HIOKI

Startup Guide

ELECTROLYSIS CELL ANALYZER

Check for the latest edition and other language versions.

Read carefully before use.
Keep for future reference.

EN

Feb. 2025 Edition 1
EA5701A971-00
600672320

Contents

Introduction

Thank you for choosing the Hioki Electrolysis Cell Analyzer.
To ensure your ability to get the most out of this system over the long term, please read this manual carefully and keep it available for future reference.

Request for product user registration
Please register this product so that you can receive important information regarding the product.
https://www.hioki.com/global/support/myhioki/registration/

The following documentation is available for reference according to your application:

Names of the instruction manuals	Contents	Form of supply
Instruction Manual	Product overview, operating instructions, function descriptions, and specifications for this system.	USB (PDF)
Startup Guide (this manual)	Information on how to use this system safely, basic operating instructions, specifications (excerpt).	Hard copy
Operating Precautions	This document contains information for the safe use of this system. Please read Operating Precautions carefully, before using this system.	Hard copy

Target audience

This manual has been written for use by individuals who use the product or provide information about how to use the product.
In explaining how to use the product, it assumes electrical knowledge (equivalent of the knowledge possessed by a graduate of an electrical program at a technical high school).

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Inspecting Package Contents

Upon receiving the products, inspect them for any damage or anomalies. If you discover any damage or find that the product does not perform as indicated in the specifications, please contact your authorized Hioki distributor or reseller.

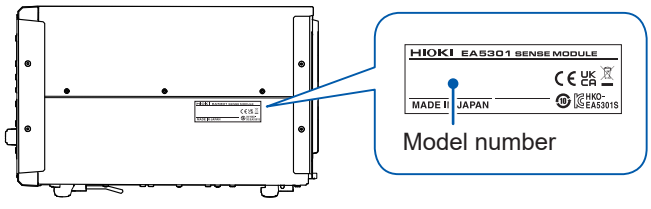
Confirm the package contents.

Product name	Accessories
EA5301 Sense Module 	• Power cord • Operating Precautions (0990A903)
EA5501 Source Module 	• Power cord (for main power supply) • Power cord for connecting devices (0.9 m) ×2 (For Sense-to-Source module and CT9557 Sensor Unit optional part) • LAN cable (for connecting PC and Source Module, 3 m) • LAN cable (for connecting Sense Module and Source Module, 1 m) • Startup Guide • Operating Precautions (0990A903)
EA5701 Electrolysis Cell Analyzer (PC application)  The latest version of the firmware is available for download from Hioki's website.	• USB memory (PC application installer, Instruction Manual) • USB dongle key (license key)

EA5301 Sense Module model number

The branch part of the model number indicates the number of input channels.

Model number (order code)	Number of channels
EA5301-01	1 channel
EA5301-02	2 channels
EA5301-03	3 channels
EA5301-04	4 channels
EA5301-05	5 channels
EA5301-06	6 channels
EA5301-07	7 channels
EA5301-08	8 channels



Right side

Options (Sold Separately)

The optional equipment listed below is available for the system. To purchase any optional equipment, please contact your authorized Hioki distributor or reseller. Please note that optional equipment offerings are subject to change without advance notice. For the latest information, check Hioki's website.

Cable for signal superposition

L1150	Source Cable (Maximum input current: 40 A AC/DC, continuous, Cable length: Approx. 2.0 m, tip: Alligator clips)	

Cable for voltage measurement

L1100	Sense Cable (Maximum input voltage: 30 V DC, Cable length: Approx. 2.2 m, Banana to banana plug, Alligator clips included)	

Products for current measurement

For details, refer to the instruction manual that came with the current sensor.

CT6841A	AC/DC Current Probe (20 A)	
CT6843A	AC/DC Current Probe (200 A)	
CT6845A	AC/DC Current Probe (500 A)	
CT6872	AC/DC Current Sensor (50 A)	
CT6873	AC/DC Current Sensor (200 A)	
CT6875A	AC/DC Current Sensor (500 A)	
CT6904A	AC/DC Current Sensor (500 A)	
CT9557	Sensor Unit The CT9557 adds current waveforms measured by multiple sensors and outputs a single signal. Use it when measuring multi-cable circuits. The CT9904 connection cable (optional) is required to connect to the EA5301 Sense Module.	

Symbols and Abbreviations

Safety

This manual classifies the seriousness of risks and hazard levels as described below.

⚠ DANGER	Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury or potential risks of damage to the supported product (or to other property).
IMPORTANT	Indicates information or content particularly important from the standpoint of operating or maintaining the product.
	Indicates a high-voltage hazard. Failure to verify safety or improper handling of the product will result in an electric shock,a burn, or injury, potentially leading to death.
	Indicates a prohibited action.
	Indicates the action which must be performed.

Symbols on the product

	Indicates the presence of a potential hazard. For more information about locations where this symbol appears on products' components, see "Precautions for Use" (p. 12) and warning messages listed at the beginning of operating instructions. In addition, see the accompanying document entitled "Operating Precautions" and "Current Sensor".
	Indicates the on position of the power switch.
	Indicates the off position of the power switch.
	Indicates the push-button switch that can turn on and off the product.
	Indicates the grounding terminal.
	Indicates that the product can be used to measure alternating current (AC) voltage/current or can be powered by utility AC power.

Symbols for various standards

	Indicates that the product is subject to the Directive on Waste Electrical and Electronic Equipment (WEEE) in EU member nations. Dispose of the product in accordance with local regulations.
	Indicates that the product complies with standards imposed by EU directives.
	Indicates that the product complies with Korean regulations. Declarer: HIOKI KOREA CO., LTD. http://www.rra.go.kr/selform/HKO-EA5301S http://www.rra.go.kr/selform/HKO-EA5501

Others

*	Indicates that additional information is described below.
(p.)	Indicates the page number to reference.
START (Bold)	The letters and key names on the screen are highlighted in bold.
[ ]	The names of user interface elements on the screen are enclosed in brackets (**[ ]**).
Windows	Unless otherwise noted, the term Windows is generically used to refer to Windows 10 and Windows 11.

Accuracy labeling

The accuracy of the measuring instrument is expressed by defining limit values for errors as a percentage of the reading and a percentage of the range.

Reading (display value)	Indicates the value displayed on the measuring instrument. Limit values for reading errors are expressed as a percentage of the reading (% of reading or % rdg).
Range	Indicates the measurement range of the measuring instrument. Limit values for range errors are expressed as a percentage of the range (% of range or % rng).

Safety Information

The products included in this system has been designed in accordance with the international standard IEC 61010 and has undergone rigorous safety testing prior to shipment. However, using the system in a way not specified in this manual may compromise its safety features.
Carefully read the following safety notes before use.

⚠ DANGER

■ **Familiarize yourself with the contents of this manual before use.**

Failure to follow this guidance will result in misuse, leading to serious bodily injury or damage to the products.

⚠ WARNING

■ **If you have not previously used electrical measuring instruments, ensure adequate supervision by a technician with experience in electrical measurement.**

Failure to follow this guidance could result in electric shock.
It could also cause serious incidents, such as heat generation, fire, or arc flash due to a short-circuit.

Measurement categories

IEC 61010 defines measurement categories to ensure the safe use of measuring instruments. Test and measurement circuits are classified into three categories based on the type of mains they are intended to be connected to. A measuring instrument that does not have a measurement category cannot be used to measure a main power supply circuit.

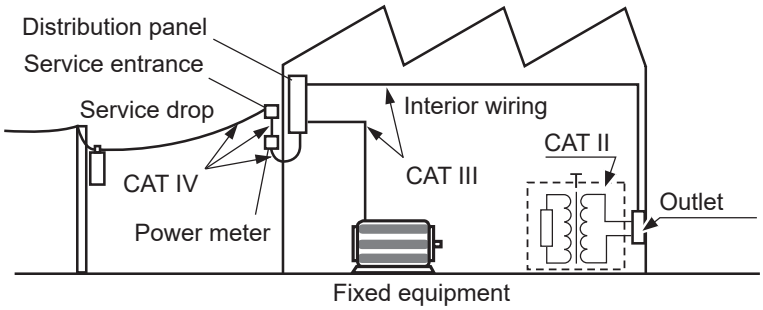
⚠ DANGER

- **Do not use a measuring instrument to measure a main power supply circuit whose category exceeds the instrument's rated measurement category.**

- **Do not use a measuring instrument that does not have a rated measurement category to measure a main power supply circuit.**

  Doing so may result in serious bodily injury or damage to the instrument or other equipment.

No measurement category (O)	Applicable to the measurement of other circuits that are not directly connected to the main power supply. EXAMPLE: Measurement on the secondary-side equipment from the socket outlet of fixed installation through a transformer, etc.
Measurement category II (CAT II)	Applicable to test and measuring circuits connected directly to utilization points (socket outlets and similar points) of a low-voltage mains installation. EXAMPLE: Measurements on household appliances, portable tools, and similar equipment, and on the consumer side only of socket outlets in the fixed installation.
Measurement category III (CAT III)	Applicable to test and measuring circuits connected to the distribution part of the a building's low-voltage mains installation. EXAMPLE: Measurements on distribution boards (including secondary meters), photovoltaic panels, circuit breakers, wiring, including cables, bus-bars, junction boxes, switches, and socket outlets in a fixed installation, as well as equipment for industrial use and some other equipment such as stationary motors with permanent connection to the fixed installation.
Measurement category IV (CAT IV)	Applicable to test and measuring circuits connected at the source of the a building's low-voltage mains installation. EXAMPLE: Measurements on devices installed before the main fuse or circuit breaker in the building installation.



Precautions for Use

Be sure to follow the precautions listed below in order to use the system safely and in a manner that allows it to function effectively.
Use of the system should conform not only to its specifications, but also to the specifications of all accessories, options, and other equipment in use.

Installing the system

⚠WARNING

Do not install the system in the following locations:

- **Locations with direct sunlight exposure or high temperatures**
- **Locations where corrosive or explosive gases are generated**
- **Locations with powerful electromagnetic radiation exposure or electrostatic charges**
- **Close to inductive heating devices (high-frequency inductive heating devices, IH cook-tops, etc.)**
- **Places where there is a lot of mechanical vibration**
- **Locations exposed to water, oil, chemicals, or solvents**
- **Places with high humidity or condensation**
- **Locations with an excessive amount of dust**
- **Locations with an unstable or inclined position**

Doing so could damage the system or cause it to malfunction, resulting in bodily injury.

- **Place the Source Module, leaving enough space around it to facilitate unplugging the power cord.**

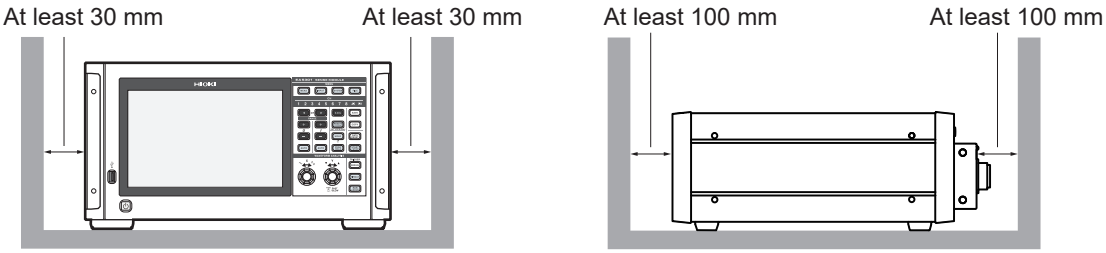
If there is not enough space left around, the power cannot be shut off immediately in an emergency.
Failure to follow this guidance could result in bodily injury, fire, or damage to the device.

⚠CAUTION

- **When placing the Sense Module on top of the Source Module, take measures to prevent them from tipping over or falling, such as securing them with Velcro belts.**

If not secured properly, the Sense Module could tip over or fall, causing damage.

- Leave the specified distance of space from the modules to prevent their temperature from rising.
- Sense Module: At least 30 mm (all surfaces except bottom) and at least 15 mm (height of support legs) above surface on which installed
- Source Module: At least 100 mm (front), at least 600 mm (rear)
- Place with its bottom side facing downward.
- Do not block vent openings.



Sense Module　　Source Module

The modules are classified as a Class A device under the EN 61326 standard.
Use of them in a residential setting such as a neighborhood could interfere with reception of radio and television broadcasts. If this occurs, take appropriate steps to counteract the issue.

Cautions for measurement

⚠ DANGER

■ **Do not use the system to measure circuits that exceed the ratings or specifications of the system.**

Doing so could cause damage to the system or overheating, resulting in serious bodily injury.

⚠ WARNING

■ **Do not measure a voltage of 30 V DC or more.**

■ **Do not measure AC voltages.**

Failure to follow this guidance could damage the system, resulting in bodily injury.

■ **Do not touch the wires being measured.**

The wires being measured could become hot, possibly resulting in burns.

■ **When connecting measurement cables, exercise care not to mistake voltage input terminals for current input terminals.**

Mistaking these cables could damage the system or cause the circuit under measurement to short-circuit, resulting in bodily injury.

Cautions for transporting the products

⚠ CAUTION

- **Do not subject the products to vibration or mechanical shock while transporting or handling them.**
- **Do not drop the products.**

Failure to follow this guidance could damage the products.

- **Work with at least one other person to shift the Source Module using the handles on the left and right sides.**

Source Module weight: Approx. 27.0 kg

- **Follow your company's safety guidelines, such as using anti-slip gloves and safety boots.**

Failure to follow this guidance could cause bodily injury.

Shipping precautions

- When shipping the system, use the original boxes and packaging materials in which they were delivered. However, do not use the original boxes and packaging materials if they are damaged. If the original boxes and packaging materials cannot be used, contact your Hioki distributor. You will be sent suitable boxes and packaging materials.
- When packing the system, disconnect test leads and a USB flash drive.
- When transporting the system, exercise care to avoid dropping them or otherwise subjecting them to rough handling.

Warranty

- Please note that in the event the system is embedded in another system or sold to another owner, Hioki is not liable for any direct or indirect damage sustained by the end-user.
- The L1100 Sense Cable and L1150 Source Cable are not covered by the warranty.

1 Overview

1.1 Product Overview and Features

This product is an electrolysis cell analyzer that can analyze the impedance and I-V characteristics of an electrolysis cell during its operation.

Impedance measurement with excellent reproducibility

The system is capable of delivering accurate and consistent impedance measurements, even in environments with a lot of electrical noise, such as those from electrolysis devices in operation.

Simultaneous multichannel measurement

The Sense Module can measure up to eight channels simultaneously.

Cole-Cole plots (Nyquist plots)

The system can perform impedance measurement and generating Cole-Cole plots (Nyquist plots) based on user-defined frequency lists ranging from 0.01 Hz to 10 kHz.

Extended duration impedance measurement

The system can measure impedance at a user-defined frequency and fixed interval, logging readings up to 180 days.

Parameter comparisons on the graph

The measured data can be compared on a graph instantly to verify the measurement parameters of the experiment.

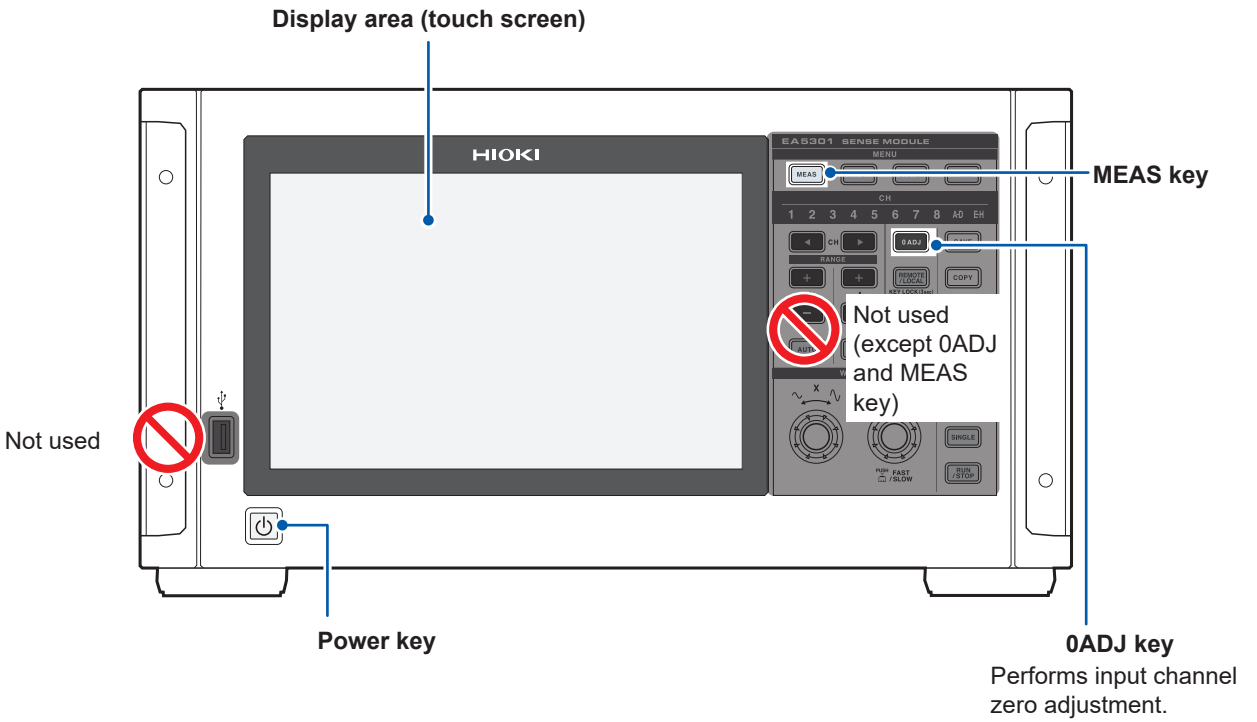
I-V graph

The system plots the I-V graphs based on the DC current and DC voltage values acquired simultaneously with impedance measurements.

1.2 Part Names and Functions

Sense Module

Front side



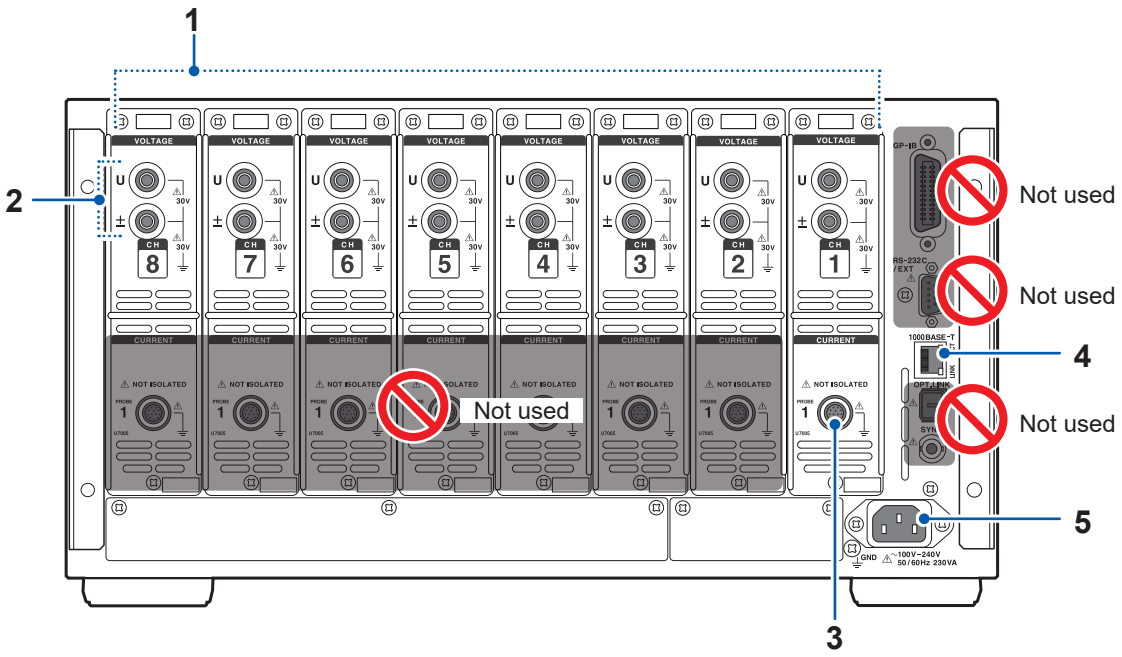
Handling the touch screen

⚠ CAUTION

- **Do not press too hard on the touch screen.**
- **Do not use hard or sharp objects to operate the touch screen.**

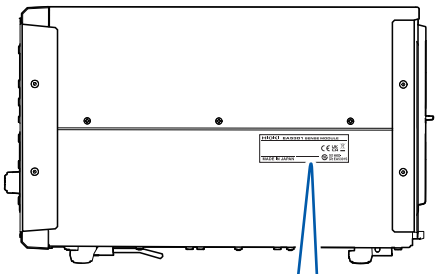
Failure to follow this guidance could damage the module.

Rear side

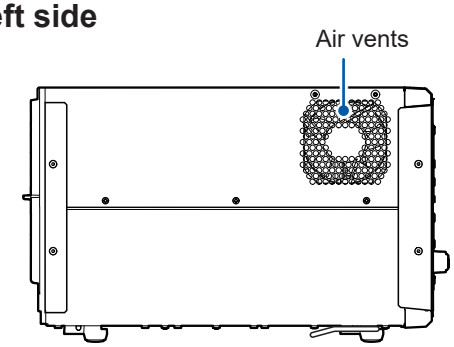


1	**Input channels**	The Sense Module accepts up to eight voltage input channels. (Specify the number of input channels when ordering.)
2	**Voltage input terminals**	Connect the L1100 Sense Cable.
3	**Probe 1 terminals (For current sensors)**	Connect Hioki's current sensors. The Sense Module automatically recognizes current sensors. It also supplies power to the current sensors.
4	**RJ-45 connector (Gigabit Ethernet)**	Connect the Sense Module and Source Module with a LAN cable.
5	**Power supply inlet**	Connect the supplied power cord for connecting devices and plug it to the Source Module's power outlet.

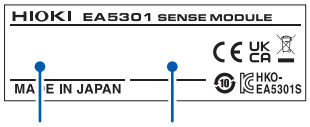
Right side



Left side



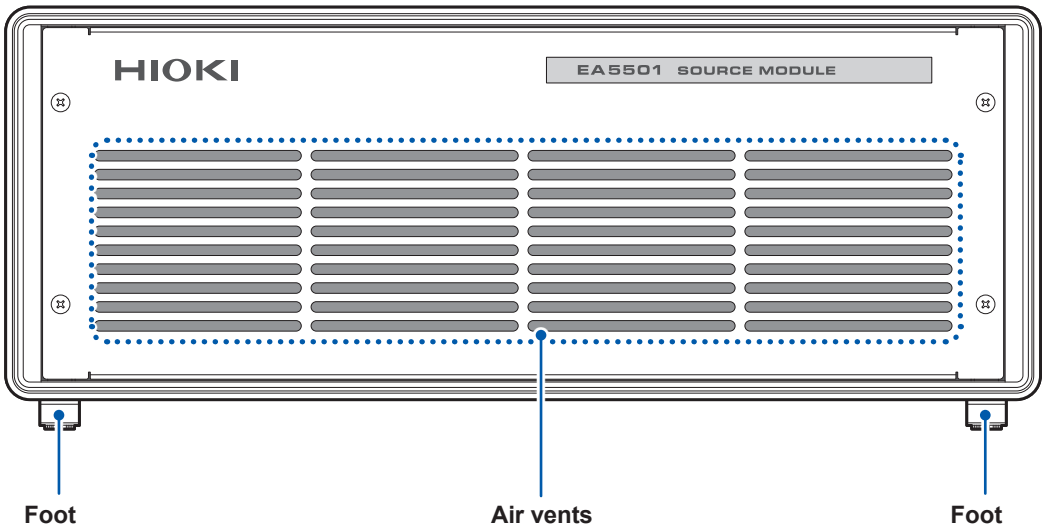
Label



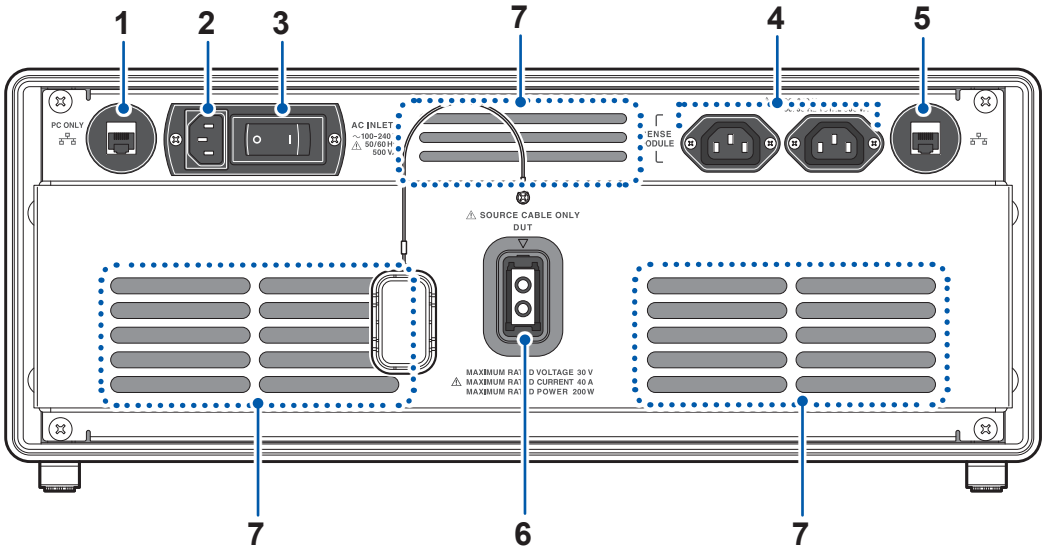
*: Serial number
For the latest information, check Hioki's website.
Do not remove this sticker as the number is important.

Source Module

Front side



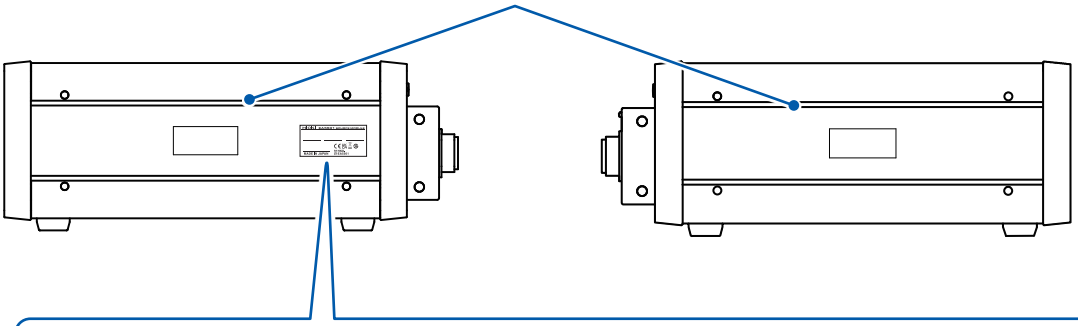
Rear side



1	**RJ-45 connector**	Connect the Source Module and the computer with a LAN cable.
2	**Power supply inlet**	Connect the included power cord to the power supply.
3	**Main breaker**	Turns the entire system's main power supply on and off.
4	**Power outlets**	Plug in the Sense Module power cord to one of the power outlets. If necessary, you can connect the optional CT9557 to the second power outlet.
5	**RJ-45 connector**	Connect the Sense Module and Source Module with a LAN cable.
6	**Signal superposition terminal**	Connect the L1150 Source Cable.
7	**Air vents**	These ventilation holes prevent the internal parts from overheating. Do not block the air vents or insert any foreign.

Right side **Left side**

Handles (recessed side handle on both sides)



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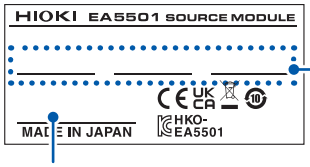
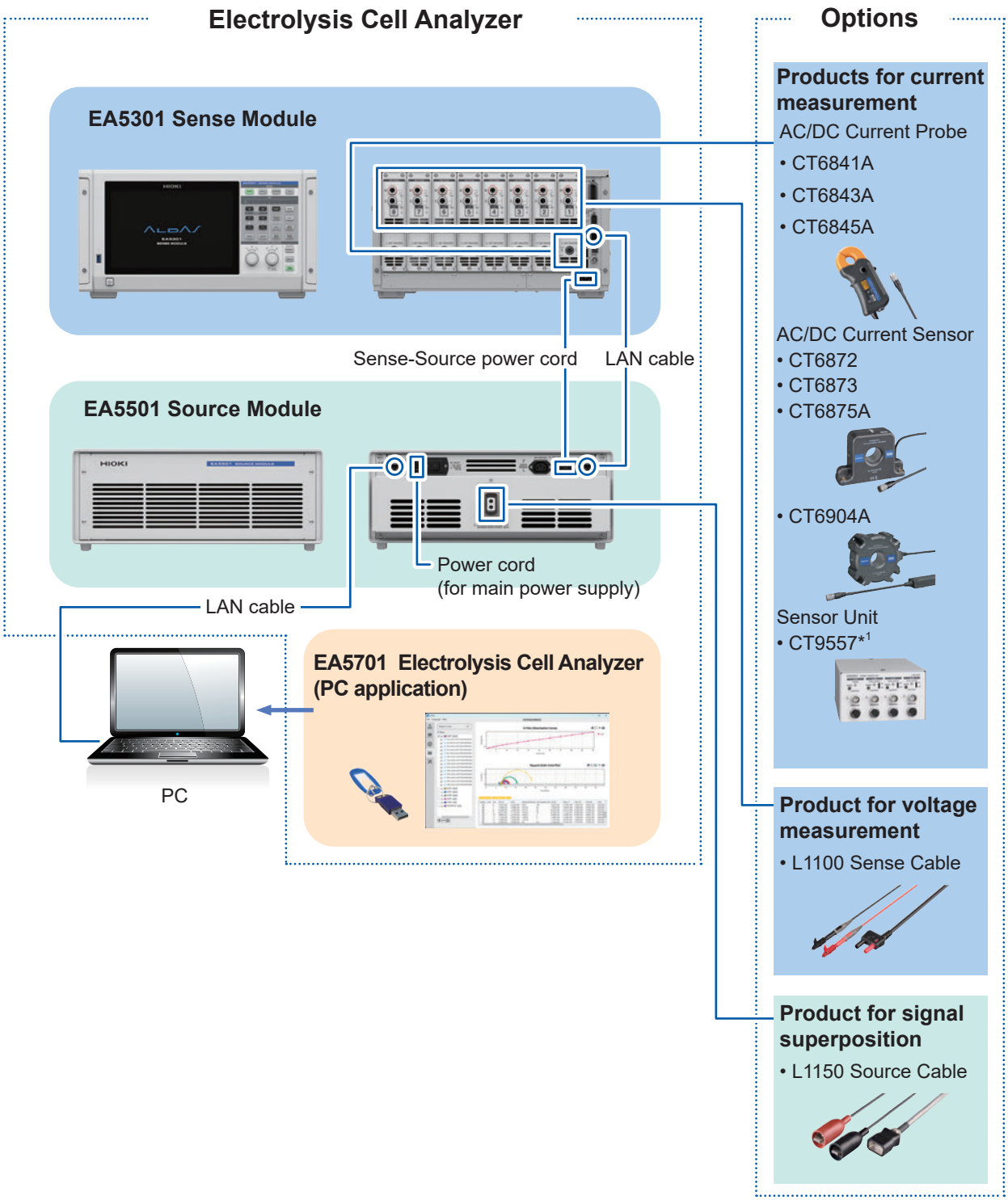


Serial number*

MAC address

*: Serial number
For the latest information, check Hioki's website.
Do not remove this sticker as the number is important.

1.3 System Architecture

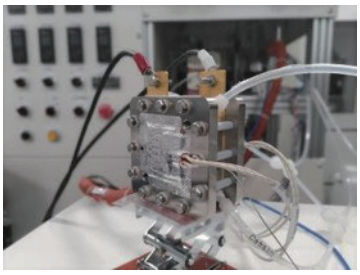


*1. The CT9904 connection cable (optional) is required to connect to the EA5301 Sense Module.

2 Measurement Procedure

2.1 Measurement Flow

Before starting measurement, inspect the instruments, accessories, and options.



2.2 Inspecting the Products Before Use

Before starting measurement, inspect the system including the modules, accessories, and optional equipments.

⚠ DANGER

■ **Inspect the system and verify proper operation before use.**

Use of the system while it is malfunctioning could result in serious bodily injury.
If you find any damage, contact your authorized Hioki distributor or reseller.

Inspecting accessories and optional equipments

Make sure that . . .	Action
Insulation of the power cords, Sense Cable, and Source Cable are not damaged. No metal is exposed.	Do not use damaged products with the system to avoid electric shock or short circuits. The system cannot perform measurements in this state. Contact your authorized Hioki distributor or reseller.
The current sensor's clamps are not cracked or damaged.	

Inspecting the system

Make sure that . . .	Action
The products are not damaged.	If damage is found, request repair.
The Sense Module displays **[EA5301 SENSE MODULE]** when turned on.	If **[EA5301 SENSE MODULE]** is not displayed, there could be damage to the power cord or a product malfunction. Please contact your authorized Hioki distributor or reseller.

2.3 Preparing for Measurement

⚠ DANGER

■ **Do not use the current sensors to measure a circuit carrying a voltage greater than the maximum rated line-to-ground voltage.**

■ **Do not use the current sensors for measuring bare conductors.**

Doing so could result in serious bodily injury or a short circuit.
*: For details about the maximum rated line-to-ground voltage of the current sensor, refer to the instruction manual that came with the current sensor.

■ **Do not short the positive and negative measurement lines with the metal part of the Sense Cable clip.**

Doing so can cause arc flash, resulting in serious bodily injury or damage to the products in the system or other equipment.

■ **Never touch the metal areas on test leads or at the tips of voltage cords during measurement.**

Doing so could result in serious bodily injury or a short circuit.

■ **Connect the current sensor to the Probe 1 terminal only.**

Using a current sensor other than the option listed in this manual may result in serious personal injury.

■ **Turn off measurement target's power supply before disconnecting the Sense Cable, Source Cable and current sensor.**

Failure to do so could result in electric shock.

■ **Use only the specified power cord to provide power to the modules.**

Using a power cord other than those specified could cause a fire, resulting in serious bodily injury.

⚠ WARNING

■ **After turning off the measurement target's power and the modules power, connect the Sense Cable, current sensor, and Source Cable.**

Doing so could damage the instrument, resulting in bodily injury.

■ **Turn off power to the measurement target's circuitry and connect the cables.**

Failure to do so could damage the module, resulting in bodily injury.

Tools to be prepared:

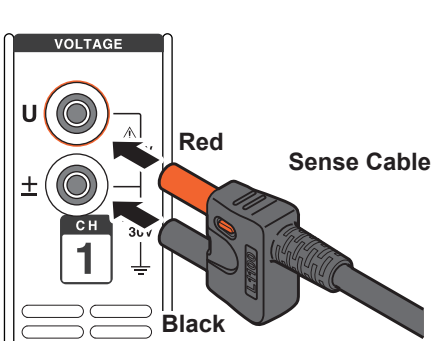
- Relay cable ×2
  (Please have the customer prepare the cables according to the current value required for electrolysis.)
- L1100 Sense Cable
- L1150 Source Cable
- Current sensor
- Power cord ×2 (for connecting the Sense Module and Source Module, main power supply)

1 Set the IP address and subnet mask of the PC.

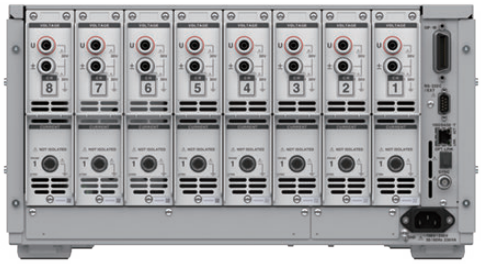
IP address: 192.168.200.200
Subnet mask: 255.255.0.0

2 Insert the USB drive of the EA5701 Electrolysis Cell Analyzer into the PC's USB port and install the PC application.

3 Insert the L1100 Sense Cable into the voltage input terminals of the EA5301 Sense Module.



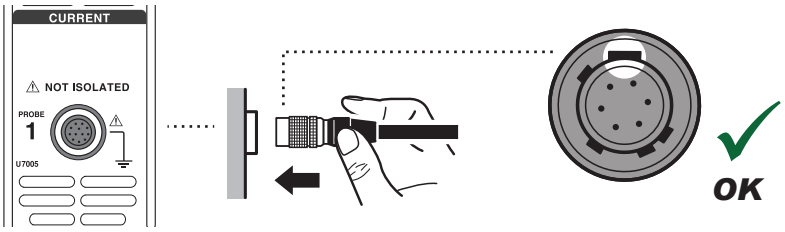
Sense Module



4 Connect the current sensor to the current input terminal (CH1 only) of the Sense Module.

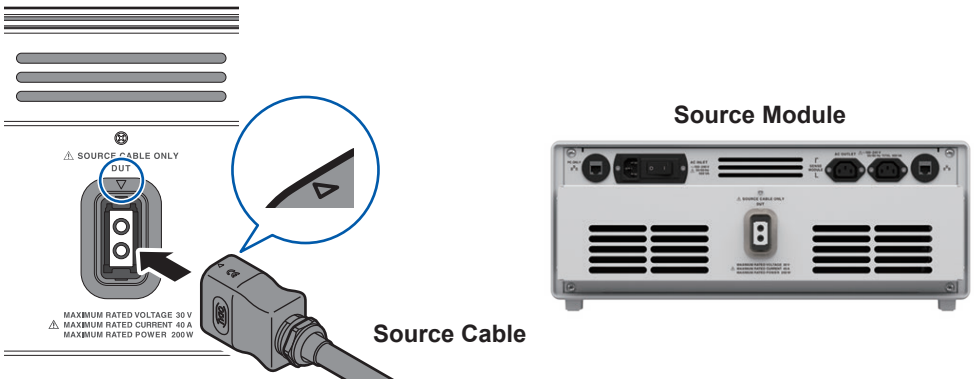
Hold the connector with its broader notch facing upward.

(CH1)



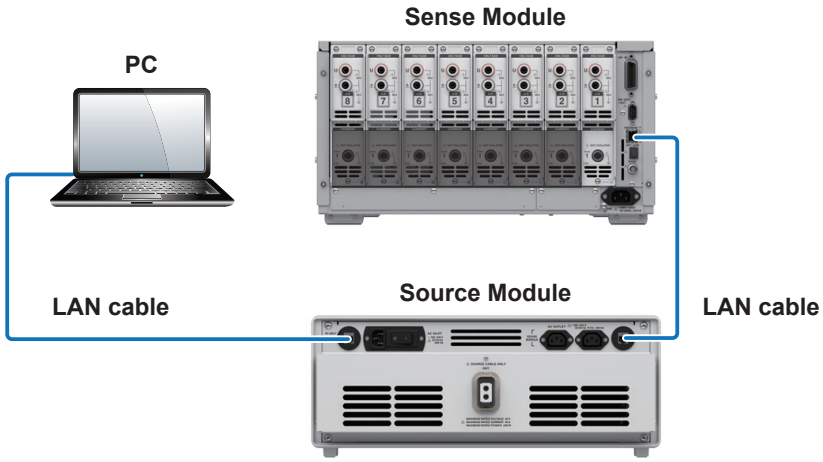
5 Connect the connector of the L1150 Source Cable to the signal superposition terminal of the EA5501 Source Module.

Align the ▽ mark on the terminal with the △ mark on the cable.



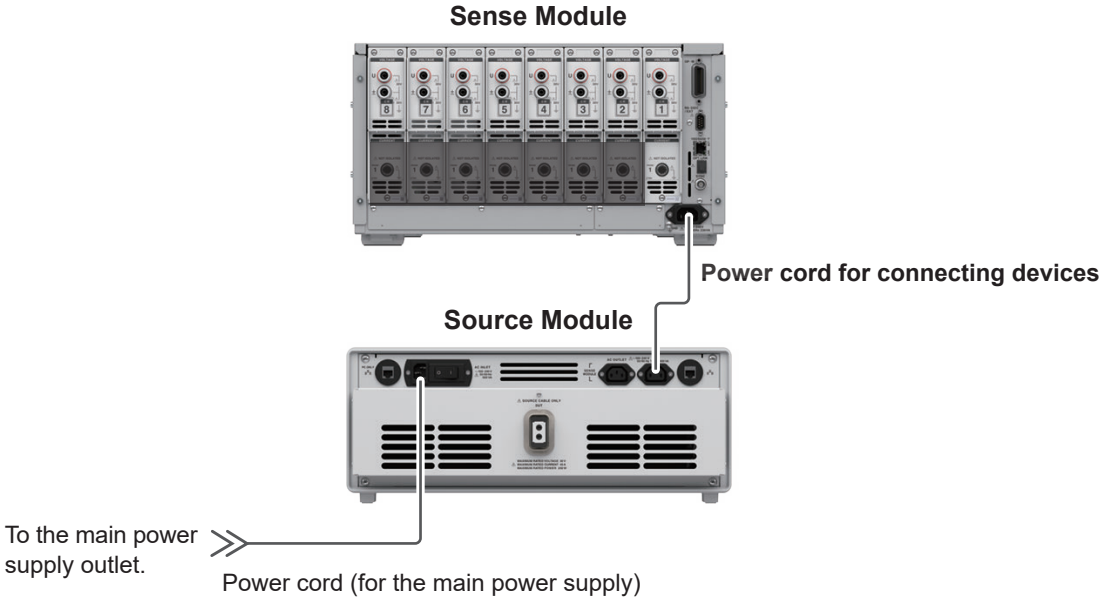
6 Connect LAN cables to the RJ-45 (Gigabit Ethernet) connectors of the modules.

- Connect the EA5301 Sense Module and EA5501 Source Module with a LAN cable.
- Connect the EA5501 Source Module and PC with a LAN cable.



7 Connect the included power cords.

- Connect the the power cord for connecting devices to the EA5301 Sense Module's power inlet.
- Connect the plug of the power cord for connecting devices to the EA5501 Source Module's power outlet.
- Connect the included power cord (for the main power supply) to the Source Module's power inlet.
- Connect the power cord's plug to a power outlet.



8 **Use the relay cables to connect the positive and negative sides of the measurement target to the Source Cable.**

The relay cable is not provided with this product. Please prepare a suitable relay cable in compliance with the measurement target (electrolysis cell) DC current specification.
Two relay cables are required (for positive and negative sides).

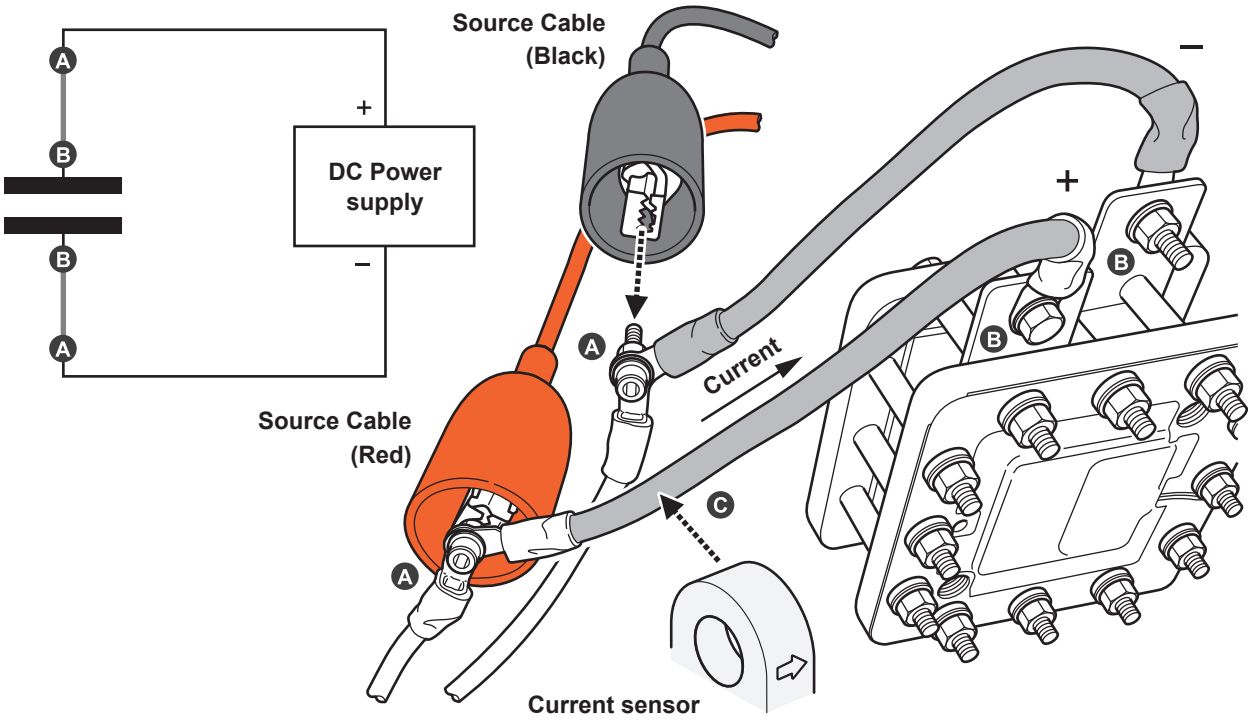
9 **Securely clip the Source Cable connector to the contact point (Ⓐ) of the relay cable.**

10 **Clip the Sense Cable securely to position (Ⓑ) where the voltage of the measurement target can be detected.**

Please clip the Sense Cable to the points where the voltage of the measurement target can be measured.

11 **Clamp the current sensor around the positive side relay cable (Ⓒ) connected to the measurement target.**

The current direction mark on the current sensor points towards the measurement target.



12 **Turn on the system.**

Let the system warm-up for at least 30 minutes before starting the measurement.

2.4 Setting the PC Application

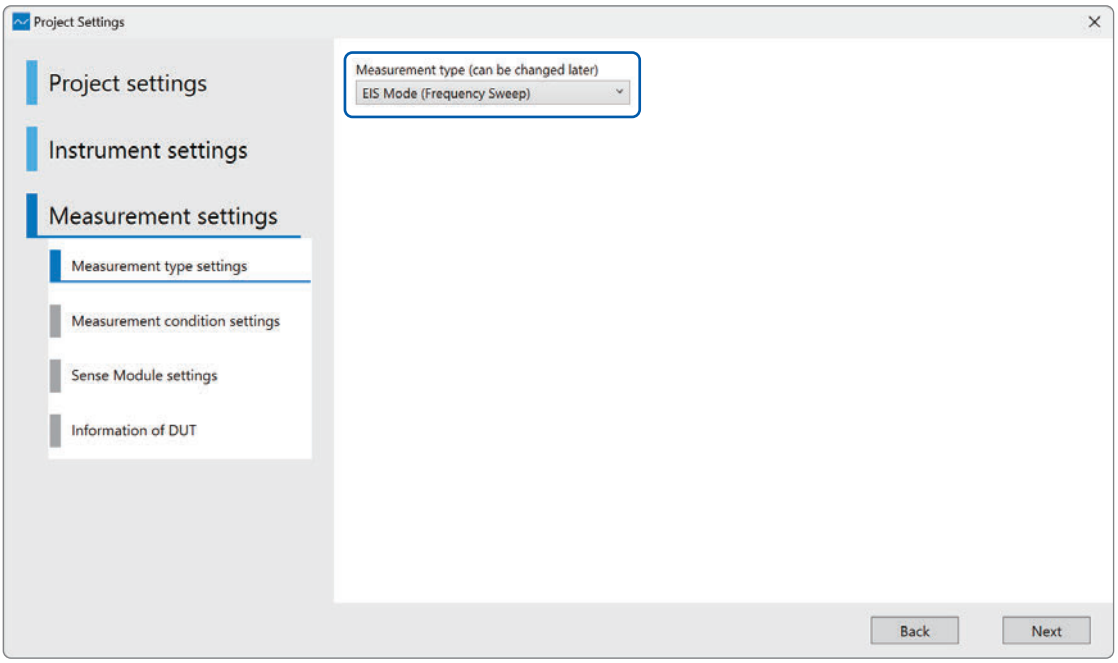
1 **Insert the USB dongle key into the USB port of the PC and launch the EA5701 Electrolysis Cell Analyzer.**

2 **Create a new measurement project in PC application.**

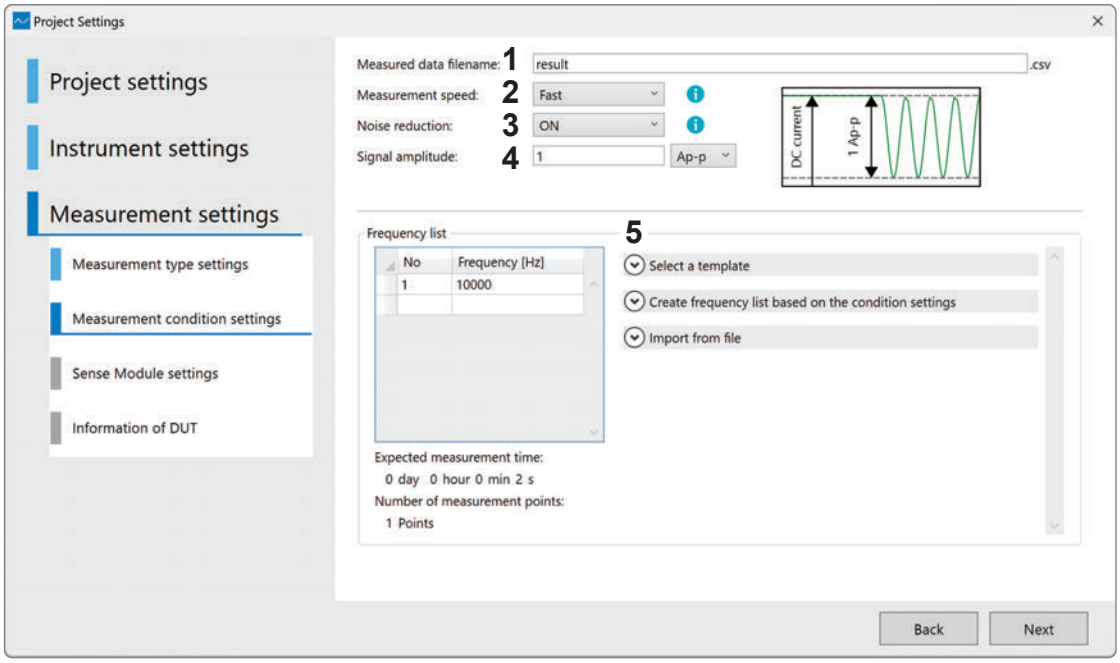
3 **Check that the PC and instruments are properly connected.**

4 **Select a measurement type from the list.**

EIS Mode (Frequency Sweep)	Measures impedance while sweeping through a range of frequencies.
Logging Mode (Fixed Frequency)	The impedance is measured continuously at a specified frequency and time interval. If the PC goes into sleep mode during measurement, the measurement will stop. Please configure your PC's power settings accordingly.



If you select the [EIS Mode].

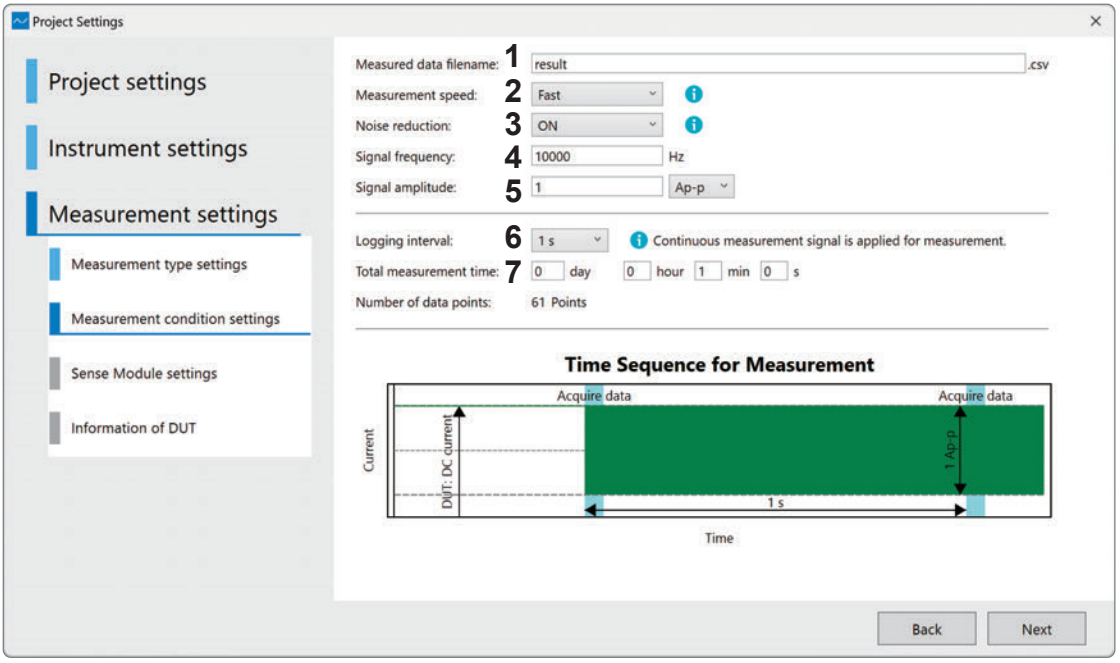


1	**Measured data filemame**	Specify the measurement results filename to save.	
2	**Measurement speed**	Select from the list **[Fast]**, **[Medium]**, or **[Slow]**.	
		[Fast]	The measurement speed takes precedence over stability. This measurement speed yields the least stable results among all the others.
		[Medium]	The measurement process ensures a balance between measurement speed and measurement stability.
		[Slow]	Priority is given to the measurement stability when taking measurements. As the number of measurements increases, the measurement speed slows down compared to other modes.
3	**Noise reduction**	Select the filter for suppressing noise.	
4	**Signal amplitude**	Specify the measurement signals' amplitude.	
5	**Frequency list**	Select the method to use to generate the frequency list.	

IMPORTANT

Set the measurement signal amplitude according to the measurement target specifications.
Start with the amplitude value at around 5% of the measurement target DC current value.
Setting the amplitude too small will result in an unstable impedance measurement.
Setting the amplitude too large will cause the measurement target current to fluctuate significantly due to the applied measurement signal.
See the Instruction Manual "11 Appendix: Impedance measurement during DC operation" for further details.

If you select the [Logging Mode].



1	**Measured data filemame**	Specify the measurement results filename to save.	
2	**Measurement speed**	Select from the list **[Fast]**, **[Medium]**, or **[Slow]**.	
		[Fast]	The measurement speed takes precedence over stability. This measurement speed yields the least stable results among all the others.
		[Medium]	The measurement process ensures a balance between measurement speed and measurement stability.
		[Slow]	Priority is given to the measurement stability when taking measurements. As the number of measurements increases, the measurement speed slows down compared to other modes.
3	**Noise reduction**	Select the filter for suppressing noise.	
4	**Signal frequency**	Specify the measurement signal's frequency.	
5	**Signal amplitude**	Specify the measurement signals' amplitude.	
6	**Logging interval**	Select the data acquisition interval for each measurement.	
7	**Total measurement time**	Specify the total time until measurement is stopped.	

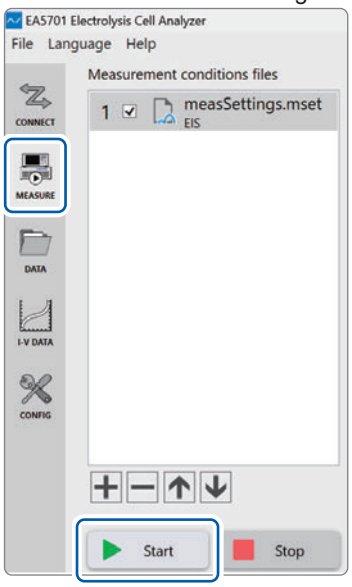
IMPORTANT

Set the measurement signal amplitude according to the measurement target specifications.
Start with the amplitude value at around 5% of the measurement target DC current value.
Setting the amplitude too small will result in an unstable impedance measurement.
Setting the amplitude too large will cause the measurement target current to fluctuate significantly due to the applied measurement signal.
See the Instruction Manual "11 Appendix: Impedance measurement during DC operation" for further details.

2.5 Starting Measurement

1 **Click the [MEASURE] tab, then click [Start].**

Measurement will start using the set conditions.



2 **Click the [DATA] tab.**

Measured data will automatically be added to the graph.

3 Specifications

3.1 General Specifications

Operating environment	Indoor use, pollution degree 2, altitude up to 2000 m (6562 ft.)	
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensing)	
Storage temperature and humidity range	−10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)	
Standards	Safety: EN 61010 EMC: EN 61326, Class A	
Power supply	Grid power	
	Rated supply voltage:	100 to 240 V AC (Assuming voltage fluctuations of ±10% of the rated supply voltage)
	Rated power supply frequency:	50 Hz/60 Hz
	Anticipated transient overvoltage:	2500 V
	Maximum rated power:	500 VA
Dimensions	EA5301 Sense Module	Approx. 430W × 221H × 361D mm (16.9W × 8.7H × 14.2D in.) (excluding protruding parts)
	EA5501 Source Module	Approx. 520W × 197H × 540D mm (20.5W × 7.8H × 21.3D in.) (excluding protruding parts)
Weight	EA5301-08 Sense Module	Approx. 12.7 kg (28.0 lbs)
	EA5501 Source Module	Approx. 27.0 kg (59.5 lbs) (not including cables)
Product warranty duration	1 year (Sense and Source Cables are not covered by the warranty.)	
Accessories	Reference: p.6	
Option	Reference: p.7	

3.2 System Specifications

System architecture

System architecture	EA5301 Sense Module	Voltage and current measurement
	EA5501 Source Module	• Signal superposition on the measurement target • Supply power to the EA5301, LAN communications with PC
	EA5701 Electrolysis Cell Analyzer (PC application)	Instruments (Sense Module and Source Module) control, impedance calculations, display of results, etc.

Sense Module specifications

(1) Sense Module voltage and current measurement shared specifications

Sampling	15 MHz, 18-bit
Effective measuring range	1% to 100% of range

(2) Sense Module voltage measurement specifications

Number of input channels	1 channel: EA5301-01 2 channels: EA5301-02 3 channels: EA5301-03 4 channels: EA5301-04 5 channels: EA5301-05 6 channels: EA5301-06 7 channels: EA5301-07 8 channels: EA5301-08
Input terminal profile	Plug-in terminals (safety terminals)
Input type	Isolated, resistive potential divider
Range	6 V, 15 V, 30 V
Crest factor	3 relative to voltage range ratings
Input resistance, input capacitance	4 MΩ ±20 kΩ, 6 pF typical
Maximum input voltage	30 V
Maximum rated terminal-to-ground voltage	30 V

(3) Sense Module current measurement shared specifications

Number of input channels	1 channel (only CH1 enabled)
Input terminal profile	Probe 1: Dedicated connector (ME15W)
Input type	Current sensor input method

Range	Probe1:	
	400 mA, 800 mA, 2 A, 4 A, 8 A, 20 A	(with 20 A sensor)
	4 A, 8 A, 20 A, 40 A, 80 A, 200 A	(with 200 A sensor)
	1 A, 2 A, 5 A, 10 A, 20 A, 50 A	(with 50 A sensor)
	10 A, 20 A, 50 A, 100 A, 200 A, 500 A	(with 500 A sensor)
Crest factor	3 relative to current range ratings	

(4) Sense Module functionality

a. Scaling

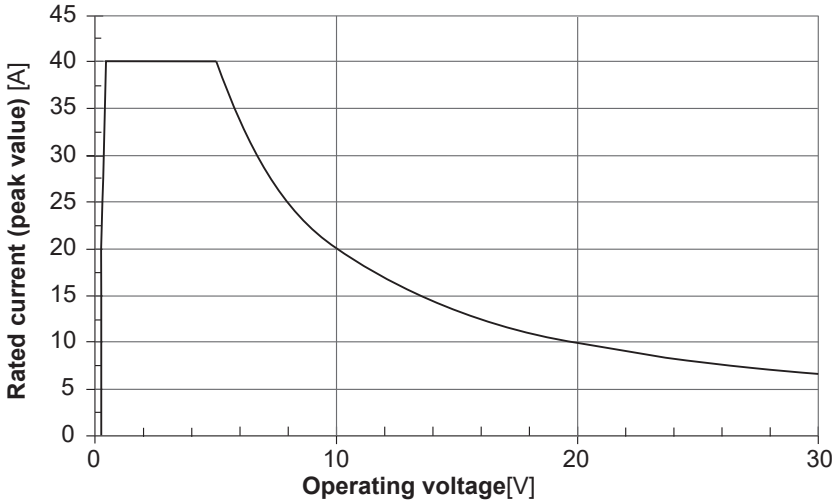
Functionality	Sets the CT ratio and applies it to measured values.
CT ratio	0.00001 to 9999.99

b. Current sensor phase correction

Functionality	Corrects current sensor high-frequency phase characteristics in calculations.
Operating modes	OFF, ON, AUTO The AUTO setting can be selected when connected to a current sensor that supports the automatic detection function.
Correction value setting	Sets the frequency and phase difference for correction points. Frequency: 0.1 kHz to 5000.0 kHz (0.1 kHz increments) Phase difference: 0.000° to ±180.000° (0.001° increments) When the operating mode is set to AUTO, these settings are configured automatically when a sensor is connected.

Source Module specifications

Source operation method	Electronic load	
Load operating modes	Constant-current (CC)	
Signal superposition terminal ratings	• Rated power: 200 W • Operating voltage: 0.25 V to 30 V • Rated current: See figure below.	



Rated current relative to Source Module operating voltage

Signal superposition method	Signal superposition by drawing some of the DC current flowing to the measurement target to the Source Module (See figure below.)

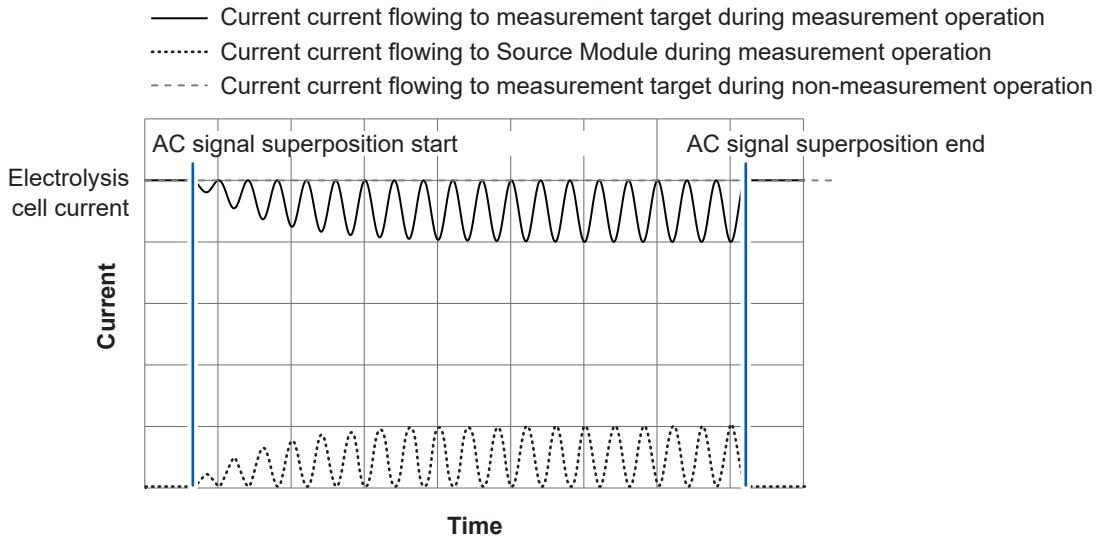


Diagram of current applied to measurement target during measurement

Power outlets	Number of power outlets	2
	Power supply	100 V to 240 V 50 Hz/60 Hz 300 VA (Outputs voltage input to the power inlet.)
	Connectable devices	EA5301-01, EA5301-02, EA5301-03, EA5301-04, EA5301-05, EA5301-06, EA5301-07, EA5301-08, CT9557

LAN interface	Number of ports	2 ports (For PC connection and Sense Module/Source Module connection)
	Connector	RJ-45 8-pole (shielded type)
	Cable specifications	STP LAN cable
	Rating/method	IEEE 802.3ab compliant
	Transmission method	1000Base-T auto negotiation
	Protocol	TCP/IP

Measurement specifications

(1) Current and voltage measurement accuracy specifications

Accuracy guarantee range	1% to 100% of range
Accuracy guarantee conditions	Accuracy guarantee duration: 1 year Accuracy guarantee temperature and humidity range: 23°C ±3°C, 80% RH or less Warm-up time: 30 min. or more Other: Sine-wave input, power factor of 1 or DC input, terminal-to-ground voltage of 0 V, within ±1°C after zero adjustment, within accuracy guarantee range

Voltage, current, power, and phase angle measurement accuracy

Accuracy	±(% of reading + % of range)	
	Voltage (U)	Current (I)
DC	0.07% + 0.03%	0.07% + 0.03%
f = 100 Hz	0.02% + 0.02%	0.02% + 0.02%
100 Hz < f ≤ 440 Hz	0.04% + 0.02%	0.04% + 0.02%
440 Hz < f ≤ 1 kHz	0.05% + 0.04%	0.05% + 0.04%
1 kHz < f ≤ 10 kHz	0.13% + 0.05%	0.13% + 0.05%

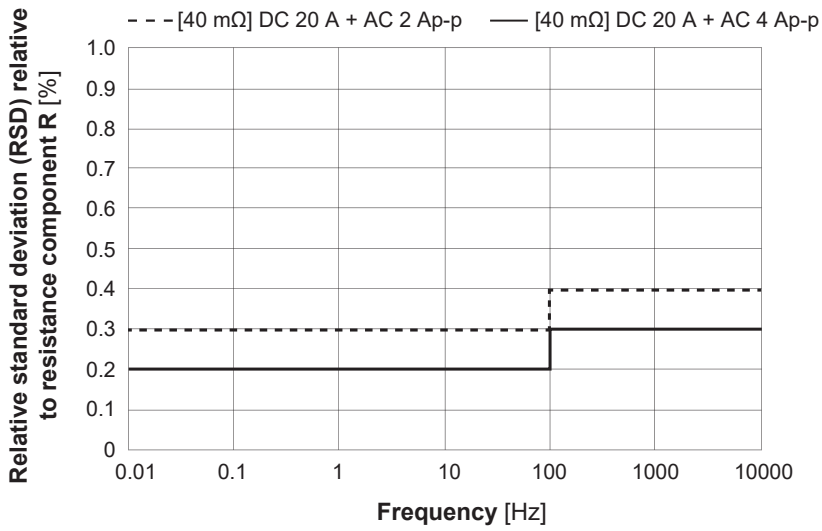
Accuracy	°
	Phase angle (ϕ) (Phase difference)
f = 100 Hz	±0.15°
100 Hz < f ≤ 440 Hz	±0.15°
440 Hz < f ≤ 1 kHz	±0.15°
1 kHz < f ≤ 10 kHz	±0.72°

- Voltage and DC current accuracy figures are defined for DC voltage and current. Accuracy figures for frequencies other than DC are defined for RMS values.
- Phase difference accuracy values are defined for 100% input with a power factor of 0.
- For current and phase angle, add the current sensor's accuracy to the above accuracy figures.
- When using the 6 V range for voltage measurement, add ±0.02% of range to the voltage accuracy.
- When using a range that is 1/10, 1/25, or 1/50 of the current sensor's rating, add ±0.02% of range to the current accuracy.
- If the temperature varies by ±1°C or more after zero adjustment, add ±0.01% of range per °C to the DC voltage and current accuracy.

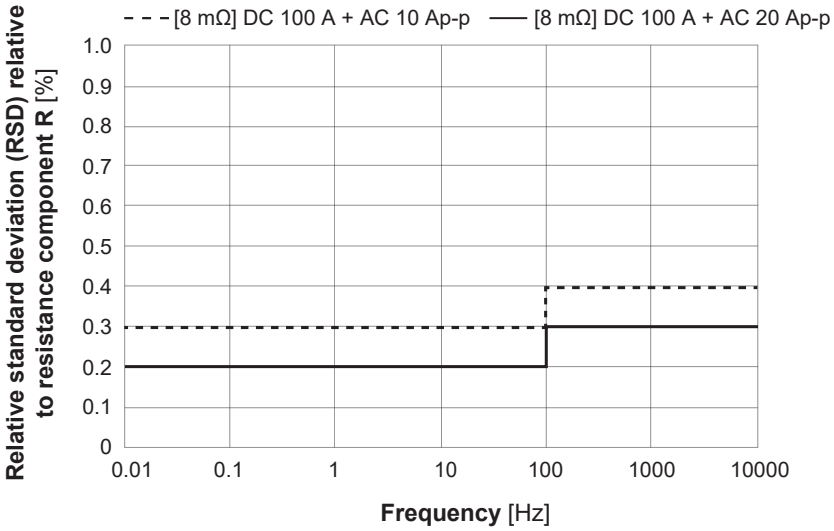
Effects of temperature	0°C to 20°C or 26°C to 40°C: Add ±0.01% of reading per °C to the voltage and current accuracy. For DC, add another 0.01% of range per °C.
Effects of external magnetic fields	±1% of range or less (400 A/m, in DC or 50 Hz/60 Hz magnetic field)

(2) Impedance measurement specifications

Impedance measurement repeatability



Relative standard deviation of measured resistance value when measuring resistive load (R = 40 mΩ, 20 A DC)



Relative standard deviation of measured resistance value when measuring resistive load (R = 8 mΩ, 100 A DC)

Measurement conditions: CT6845A current sensor
6 V range, 20 A range (20 A DC), 100 A range (100 A DC)
FAST measurement speed, noise reduction enabled
Results do not include electrical noise.

Functional specifications (PC application functionality)

(1) Impedance measurement function

Impedance measurement frequency range	10 mHz to 10 kHz
EIS Mode (Frequency Sweep)	Measures impedance at multiple user-specified frequencies.
Logging Mode (Fixed Frequency)	Repeatedly measures impedance at one user-specified frequency. Total measurement time: 1 s to 180 days Logging interval: 1 s, 2 s, 5 s, 10 s, 30 s, 1 min, 2 min, 5 min, 10 min, 30 min, 1 hour Maximum number of repeating measurement points (per channel, per set of measurement conditions): 5,000
Impedance measurement method	Real part $R = U_{sig} / I_{sig} * \cos\theta$ Imaginary part $X = U_{sig} / I_{sig} * \sin\theta$ Symbol R: Impedance real part [Ω] X: Impedance imaginary part [Ω] U_{sig}: Voltage p-p value [V] for the impedance measurement frequency component I_{sig} Current p-p value [A] for the impedance measurement frequency component θ Voltage and current phase difference [°]
Impedance measurement data	• ZView® files (.z) • Multi-plot files (.csv) • ALDAS files (.csv)
ALDAS file output parameters	Common for all measurement channels: Time and date, measurement elapsed time, frequencies set in measurement conditions For individual measurement channels: Frequencies measured, impedance real part, impedance imaginary part, impedance absolute value, impedance phase angle, voltage of impedance measurement frequency component, current of impedance measurement frequency component, DC voltage, DC current

(2) Functionality for configuring measurement conditions

Measurement speed setting	Fast, Medium, Slow Length of average processing increases in the following order: Slow > Medium > Fast.

Impedance measurement frequency resolution

Set frequency f [Hz]	**Frequency resolution** [Hz]
1000 ≤ f ≤ 10000	100
100 ≤ f < 1000	10
10 ≤ f < 100	1
1 ≤ f < 10	0.1
0.1 ≤ f < 1	0.01
0.01 ≤ f < 0.1	0.001

(3) I-V characteristics measurement function

I-V characteristics measurement function	When impedance measurement is performed, measures the DC current and DC voltage values and displays the DC current and DC voltage measured values when performing impedance under multiple conditions as I-V characteristics.	
I-V measurement method	DC currents	Measures the DC current before signal superposition.
	DC voltage	Measures the DC voltage before signal superposition.

(4) Graph rendering function

Impedance graph	Nyquist (Cole-Cole) plot	Horizontal axis: Impedance real part Vertical axis: Impedance imaginary part
	Bode plot	Horizontal axis: Frequency Vertical axis: Impedance real part, imaginary part, absolute value, phase angle, current p-p value for impedance measurement frequency component, voltage p-p value for impedance measurement frequency component, current value for DC component, voltage value for DC component (select one)
	Logging plot	Horizontal axis: Measurement time Vertical axis: Impedance real part, imaginary part, absolute value, phase angle, current p-p value for impedance measurement frequency component, voltage p-p value for impedance measurement frequency component, current value for DC component, voltage value for DC component (select one)
I-V graph	I-V Plot (Polarization Curve)	Horizontal axis: DC current Vertical axis: DC voltage
	IR-free Plot	Horizontal axis: DC current Vertical axis: IR-free voltage $V_{\text{IR-free}} = V_{\text{dc}} - R_{\text{ohm}} * I_{\text{dc}}$ $V_{\text{IR-free}}$: IR-free voltage V_{dc}: DC voltage I_{dc}: DC current R_{ohm}: Ohmic resistance (user-defined)
	I-Power Plot	Horizontal axis: DC current Vertical axis: DC power $P = I_{\text{dc}} * V_{\text{dc}}$ P: DC power V_{dc}: DC voltage I_{dc}: DC currents
	I-Impedance Plot	Horizontal axis: DC current Vertical axis: Maximum frequency resistance (RHf) or minimum frequency resistance (Rlf) (select one) Rhf : Resistance value at maximum frequency in impedance measurement file Rlf : Resistance value at minimum frequency in impedance measurement file
Impedance graph maximum number of render points	400,000	

(5) Alarm function

Sense Module error detection	Current range exceeded	If an input exceeding the current range setting is detected, signal superposition and measurement will stop.
	Voltage range exceeded	If an input exceeding the voltage range setting is detected, signal superposition and measurement will stop.
Source Module error detection	Reverse connection detection	If a reverse voltage or reverse current is detected at the EA5501 Source Module's signal superposition terminals, signal superposition and measurement will stop.
	Overheat detection	If an overheat condition is detected inside the EA5501 Source Module, signal superposition and measurement will stop.
	Network error detection	If communications between the PC and EA5501 Source Module are interrupted for 20 seconds or more during measurement operation, signal superposition and measurement will stop.
	Wiring error detection	If a short or open condition is detected at the EA5501 Source Module's signal superposition terminals, signal superposition and measurement will stop.

(6) Data saving function

Saving of settings data

Saved data	• Application settings Project-related files' relative save path, measurement data list, graph settings • Hardware settings Interface and model information for connected devices • Measurement condition settings Measurement frequency, measurement amplitude, hardware settings • Information added to data Graph render information, alert information
Data format	XAML format

Saving of measurement data

Saved data	Measurement time and date, elapsed time, set frequency, measurement frequency, impedance real part, impedance imaginary part, voltage of impedance measurement frequency component, current of impedance measurement frequency component, impedance absolute value, impedance phase angle, DC voltage, DC current
Data format	CSV format

PC application operating environment

Operating system	Windows 10 (32-bit/64-bit) or Windows 11 Home/Pro/Enterprise/Enterprise LTSC
.NET library	Microsoft .NET Framework Runtime 4.8.1 or later
Processor	Intel® Core i5 or higher (clock speed of 2 GHz or higher and at least 2 physical cores recommended)
RAM	At least 8 GB
Storage	Available space: At least 2 GB
Display	Resolution of at least 1366 × 768 pixels
Interfaces	LAN (communications between the modules and PC) USB Type A (license authentication)
License certification type	USB dongle key
Recommended PC IP address	192.168.200.5 to 192.168.200.255
Valid PC IP address setting range	192.168.0.0 to 192.168.255.255 The following IP addresses may not be used as they are reserved for use by modules: 192.168.200.1, 192.168.200.2, 192.168.200.3, 192.168.200.4
PC subnet mask settings	255.255.0.0

3.3 L1100 Sense Cable

The L1100 is designed specifically for use with the following products:
EA5301-01, EA5301-02, EA5301-03, EA5301-04, EA5301-05, EA5301-06, EA5301-07, EA5301-08

General specifications

Operating environment	Indoor use, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	−10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)
Dimensions	Full length: Approx. 2215 mm (87.2 in.)
Weight	Approx. 197 g (6.9 oz.)
Maximum input voltage	30 V DC
Maximum rated line-to-ground voltage	30 V DC
Maximum input current	50 mA
Product warranty duration	None (out of scope of coverage)

3.4 L1150 Source Cable

The L1150 is designed specifically for use with the following products:
EA5501

General specifications

Operating environment	Indoor use, pollution degree 2, altitude up to 2000 m (6562 ft.)
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensing)
Storage temperature and humidity range	−10°C to 50°C (14°F to 122°F), 80% RH or less (non-condensing)
Dimensions	Full length: Approx. 2200 mm (86.6 in.)
Weight	Approx. 1.1 kg (2.4 lb.)
Maximum input voltage	30 V DC
Maximum rated line-to-ground voltage	30 V DC
Maximum input current	40 A AC/DC, continuous
Clip opening dimensions	15 mm or more
Product warranty duration	None (out of scope of coverage)

4 Maintenance and Service

Shipping Precautions

⚠ CAUTION

Observe the following when shipping the products:

- **Remove the optional equipments.**
- **When requesting repair, include a description of the malfunction.**
- **Use the original packaging materials in which the products were delivered, and then place it in an additional box.**

Failure to follow this guidance could cause damage to the products during shipment.

4.1 Repairs, Inspections, and Cleaning

⚠ WARNING

- **Do not attempt to modify, disassemble, or repair the Sense Module or Source Module yourself.**

Failure to follow this guidance could cause bodily injury or fire.

Calibration

The calibration interval depends on factors such as the operating conditions and environment. Please determine the appropriate calibration interval based on your operating conditions and environment and have Hioki calibrate the instrument accordingly on a regular basis.

Backing up data

When repairing or calibrating the system, we may initialize it. It is recommended to back up (save/write) data such as the settings and measured data before requesting service.

IMPORTANT

If requesting repair or calibration service from Hioki, please send the following three components together:

- Sense Module
- Source Module
- Electrolysis Cell Analyzer (PC application) USB dongle key

Replaceable parts and service life

Some parts used in the products may deteriorate in characteristics after years of use.
It is recommended to replace these parts regularly to ensure long-term functionality.
To order replacements, please contact your authorized Hioki distributor or reseller.
Part service life varies with the operating environment and frequency of use.
Recommended replacement intervals do not guarantee continuous operation throughout the specified period.

Parts	Service life	Remarks and conditions
EA5301 Sense Module		
Electrolytic capacitor	About 10 years	Requires replacement of the printed circuit boards on which such parts are mounted.
Liquid crystal back-light (half life period of brightness)	About 8 years	If operated 24 hours per day
Fan motor	About 10 years	If operated 24 hours per day
Backup battery	About 10 years	Requires replacement if the time and date are significantly deviated.
Optical insulation element	About 10 years	If operated 24 hours per day
Optical connection cable connector	About 10 years	If operated 24 hours per day
EA5501 Source Module		
Backup battery	About 3 years	

Cleaning

⚠CAUTION

■ **Periodically clean the vents.**

Clogged bents could hamper the internal cooling effect of the modules, causing damage to them.

■ **To clean the products, wipe them using a soft cloth moistened with water or a neutral detergent.**

Using solvent-containing detergents, such as benzene, alcohol, acetone, ether, ketone, thinner, and gasoline, or wiping the products with excessive force could cause deformation or discoloration.

IMPORTANT

Dirt on the Sense Cable or Source Cable clips should be removed gently with a dry and clean soft cloth or with an industrial-use cotton swab. The presence of any foreign material, such as dirt, on the clips can hinder their ability to make proper contact, thus adversely affecting the measurement results.

Gently wipe the Sense Module's display with a soft and dry cloth.

4.2 Troubleshooting

If damage is suspected, refer to the “Before returning the instrument for repair” (p.45) to address the issues. If further assistance is needed, contact your authorized Hioki distributor or reseller.

Before returning the products for repair

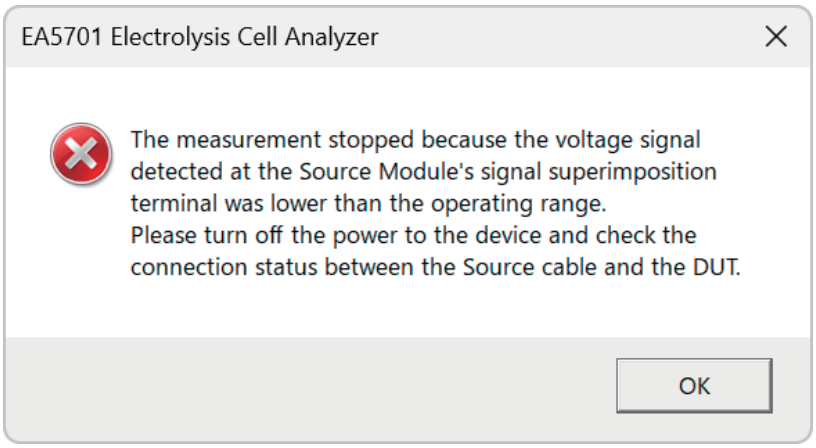
Check the following items.

Issue	Cause	Solution
The modules does not turn on.	The power cords are not connected or not properly connected.	Connect the power cords properly.
The PC application does not start.	The USB dongle key is not connected to the PC.	Connect the USB dongle key to the PC.
The PC cannot connect to the system instruments.	The LAN cable is not connected or not connected properly.	Connect the LAN cable between modules and PC properly.
	The PC’s IP address setting is not configured properly.	Configure the PC’s IP address properly.
	No current sensor is connected.	Verify that the current sensor is properly connected to CH1 of the Sense Module.
Communications between the PC and modules were interrupted.	The modules have hung.	Reconnect the modules to PC. Restart the system.
Voltage and current measurement values are abnormal. Measured values were unstable.	The Sense Cable, Source Cable, and current sensor are not connected properly.	Verify that the Sense Cable, Source Cable, and current sensor are connected properly. To achieve stable measurements, see the Instruction Manual “Methods for Stabilizing Measurement”.
	The voltage range and current range are not configured properly.	Configure the voltage range and current range properly.
	The current sensor’s phase correction setting is not configured properly.	Configure the current sensor’s phase correction setting (for the selected current sensor model) properly.
	The measurement signal amplitude is too small.	Check the measurement value, and if the Isig is extremely small, please increase **[Signal Amplitude]** value in the measurement condition setting.
The PC application was slow, making measurement impossible.	The data is too large because there are many measurement points plotted on the graph.	Data is saved as a CSV format file in the **[DataFiles]** folder inside the project folder. If you do not need to compare the data, perform measurement with separate project file that contains no measurement data.
Measurement was aborted.	The PC went to sleep during measurement.	Configure the PC so that it does not go into sleep-mode.

4.3 Error Messages

- When an error is displayed on the LCD screen, repair is necessary. Contact your authorized Hioki distributor or reseller.
- Starting the system while the lines to be measured are live may damage it or cause an error to be displayed. Always start the system on first and then activate power to the lines to be measured once you have verified that the computer screen displays no errors.

If a measurement system error occurs, a dialog box including an error message will be displayed by the PC application.



Please address the issue described in the error message.

Message	Solution
The measurement stopped because the measured current exceeded the measurable current range. Please go to the MEASURE tab and set the suitable current range.	Edit the measurement conditions and set the current range to an appropriate value. See the Instruction Manual “Configuring the Sense Module”.
The measurement stopped because the measured voltage exceeded the measurable voltage range. Please go to the MEASURE tab and set the suitable voltage range.	Edit the measurement conditions and set the voltage range to an appropriate value. See the Instruction Manual “Configuring the Sense Module”.
The measurement stopped because reverse voltage was detected at the Source Module’s signal superposition terminal. Please turn off the power to the device and check the connection status between the Source Cable and the DUT.	Turn off power to the measurement target and Source Module and check whether the Source Cable is connected to the measurement target with the proper polarity *1. The Source Cable’s red clip should be connected to the positive (high-potential) side, and the black clip should be connected to the negative (low-potential) side. See the Instruction Manual “2.8 Connecting to the Measurement Target”.
The measurement stopped because the voltage signal detected at the Source Module’s signal superposition terminal was lower than the operating range. Please turn off the power to the device and check the connection status between the Source Cable and the DUT.	Turn off power to the measurement target and Source Module and check whether the Source Cable is connected to the measurement target with the proper polarity *1. The Source Cable’s red clip should be connected to the positive (high-potential) side, and the black clip should be connected to the negative (low-potential) side. See the Instruction Manual “2.8 Connecting to the Measurement Target”.

Message	Solution
The measurement stopped due to a communication failure with the device. To restore the connection, please go to the CONNECT tab and click the button under “Connection status”.	• Check the LAN cable connection between the Sense Module and the Source Module. See the Instruction Manual ”2.6 Connecting LAN cables”. • Open the **[CONNECT]** tab on the main screen and reconnect the modules. See the Instruction Manual “7.3 Reconnecting to the Instruments”.
The measurement stopped because the watchdog protection was activated. To restore the connection, please go to the CONNECT tab and click the button under “Connection status”.	
The measurement stopped because the current sensor in the Sense Module was changed. Please go to the MEASURE tab and check the setting for the Sense Module.	• Verify that the current sensor is connected to the Sense Module. • Open the **[CONNECT]** tab on the main screen and reconnect the modules. Once connected, do not disconnect or reconnect the current sensor. See the Instruction Manual “7.3 Reconnecting to the Instruments”. • Edit the measurement conditions and set the current range to an appropriate value. See the Instruction Manual “Configuring the Sense Module”.
The measurement stopped because an over-voltage was detected at the Source Module’s signal superposition terminal. Please check if the DUT’s voltage is within the rated value.	• Verify that the measurement target’s DC voltage value does not exceeded 30 V. See Instruction manual “Precautions for Use”, “9.2 System Specifications” • Verify that the Source Cable is properly connected to the measurement target. See the Instruction Manual “2.8 Connecting the Instrument to the Measurement Target”.
The measurement stopped because excessive power was detected at the Source Module’s signal superposition terminal. Please check if the DUT’s voltage is within the rated value.	
The measurement stopped because an over-current was detected at the Source Module’s signal superposition terminal. Please check the condition of the Source Cable connection.	
The measurement stopped because an error occurred in the device. Please restart the device.	1. Turn off the Sense Module and Source Module and verify that the following two LAN cables are connected: • Between the Sense Module and the Source Module • Between the Source Module and the PC 2. Turn the Sense Module and Source Module back on.
The measurement stopped because the device has entered an abnormal state. Please restart the device.	
The measurement stopped due to an external error in the device. Please restart the device.	
The measurement stopped because the Source Module shut down. Please restart the device.	
The measurement stopped because the Source Module overheated. Please check the Source Module installation and verify that the vent is not obstructed.	Turn off the Source Module and verify that its air vent is not blocked. Ensure that the Source Module is positioned far from nearby objects (see minimum space requirements). After checking these points, leave the Source Module powered on for at least 30 minutes before use to allow the fan to cool it down before use. See the Instruction Manual “Precautions for Use”.

4.4 Disposal of the Products

When disposing of the products, remove the lithium batteries and dispose of the batteries in accordance with local regulations. Dispose of all optional accessories in accordance with applicable instructions.

⚠WARNING

- **Do not short-circuit the batteries.**
- **Do not charge the batteries.**
- **Do not disassemble batteries.**
- **Do not throw the batteries into fire or expose them to heat.**

  Failure to follow this guidance could cause the batteries to explode, resulting in bodily injury.

- **Before removing the lithium batteries, first set the switches of the modules to the off position and then remove the remove the power cords and the measurement cables from the measurement target.**
- **Store the removed batteries out of reach of young children.**

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

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.

HIOKI E.E. CORPORATION
http://www.hioki.com
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HIOKI

www.hioki.com/

All regional contact information

HIOKI E.E. CORPORATION
81 Koizumi, Ueda, Nagano 386-1192 Japan

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・EU declaration of conformity can be downloaded from our website.
・Contact in Europe: HIOKI EUROPE GmbH
Helfmann-Park 2, 65760 Eschborn, Germany hioki@hioki.eu