}{(Z_L+R_2)\{R_1 Z_L+R_1 R_2+(\omega_0 L_{m\,cal})^2\}}$
		Mutual inductance (calculated value)		$L_{m\,cal}$	
		Reception side load impedance *1		Z_L	
		Transmission coil resistance component *1		R_1	
		Reception coil resistance component *1		R_2	
User-defined calculation (Including the scaling function)	Any character *2	User optional definition			

*1: Constant input by the user.
*2: Reserved/prohibited characters are excluded.

Control and Data Collection Mode Function

Mode	Data collection trigger	Stage move command	Z5018 Switch Box switching connection	Workpiece load control Workpiece power supply control	Wait
Manual	Soft button operation	Destination coordinate input and soft button operation	Soft button operation	ON/OFF by soft button operation	–
Automatic	Can be set for each execution step. Each 200 ms of fastest time interval	Can be set for each execution step.			

The automatic operation program can be input/output in a text format file.

Screen display

Item		Description
Real time measured value		Displays the present values of each measuring instrument and stage coordinates.
Graph (Present collected data and reference data overwritten)	2D	2D graph that allows user-defined measured value to be set for each axis
	3D	3D graph that allows user-defined measured value to be set for each axis
	3D contour	3D graph and color graph that allow user-defined measured value to be set for each axis
	Smith chart	Plots the impedance of the transmission/reception coils.
Trend graph	Displays the time series transition of user-defined measured value.	
Thermography	Displays the heat distribution as a graph.	
List display	Displays the collected data in order in a list.	
Warning	Measured/ calculated value upper/lower limit	Displays the “*** (Parameter name) upper/lower limit” dialog box.
	Emergency stop	Displays the “Emergency stop” dialog box.
	PLC failure	Displays the “PLC failure” dialog box.

Processing During Data Collection

Data update interval	200 ms (reference value)
Moving average	Target: All measured value primary data Number of data to be averaged: 1 to 100 (A number is to be set by the user.)

Data save/read

Save	The collected data can be output in a CSV format. The memo description in the main window is also included in the file along with the collected data.
Read	The saved CSV file can be read and handled in the same way as for the collected data.

Measured Value Warning Function

Measurement item	The upper and lower limit threshold values can be set for each item.
Stage coordinates	Any values outside the axis movement range cannot be input or specified.

5.3 Model Z5015 PC System

General Specifications

This product is composed of the following PC and software.

PC	Suzuden SSM-WM700V2
Software	Model SF2400 WPT Testing Software

Other general specifications are shown below.

OS	Microsoft® Windows 10 Professional, 64-bit
Power supply	AC adapter Rated supply voltage: 100 to 240 V AC (A voltage fluctuation of ±10% must be considered for the rated supply voltage.) Rated supply frequency: 50 Hz/60 Hz Anticipated transient overvoltage: 2500 V Maximum rated power: 80 VA (PC only)
Backup battery life	Approx. 6 years (Reference value at 23°C)
CPU	Intel Atom E3845 (1.91 GHz 4-core/4-thread) or equivalent
Memory	4 GB
Storage	SSD 64 GB
Interface (Overview)	USB 3.0 ×1, USB 2.0 ×4 RS-232C ×4 Ethernet ×2 HDMI ×1, analog VGA ×1
Dimensions	Approx. 180W × 33H × 121D mm (7.09″W × 1.30″H × 4.76″D)
Mass	Approx. 800 g (28.2 oz.)
Product warranty period	1 year
Accessories	Reference: "Accessories" (p.3)
Options	None

5.4 Model Z5016 WPT Testing Platform

General Specifications

Operating environment	Indoors, pollution degree 2, altitude up to 2000 m (6562 ft.)
Floor strength	Approx. 500 kg/m^2 or more
Floor area	3 mm or less
Operating temperature and humidity	23°C ± 5°C (73°F±9°F), 80% RH or less (no condensation)
Storage temperature and humidity	10°C to 40°C (50°F to 104°F), 80% RH or less (no condensation)
Dimensions	Approx. 1600W × 900H × 1200D mm (62.99″W × 35.43″H × 47.24″D) (When the axes are at the home positions)
Mass	Approx. 350 kg (12345 oz.)
Product warranty period	1 year
Accessories	None
Options	None

Mechanical Unit Specifications

(1) Work table operation

Automatic control axes	X-, Y-, Z-axis	
Manual adjustment axes	θ-, ϕ-, ψ-axis	
Movable range	X-axis	±300 mm
	Y-axis	±300 mm
	Z-axis	±100 mm
	θ-axis	±10 deg
	ϕ-axis	±5 deg
	ψ-axis	±45 deg
Position command minimum resolution	X-axis	0.1 mm or less
	Y-axis	0.1 mm or less
	Z-axis	0.1 mm or less
Positioning error	X-axis	±0.5 mm
	Y-axis	±0.5 mm
	Z-axis	±0.5 mm
	θ-axis	±0.4 deg
	ϕ-axis	±0.4 deg
	ψ-axis	±0.4 deg
Movement speed during automatic control	X-axis	3 ranges FAST: 60 mm/s, MID: FAST×50%, SLOW: FAST×20%
	Y-axis	
	Z-axis	3 ranges FAST: 20 mm/s, MID: FAST×50%, SLOW: FAST×20%

(2) Evaluand workpiece

Maximum dimensions	800W × 70H × 800D mm (31.50″W × 2.76″H × 31.50″D)
Maximum mass	100 kg (3527 oz.)

(3) Measured value warning function

Prevention of being caught	The tape switches detect objects and shut off all axis powers.
Axis limit	• The axes are stopped by optical limit detection. • The axes can only move in the opposite direction from limit detection. • The sensor height can be adjusted only for the Z-axis.

5.5 Model Z5017 PLC Rack

General Specifications

Operating environment	Indoors, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity	23°C ± 5°C (73°F±9°F), 80% RH or less (no condensation)
Storage temperature and humidity	10°C to 40°C (50°F to 104°F), 80% RH or less (no condensation)
Power supply (input)	Rated supply voltage: 200 V / 220 V / 230 V / 240 V AC, single phase (specified at the time of shipment) ±10% Rated supply frequency: 50 Hz/60 Hz Anticipated transient overvoltage: 2500 V Maximum rated power: 3 kVA
Backup battery life	3 years (Reference value when the battery is not powered according to the YASKAWA Electric Corporation MP2310 machine controller)
Main breaker	Rated current: 30 A, rated breaking capacity: 15 kVA
Earth leakage circuit breaker	Rated current: 20 A, rated sensitivity current: 15 mA
Circuit protector	Rated current Control power system 200 V AC: 20 A
Emergency stop switch	2 locations (Front of the main unit and pendant unit)
Measured value warning	All servo powers are shut down and workpiece power ON signal output is stopped by a interlock command from the Z5015 PC System.
Dimensions	Approx. 570W × 1350H × 710D mm (22.44″W × 53.15″H × 27.95″D)
Mass	Approx. 115 kg (4056.4 oz.) (Options and measuring instruments are not included.)
Product warranty period	1 year
Accessories	None
Options	None

Operation/Display Unit Specifications

(1) Front of the main unit

Operation switches	Main power, operation preparation, emergency stop, operation authority change (main unit ↔ pendant)*1, and warning reset
Indicators	Main power, ready for operation preparation (built into the **[READY]** button), in operation, stop, and warning/emergency stop

*1: The axis operation is enabled only when the front selector switch selection matches with the pendant remote controller selector switch selection.

(2) Pendant unit

Dimensions	Approx. 315W × 80H × 80D mm (12.40″W × 3.15″H × 3.15″D)
Operation items	Axis movement (jog operation)*2, axis movement enable*2, axis movement speed change, operation authority change (main unit ↔ pendant)*3, and emergency stop
Display items	Operation enable indicator (Built into the operation authority selector)

*2: The axis movement operation is enabled only when the axis movement enable button is pressed.
*3: The axis operation is enabled only when the front selector switch selection matches with the pendant remote controller selector switch selection.

(3) Signal tower at the top of the main unit

Display color/blinking	Instrument status
Lit in green	Ready for operation preparation
Lit in orange	The Z5016 WPT Testing Platform is in operation.
Lit in red	Warning stop/emergency stop

I/O Specifications

(1) External output

Number of channels	2
Control method	ON/OFF
Power (V terminal) voltage	24 V DC ±10%
External load maximum supplied current	100 mA
Output type	Open collector (NPN)

(2) Workpiece load control output

Control method	ON/OFF
Power (V terminal) voltage	24 V DC ±10%
External load maximum supplied current	100 mA
Output type	Open collector (NPN)

(3) Electromagnetic lock external I/O

a. Contact input

Number of channels	2
Operation logic	Emergency stop is activated when “between contact 11 and 12 are opened” or “between contact 21 and 22 are opened”.
Current between contacts	40 mA or less

b. PNP input

Number of channels	1
Power voltage	24 V DC ±5%
ON voltage	20 V DC or more

Maximum input voltage	26.4 V DC
Input current	20 mA or less
Operation logic	Contact 31 input voltage 0 V DC: Emergency stop activated +24 V DC: Emergency stop canceled

c. Electromagnetic lock power output

Power voltage	24 V DC ±5%
Maximum current	1 A
Link with emergency stop and interlock	Not linked (Power is always output when the main power is ON.)

(4) Interlock external output

Number of channels	2
Power (V terminal) voltage	24 V DC ±10%
External load maximum supplied current	100 mA/channel
Output type	Open collector (NPN)

5.6 Model Z5018 Switch Box

General Specifications

Operating environment	Indoors, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity	23°C ± 5°C (73°F±9°F), 80% RH or less (no condensation)
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Standards (Safety)	EN61010
Dimensions	Switch box: Approx. 130W × 35H × 110D mm (5.12″W × 1.38″H × 4.33″D) OSB (open and short box): Approx. 80W × 25H × 110D mm (3.15″W × 0.98″H × 4.33″D) Clip length: Approx. 280 mm (11.02″) Cord length between switch box and OSB: Approx. 2900 mm (114.17″) Control cord length: Approx. 650 mm (25.59″) LCR connection cord length: Approx. 550 mm (21.65″) All cord lengths: Approx. 4000 mm (157.48″)
Mass	Approx. 1.2 kg (42 oz.) (The clip, open and short box, cord between the main unit and OSB*, and control cord are included.)
Product warranty period	1 year
Accessories	None
Options	None

Input/Output/Measurement Specifications

(1) Basic specifications

Function	OSB: When Probe-LCR is not connected, between the OSB and switch box are not connected and two clips are shorted or opened. When Probe-LCR is connected, between the OSB and switch box and between the clip and LCR are connected (normal LCR cable). Switch Box: Switches the LCR connection between Probe 1 or Probe 2.
Measurement terminal	2-terminal structure clip × 2 (red and black each from the OSB for connecting a measurement object)
LCR connection terminal	4-terminal pair BNC cord
Control terminal	7-wire cable (4 for power, 2 for control, 1 for NC for connecting to the model Z5017)
Clip terminal treatment	Gold plated
Measurable terminal diameter	5 mm or less
Cable used	1.5D-2 V or equivalent
Structure	4-terminal pair structure
Characteristic impedance	50 Ω
Measurable frequency range	DC to 1 MHz, measurement impedance must be 1 kΩ or less.

Measurement terminal maximum applied voltage	±20 V DC
Measurement terminal maximum applied current	±160 mA DC
Control power supply (Vcc)	24 V DC ±5%
Signal line allowable voltage	GND −0.5 V to Vcc +0.5 V
Models to be connected	LCR: Models IM3570 and IM3536 Control (master): Model Z5017

(2) Measurement specifications

Number of connection items	4 patterns
Connection method	1. Primary coil: To LCR, secondary coil: Open 2. Primary coil: To LCR, secondary coil: Short 3. Primary coil: Open, secondary coil: To LCR 4. Primary coil: Short, secondary coil: To LCR

6 Maintenance and Service

Calibration and repair

⚠ WARNING

Touching any of the high-voltage points inside the instrument is very dangerous. Customers are not allowed to modify, disassemble, or repair the instrument. Doing so may cause fire, electric shock, or injury.

Calibrations

The calibration period varies depending on the status of the instrument or installation environment. We recommend that the calibration period be determined in accordance with the status of the instrument or installation environment. Please contact your Hioki distributor to have your instrument periodically calibrated.

Replacement parts and service life

The Z5016 WPT Testing Platform has some parts that need to be replaced periodically.

Z-axis timing belt: Recommended replacement cycle 1 year

Name	Model	Code	Specified item	Remarks
Timing belt	–	600481850	150S5M950	Made by Mitsuboshi Belting Ltd.

For the replacement parts of measuring instruments (optional) and their service life, see the Instruction Manual of each measuring instrument.

6.1 Troubleshooting

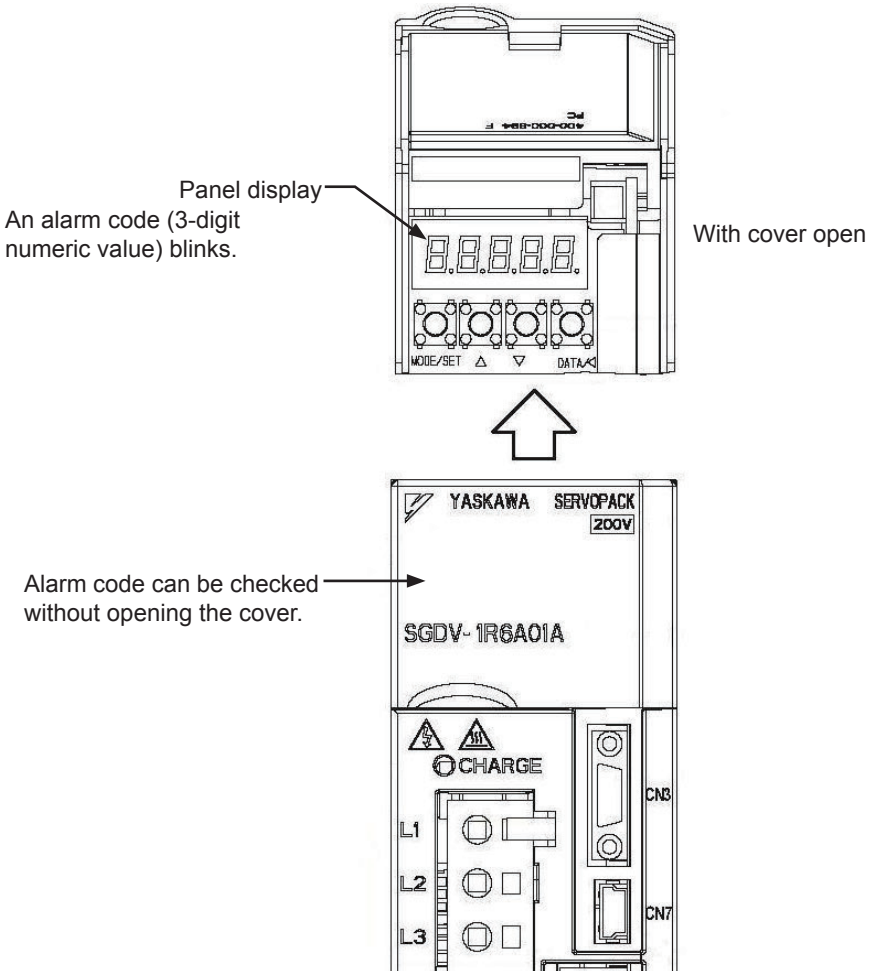
If damage is suspected, check the “Before sending the instrument for repair” section before contacting your authorized Hioki distributor or reseller.

Before sending the instrument for repair

A servo system error is suspected if a warning/emergency stop of unknown cause occurs. Check the description of the error and take corrective actions according to the following table.

Error checking procedure

If a servo system error occurs in the system error display on the computer, look inside through the vent holes of the PLC rack and check the status of the servo driver LED display.
If an error occurs, a 3-digit numeric value (hexadecimal number) blinks in the panel display.



X-/Y-/Z- servo pack alarm display list

The following table shows details of alarms. If the cause of an alarm cannot be determined through inspection, contact your Hioki service representative.

Alarm display	Alarm name	Description	Cause and solution
A. 020	Parameter checksum error	The data of the parameter in the servo pack is incorrect.	• The power supply voltage suddenly dropped. • Malfunction caused by noise from the AC power supply, static electricity noise, etc. • The servo pack has failed.
A. 021	Parameter format error	The data of the parameter in the servo pack is incorrect.	• The software version is different. • Check the software version via parameter Fn012. • The servo pack has failed.
A. 022	System checksum error	The data of the parameter in the servo pack is incorrect.	• The power supply voltage suddenly dropped. • The servo pack has failed.
A. 030	Main circuit detector error	Detection data for main circuit is incorrect.	• The servo pack has failed.
A. 040	Parameter setting error	The parameter setting is outside the setting range.	• The servo pack and servomotor capacities do not match each other. • The servo pack has failed.
A. 041	Encoder output pulse setting error	The encoder output pulse (Pn212) is outside the setting range or does not satisfy the setting conditions.	• Check parameter Pn212.
A. 042	Parameter combination error	Combination of some parameters exceeds the setting range.	• The speed of program JOG operation (Fn004) is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor. • The speed of program JOG operation (Fn004) is lower than the setting range after having changed the setting of the program JOG movement speed (Pn533). • The movement speed of advanced autotuning is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor.
A. 044	Semi-closed/Fully-closed loop control parameter setting error	The settings of the option module and Pn00B.3, Pn002.3 do not match.	• Check the settings of Pn002.3.
A. 050	Combination error	The servo pack and the servomotor capacities do not match each other.	• The servo pack and servomotor capacities do not match each other. • An encoder fault occurred. • The servo pack has failed.
A. 051	Unsupported device alarm	The unsupported device was connected.	• Check the product specifications, and select the correct model.
A. 0b0	Canceled servo ON command alarm	The servo ON signal (/S-ON) was sent from the host controller after executing a utility function that turns ON servomotor.	• Turn on the servo pack power again. • Perform a software reset.

Alarm display	Alarm name	Description	Cause and solution
A. 100	Overcurrent or heat sink overheated	An overcurrent flowed through the IGBT or the heat sink of the servo pack was overheated.	• Motor oscillation: There is a problem with the drive mechanism. • Motor power line wiring mistake, broken connection, or short. • Malfunction caused by noise interference. • Servo pack or motor failure
A. 300	Regeneration error	Regenerative circuit or regenerative resistor is faulty.	• The external regenerative resistor is not securely wired or is disconnected. • The servo pack has failed.
A. 320	Regenerative overload	Regenerative energy exceeds regenerative resistor capacity.	• Abnormal supply voltage: Check whether the supply voltage is exceeding system specifications. • Insufficient external regenerative resistance, regenerative resistor capacity, or regenerative power has been continuously flowing back. • Regenerative power continuously flowed back because negative load was continuously applied. • The servo pack has failed.
A. 330	Main circuit power supply wiring error	Setting of AC input/DC input is incorrect. Power supply wiring is incorrect.	• The regenerative resistor disconnected when the servo pack power supply voltage was high. • The servo pack has failed.
A. 400	Overvoltage	Main circuit DC voltage is excessively high.	• A 290 V or higher AC power supply voltage is detected. • The power supply is unstable, or was influenced by a lightning surge. • The servo pack has failed.
A. 410	Undervoltage	Main circuit DC voltage is excessively low.	• The AC power supply voltage is 120 V or lower. • The power supply voltage dropped during operation. • Occurrence of instantaneous power interruption. • The servo pack fuse is blown out. • The servo pack has failed.
A. 450	Main-circuit capacitor overvoltage	The capacitor of the main circuit has deteriorated or is faulty.	• The servo pack has failed.
A. 510	Overspeed	The servomotor speed is above the maximum rotational speed.	• The order of phases U, V, and W in the servomotor wiring is incorrect. • A reference value exceeding the overspeed detection level was input. • The motor speed exceeded the maximum. • The servo pack has failed.
A. 511	Overspeed of encoder output pulse rate	The pulse output speed upper limit of the set encoder output pulse (Pn212) is exceeded.	• Check the setting of the encoder output pulse as well as the motor speed. Reduce the motor speed. • The servo pack has failed.
A. 520	Oscillation alarm	Abnormal oscillation was detected in the motor's rotational speed.	• There is a problem in the drive mechanism. • Motor oscillation: Inspect for loose couplings or belts.

Alarm display	Alarm name	Description	Cause and solution
A. 521	Autotuning alarm	Oscillation was detected while the tuningless function was being performed.	• There is a problem in the drive mechanism. • Motor oscillation: Inspect for loose couplings or belts.
A. 710	Overload (instantaneous maximum load)	The servo pack has been operated for several to dozens of seconds at a torque substantially greater than the rated torque.	• There is a problem in the drive mechanism: Motor operation is sluggish and is being blocked. • Motor oscillation: Inspect for loose couplings or belts. • The servo pack has failed.
A. 720	Overload (continuous maximum load)	The servo pack has been operated continuously at a torque greater than the rated torque.	• There is a problem in the drive mechanism: Motor operation is sluggish and is being blocked. • Motor oscillation: Inspect for loose couplings or belts. • The servo pack has failed.
A. 730 A. 731	DB overload	The DB (dynamic break) rotation energy is greater than the DB resistance.	• The servo pack has failed.
A. 740	Inrush current limiting resistor overload	The main-circuit power supply has been turned on/off continually.	• This error occurs when doors are opened or the emergency stop button is pressed repeatedly during a short period of time. Wait for a while and then retry the operation. • The servo pack has failed.
A. 7A0	Heatsink overheat	The temperature of the servo pack heat sink exceeds 100°C	• High ambient temperature: Stop operation and wait for the instrument to cool. Check whether the error condition is cleared. • The servo pack has failed.
A. 7AB	Built-in fan in servo pack stopped	The fan inside the servo pack stopped.	• Check for foreign matter or debris inside the servo pack. • The servo pack has failed.
A. 810	Encoder backup alarm	All encoder power supplies are down and positioning data has been cleared.	• The servo pack has failed.
A. 820	Encoder checksum alarm	The checksum result in the encoder memory is incorrect.	• Motor encoder failure • The servo pack has failed.
A. 830	Encoder battery alarm	The battery voltage was lower than the specified value after the control power supply was turned on.	• Check the battery voltage. • The servo pack has failed.
A. 840	Encoder data alarm	There is an error in the encoder's internal data.	• Motor encoder malfunction • Motor encoder failure • The servo pack has failed.
A. 850	Encoder overspeed	The encoder rotated rapidly when the power supply was turned on.	• Motor encoder failure • The servo pack has failed.
A. 860	Encoder overheat	The temperature inside the encoder is too high.	• High motor ambient temperature: Stop operation and wait for the instrument to cool. Check whether the error condition is cleared. • Motor encoder failure • The servo pack has failed.

Alarm display	Alarm name	Description	Cause and solution
A. 8A0	External encoder error	An external encoder fault occurred.	• The servo pack has failed.
A. 8A1	External encoder error of module	A serial converter unit fault occurred.	• The servo pack has failed.
A. 8A2	External encoder error of sensor (Incremental)	An external encoder fault occurred.	• The servo pack has failed.
A. 8A3	External encoder error of position (Absolute)	Positioning data error of the external encoder	• The servo pack has failed.
A. 8A5	External encoder overspeed	The overspeed from the external encoder occurred.	• The servo pack has failed.
A. 8A6	External encoder overheated	The overheat from the external encoder occurred.	• The servo pack has failed.
A. b10	Speed-command A/D error	The A/D converter to which the speed command is input is defective.	• The servo pack has failed.
A. b11	Speed-command A/D data error	Speed-command A/D conversion data error	• The servo pack has failed.
A. b20	Torque-command A/D error	The A/D converter to which the torque command is input is defective.	• The servo pack has failed.
A. b31	Current detection error 1	The current detection circuit for phase U is faulty.	• The servo pack has failed.
A. b32	Current detection error 2	The current detection circuit for phase V is faulty.	• The servo pack has failed.
A. b33	Current detection error 3	The detection circuit for the current is faulty.	• The servomotor main circuit cable is disconnected. • The servo pack has failed.
A. bF0	System alarm 0	Servo pack internal program error 0 occurred.	• The servo pack has failed.
A. bF1	System alarm 1	Servo pack internal program error 1 occurred.	• The servo pack has failed.
A. bF2	System alarm 2	Servo pack internal program error 2 occurred.	• The servo pack has failed.
A. bF3	System alarm 3	Servo pack internal program error 3 occurred.	• The servo pack has failed.
A. bF4	System alarm 4	Servo pack internal program error 4 occurred.	• The servo pack has failed.
A. C10	Servo overrun detected	The servo motor cannot be controlled.	• Bad motor wiring connection: Check the phase sequence. • Motor encoder failure • The servo pack has failed.
A. C80	Encoder clear error (Multi-Turn Limit Setting Error)	A large number of rotations of the absolute encoder cannot be cleared or set correctly.	• Encoder failure: The motor needs to be replaced. • The servo pack has failed.
A. C90	Encoder communication error	Communication has failed between the encoder and the servo pack.	• The encoder cable has been disconnected or is broken: Inspect and/or replace the cable.

Alarm display	Alarm name	Description	Cause and solution
A. C91	Encoder communications: Positioning data acceleration error	An error occurred while calculating the encoder's positioning data.	• Encoder cable malfunction: Inspect and/or replace the cable.
A. C92	Encoder communications: Timer malfunction	An error occurred in the communications timer between the encoder and the servo pack.	• The signal line from the encoder is generating noise; take appropriate corrective action related to wiring or replace the cable. • Encoder failure: The motor needs to be replaced. • The servo pack has failed.
A. CA0	Encoder parameter error	The encoder parameters is broken.	• Encoder failure: The motor needs to be replaced. • The servo pack has failed.
A. Cb0	Encoder echo-back error	The communication data differs from that in the encoder.	• Encoder cable malfunction: Inspect and/or replace the cable. • An encoder fault occurred. • The servo pack has failed.
A. CC0	Multi-turn limit value mismatch	Multi-turn limit values for the encoder and servo pack do not match.	• The servo pack has failed.
A. CF1	Feedback option module communications error (Reception error)	Reception from the feedback option module is faulty.	• Encoder cable malfunction: Inspect and/or replace the cable. • The servo pack has failed.
A. CF2	Feedback option module communications error (Timer stop)	Timer for communications with the feedback option module is faulty.	• The servo pack has failed.
A. d00	Over-deviation	Position deviation exceeded the value of excessive position deviation error alarm level (Pn520) when the servo motor power is on.	• Bad motor wiring connection: Check the phase sequence. • Excessive speed: Lower the operating speed. • Servo parameters need to be adjusted.
A. d01	Excessive position deviation while servo on	This alarm occurs if the servo motor power is turned on when the position deviation is greater than the set value of Pn526 while the servo motor power is off.	• Motor control board failure • Control cable failure
A. d02	Excessive position deviation caused by speed limitations while servo on	If the servo turns on while position deviation pulses have accumulated, the speed is limited by the level of speed limitations at servo on (Pn529). An instruction pulse exceeding the position deviation alarm level (Pn520) was input during that time without the limitation being canceled first.	• Motor control board failure • Control cable failure • There is a problem in the drive mechanism.
A. d10	Excessive deviation between motor load positions	The deviation between the motor load positions is excessively large under fully-closed control.	• Motor control board failure • Control cable failure

Alarm display	Alarm name	Description	Cause and solution
A. E71	Safety option module detection failure	Detection of the safety option module failed.	• The servo pack has failed.
A. E72	Feedback option module detection failure	Detection of the feedback option module failed.	• The servo pack has failed.
A. E74	Unsupported safety option module	An unsupported safety option module was connected.	• The servo pack has failed.
A. E75	Unsupported feedback option module	An unsupported feedback option module was connected.	• The servo pack has failed.
A. Eb1	Safety function signal input timing error	The safety function signal input timing is faulty.	• The servo pack has failed.
A. F10	Main circuit cable open phase	With the main power supply on, voltage was low for more than 1 second in phase R, S, or T.	• Wiring of the 3-phase power supply is detective; check the wiring. • The voltage of the 3-phase power supply is not well-balanced: check the voltage. • The servo pack has failed.
FL-1	System alarm	Internal program error occurred in the servo pack.	• The servo pack has failed.
FL-2			
CPF00	Digital operator transmission error 1	Digital operator (JUSP-OP05A-1-E) fails to communicate with the servo pack (e.g., CPU error).	• The servo pack has failed.
CPF01	Digital operator transmission error 2		
A. - -	This is not an error display.	This display indicates normal operation.	

X-/Y-/Z- servo pack warning display list

The following table shows details of warnings. If the cause of a warning cannot be determined through inspection, contact Hioki.

Alarm display	Warning name	Description	Cause and solution
A.900	Over-deviation	Position deviation exceeded the parameter setting (Pn520×Pn51E/100).	• The position command acceleration is large. • The servo pack has failed.
A.901	Excessive position deviation while servo on	When the servo motor power is on, the position deviation exceeded the parameter setting (Pn526×Pn528/100).	• Motor control board or control cable failure
A.910	Overload	This warning is issued before reaching an A.710 or A.720 alarm. Continued operation may trigger the alarm.	• There is a problem in the drive mechanism: Motor operation is sluggish and is being blocked. • Motor oscillation: Inspect for loose couplings or belts. • The servo pack has failed.
A.911	Oscillation	An abnormal oscillations was detected. The detection level for this error is the same as for A.520. However, whether to issue an alarm or warning can be set with the Pn310 oscillation detection switch.	• There may be a problem in the drive mechanism. • Motor oscillation: Inspect for loose couplings or belts.
A.920	Regenerative overload	This warning is issued before reaching the regeneration overload alarm (A.320). Continued operation may trigger the alarm.	• Abnormal supply voltage: Check whether the supply voltage is exceeding system specifications.
A.921	DB overload	This warning is issued before reaching the DB overload alarm (A.731). Continued operation may trigger the alarm.	• Abnormal supply voltage: Check whether the supply voltage is exceeding system specifications. • The servo pack has failed.
A.930	Absolute value encoder battery error	This warning indicates a drop in the absolute value encoder's battery voltage.	• This error should not be encountered during the course of normal operation. • The servo pack has failed.
A.941	Change to parameter requiring system power to be cycled	A parameter that requires the system power to be cycled was changed.	• This error should not be encountered during the course of normal operation. • This error occurs when the servo parameters are changed (during service).
A.971	Undervoltage	This warning is issued before reaching the undervoltage alarm (A.731). Continued operation may trigger the alarm.	• The AC power supply voltage is 140 V or less. • Power supply voltage error; check that the power supply voltage is not lower than the voltage in the specification.
A.9A0	Overtravel	When the servomotor power is on, overtravel status is detected.	• Use the input signal monitor (Un005) to check the status of the overtravel signals.

6.2 Cleaning

⚠WARNING

- **Always set the main breaker to off before cleaning the instrument.**
- **Never use detergents that contain alcohol, benzene, thinners, acetone, ether, ketone, or gasoline for resin-based parts.**
  Doing so may cause a fire if they come in contact with the internal electrical components as well as distortion or discoloration of the instrument.

- To clean the instrument, wipe it gently with a soft cloth moistened with water or mild detergent.
- Do not use rust-preventive agents as they may remove paint.

6.3 Scheduled check (monthly)

Point/Location	Description	Procedures	Remarks
Adjuster	There should be no gap between all adjusters and the floor.	Verify that the four adjusters are all in contact with the floor.	“Installing the instrument” (p.8)
X-, Y-, Z-axis	Grease should be sufficiently spread to the liner guide, guide shaft, and ball screw of each axis.	Verify that the surfaces of the sliding parts and rolling parts are not dry and that a thin film of oil has been applied. Apply grease after approximately every 100 operating hours.	“Lubrication” (p.105)
	Any grease on the linear guide, guide shaft, and ball screw of each axis should not be significantly contaminated.	Remove any contaminated grease and then lubricate with new grease if necessary.	
	Grease should not be scattered.	Remove any excess grease.	
Vent holes	Dust or grime should not be accumulated.	Remove dust and grime with a vacuum cleaner.	

Lubrication

The ball screw and linear guide must be lubricated periodically.
Have specified grease and a grease gun ready and available.
Apply grease after approximately every 100 operating hours.

⚠ WARNING

Always set the main breaker to off before applying grease.

⚠ CAUTION

- Use the specified grease. Using grease that is not specified can affect the service life of the parts.
- Wipe away old grease before applying new grease.
- If excessive grease is applied, grease may come into contact with the instrument inside or the test object, resulting in contamination which will cause malfunction.
- Use care to keep grease off instrument belts. Failure to do so may cause the belts to deteriorate.
- Do not bend covers.

Required items (Accessories for the Z5016 WPT Testing Platform)

Name	Code	Specified item	Remarks
Grease	78620011	AFC grease accordion cartridge of 70 g	Standard product manufactured by THK Co., Ltd.
Grease gun	77890011	MG70	Standard product manufactured by THK Co., Ltd.

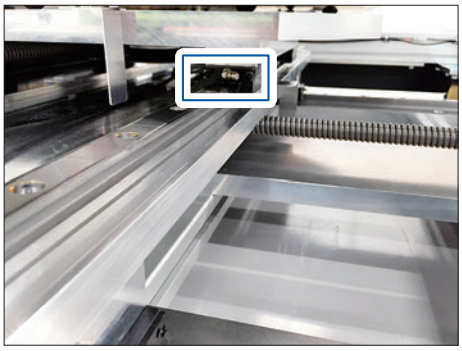
Linear guide and ball screw for the X-axis, Y-axis, and Z-axis units
Apply grease after approximately every 100 operating hours.
Grease: Specified grease THK: AFC grease (urea-based)

X-axis unit and Y-axis unit lubrication

Grease nipples are located at all lubrication points. Using a grease gun, supply grease via the grease nipples.

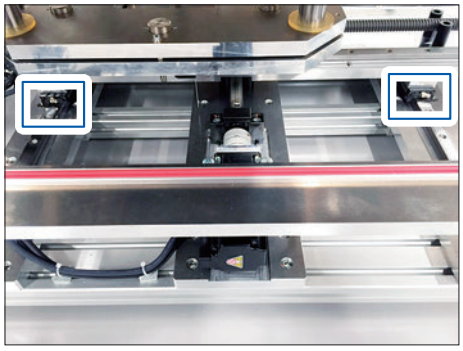
Linear guide X-axis: 4 locations

These are also located on another linear guide and on the opposite side of each linear guide.

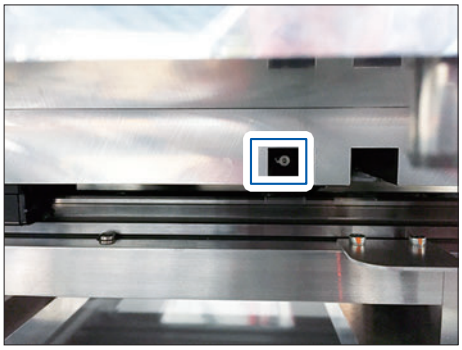


Linear guide Y-axis: 4 locations

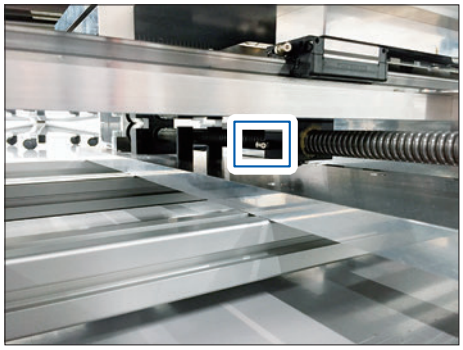
These are also located on the opposite side.



Ball screw X-axis



Ball screw Y-axis

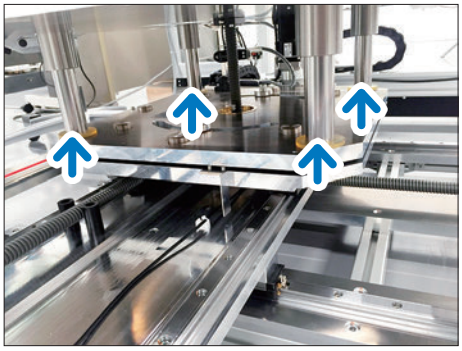


Z-axis unit lubrication

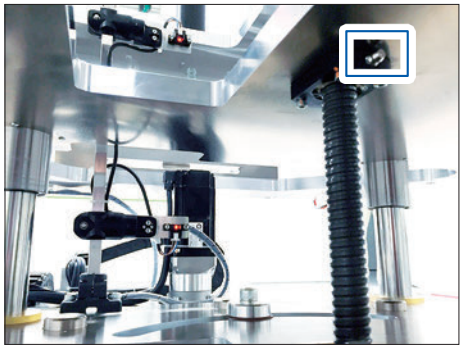
Grease nipples are provided for the ball screw. Using a grease gun, supply grease via the grease nipples.

Grease nipples are not provided for the linear shaft. Use your finger to apply an appropriate amount of grease to the surface of the linear shaft. Wipe away any excess grease with a soft cloth.

Linear shaft



Ball screw



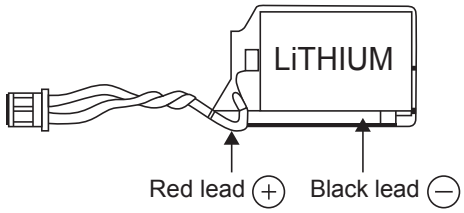
6.4 Error display

Window display when an error occurs

Display	Cause and solution
<Emergency Stop Conditions> • **Emergency button pressed, malfunction or wire disconnection** • **External interlock** • **Operation Selector switched**	The following causes are suspected. • Measurement stopped because the emergency stop button was pressed or an interlock signal was externally input. → Press the **[Reset]** button of the Z5017 PLC Rack to cancel the error. • The instrument failed or is disconnected. → Contact your authorized Hioki distributor or reseller.
Tape switch was pressed.	The tape switches of the stage were touched. Press the **[Reset]** button to cancel the error.
Tape switch was disconnected.	The tape switches are disconnected. Contact your authorized Hioki distributor or reseller.
Possibility of the problem of PLC.	There may be problems inside the PLC. Contact your authorized Hioki distributor or reseller.
Disconnection of a Cable	The following causes are suspected. • The LAN cable is not connected. • The PLC is not in operation. Check the LAN cable connection. If there is no problem with the LAN cable connection, the PLC may have failed. Contact your authorized Hioki distributor or reseller.
The detection of an axis limit.	The stage is outside of the movable range. Operate the pendant and return the stage to the movable range. Reference: “3.17 Positioning a Workpiece” (p.70)
Low Battery of PLC (or Servopack).	The battery charge is low. Replace with new batteries (model: JZSP-BA01) within two weeks. Reference: “Replacing batteries for PLC and servo pack” (p.108)

Replacing batteries for PLC and servo pack

The PLC and the servo pack each have one replaceable built-in battery. This battery is used to back up data to prevent the data stored in the PLC and the servo pack from being lost when the power supply is turned OFF or is interrupted.
The built-in battery can retain the contents of the memory until the total time of power interruptions reaches one year. The warranty period of the battery is five years from the date of purchase. These values, however, differ according to the operating conditions, including the ambient temperature. If the PC display shows **Low Battery of PLC (or Servopack)**, replace the battery with a new battery (model: JZSP-BA01) within two weeks. Any delay in battery replacement will result in the loss of data stored in the PLC and the servo pack.
The appearance of the battery is illustrated below.



JZSP-BA01 (Battery with Cable)

IMPORTANT
This battery is not commercially available. Contact Hioki for order.

6.5 Disposing of the Instrument

When disposing the instrument, remove the lithium battery and dispose of battery and instrument in accordance with local regulations.

⚠ WARNING

Battery may explode if mistreated. Do not short-circuit, recharge, disassemble or dispose of in fire.

Handle and dispose of batteries in accordance with local regulations.

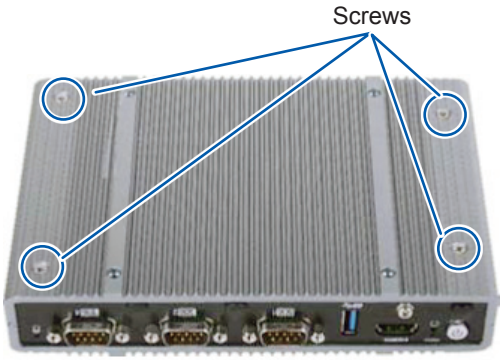
CALIFORNIA, USA ONLY
Perchlorate Material - special handling may apply.
See www.dtsc.ca.gov/hazardouswaste/perchlorate

Lithium battery removal

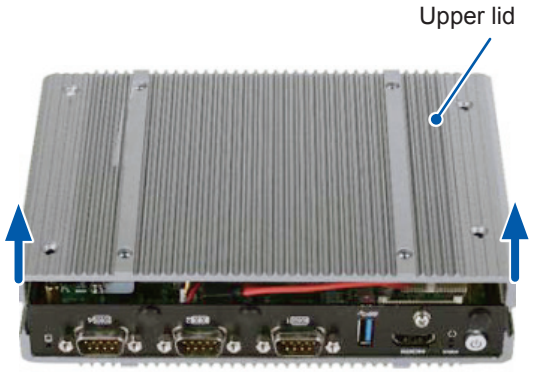
Required items: 6 mm hexagonal wrench, needle-nose pliers, and Phillips screwdriver (No. 2)

(1) Model Z5015 PC System

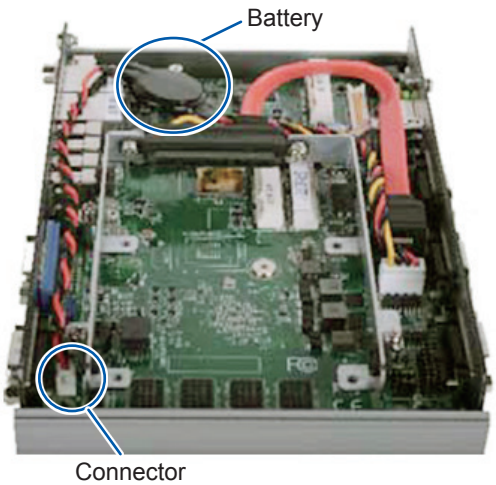
1 **Using a Phillips screwdriver, remove the screws (4 locations).**



2 **Lift and remove the housing top cover.**

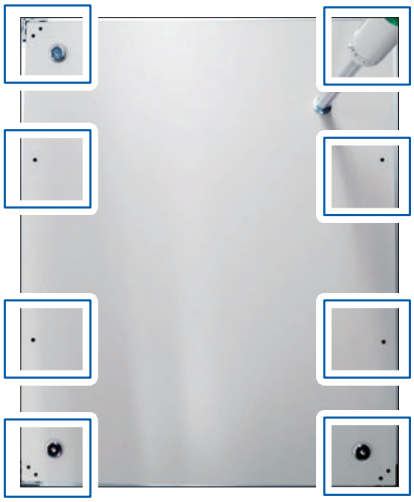


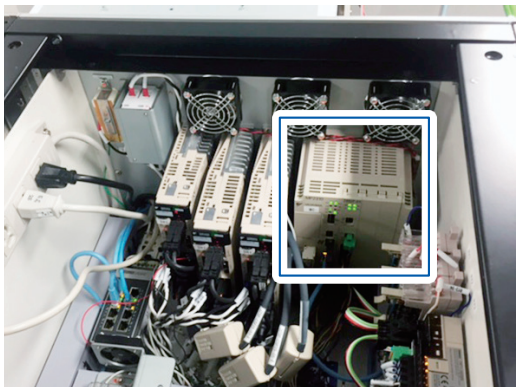
3 **Remove the connector and then remove the battery.**



(2) Model Z5017 PLC Rack

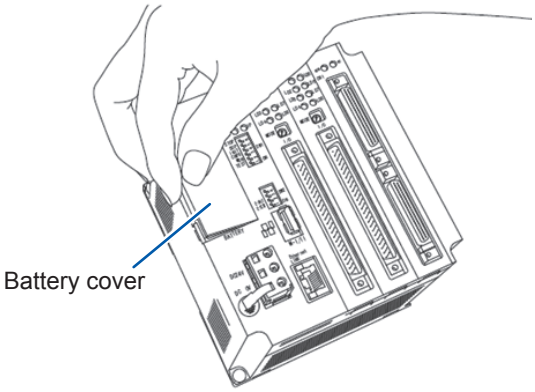
1 **Remove the bolts on the top of the Z5017 PLC Rack (8 locations) using a hexagonal wrench and the resin clips (8 locations) using needle-nose pliers to remove the top cover.**



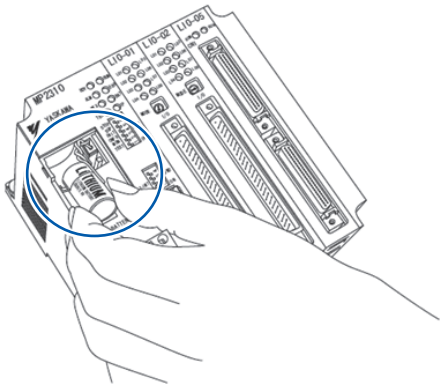


In the frame: PLC

2 **Open the battery cover on the PLC front surface.**



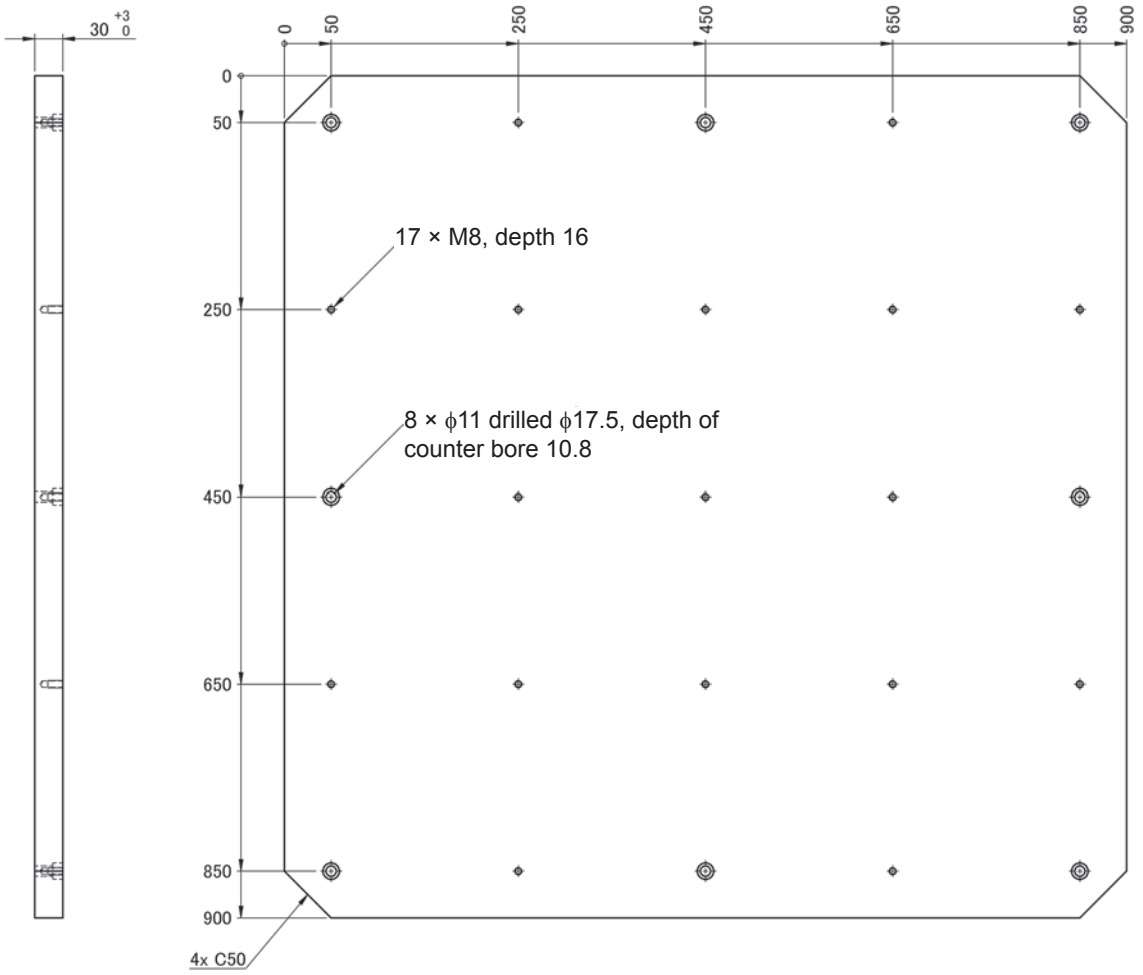
3 **Remove the connector at the end of the built-in battery lead, and then remove the built-in battery from the battery holder.**



Appendix

Appx. 1 Work Table Installation Dimensions

The installation dimensions of the standard work table are shown below. The following dimensions do not apply to special order work tables.



Appx.2

Warranty Certificate

HIOKI

Model	Serial number	Warranty period One (1) year from date of purchase (___ / ___)

Customer name: _____

Customer address: _____

Important

- Please retain this warranty certificate. Duplicates cannot be reissued.
- Complete the certificate with the model number, serial number, and date of purchase, along with your name and address. The personal information you provide on this form will only be used to provide repair service and information about Hioki products and services.

This document certifies that the product has been inspected and verified to conform to Hioki's standards.
Please contact the place of purchase in the event of a malfunction and provide this document, in which case Hioki will repair or replace the product subject to the warranty terms described below.

Warranty terms

1. The product is guaranteed to operate properly during the warranty period (one [1] year from the date of purchase). If the date of purchase is unknown, the warranty period is defined as one (1) year from the date (month and year) of manufacture (as indicated by the first four digits of the serial number in YYMM format).
2. If the product came with an AC adapter, the adapter is warrantied for one (1) year from the date of purchase.
3. The accuracy of measured values and other data generated by the product is guaranteed as described in the product specifications.
4. In the event that the product or AC adapter malfunctions during its respective warranty period due to a defect of workmanship or materials, Hioki will repair or replace the product or AC adapter free of charge.
5. The following malfunctions and issues are not covered by the warranty and as such are not subject to free repair or replacement:
   -1. Malfunctions or damage of consumables, parts with a defined service life, etc.
   -2. Malfunctions or damage of connectors, cables, etc.
   -3. Malfunctions or damage caused by shipment, dropping, relocation, etc., after purchase of the product
   -4. Malfunctions or damage caused by inappropriate handling that violates information found in the instruction manual or on precautionary labeling on the product itself
   -5. Malfunctions or damage caused by a failure to perform maintenance or inspections as required by law or recommended in the instruction manual
   -6. Malfunctions or damage caused by fire, storms or flooding, earthquakes, lightning, power anomalies (involving voltage, frequency, etc.), war or unrest, contamination with radiation, or other acts of God
   -7. Damage that is limited to the product's appearance (cosmetic blemishes, deformation of enclosure shape, fading of color, etc.)
   -8. Other malfunctions or damage for which Hioki is not responsible
6. The warranty will be considered invalidated in the following circumstances, in which case Hioki will be unable to perform service such as repair or calibration:
   -1. If the product has been repaired or modified by a company, entity, or individual other than Hioki
   -2. If the product has been embedded in another piece of equipment for use in a special application (aerospace, nuclear power, medical use, vehicle control, etc.) without Hioki's having received prior notice
7. If you experience a loss caused by use of the product and Hioki determines that it is responsible for the underlying issue, Hioki will provide compensation in an amount not to exceed the purchase price, with the following exceptions:
   -1. Secondary damage arising from damage to a measured device or component that was caused by use of the product
   -2. Damage arising from measurement results provided by the product
   -3. Damage to a device other than the product that was sustained when connecting the device to the product (including via network connections)
8. Hioki reserves the right to decline to perform repair, calibration, or other service for products for which a certain amount of time has passed since their manufacture, products whose parts have been discontinued, and products that cannot be repaired due to unforeseen circumstances.

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18-07 EN-1

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