



IMPEDANCE ANALYZER

ZA57630

**INSTRUCTION MANUAL
(BASICS)**

NF Corporation

DA00068820-003

IMPEDANCE ANALYZER

ZA57630

**INSTRUCTION MANUAL
(BASICS)**

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— Preface —

Thank you for purchasing the "ZA57630 IMPEDANCE ANALYZER".

For safe and correct use of this product, please read the "Safety Precautions" section that follows before attempting to use this instrument.

■ Marks and symbols

For safe operation by the user and to prevent damage to this instrument, please give attention to the following marks and symbols that are used in this manual.

WARNING

This mark indicates information for preventing the possibility of death or serious personal injury from electrical shock or other hazards or damage to this instrument in the use or handling of this instrument.

CAUTION

This mark indicates information for preventing the possibility of injury to the user or damage to this instrument and the use for handling of this instrument.

■ The scope of this Manual

This manual describes the ZA57630 that conform to requirements of CE marking.

Products without CE marking affixed, may not meet directives for CE marking (EMC and others).

Please confirm the CE marking is affixed on the rear panel.

- The manuals provided for the ZA57630 are listed below.
 - Instruction manual (Basics)

This manual describes operation of the ZA57630 from this instrument's control panel, specifications, and other basic matters.

If you're using this equipment for the first time, begin reading from Chapter 1.
 - Instruction manual (Advanced)

This manual describes more advanced operation and maintenance.
 - Instruction manual (Remote Control)

This manual describes remote control of the ZA57630

Basics

1. Introduction

This chapter provides a general description of this instrument, including its features, applications, functions, and basic operating principles.

2. Preparation before use

This chapter describes important preparation that must be done before operating this instrument.

3. Panel operations

This chapter explains the function, operating procedure, default values, and measurement values for each part of the display screen. Read this chapter for a quick overall understanding of the panel and its use.

4. Basic operation

This chapter explains the basic operating procedures of the ZA57630. Refer to this chapter as you use this instrument.

5. Specifications

This chapter describes this instrument specifications (functions and performance).

Advanced

1. Advanced operation

This chapter explains a wider range of operations.

2. File formats

This chapter explains the various file formats for saving data in external storage devices (USB memory device).

3. Troubleshooting

This chapter describes how to deal with error messages and cases in which you think this instrument is malfunctioning.

4. Maintenance

This chapter explains maintenance, repacking, transportation, and performance testing methods.

—— Safety Precautions ——

For safe use of this product, give full attention to the following warnings and cautions.

The NF Corporation shall not be held liable for damages that arise from failure to observe these warnings and cautions.

This product is a Class I device (with protective conductor terminal) that conforms to the IEC insulation standards.

- Be sure to observe the instructions in the instruction manual.

This instruction manual contains information for the safe operation and use of this product.

Read the instructions and information before using the product.

All of the warning items contained in this instruction manual are intended to avoid risks that may lead to serious accidents. Follow the warnings and instructions carefully.

- Be certain that the product is properly grounded.

This product uses a line filter which may cause electric shock if the product is not grounded.

To prevent electrical shock accidents, connect the product to an earth ground so that ground resistance is 100 Ω or less.

This product is automatically grounded by connecting a 3-pin power plug to a power outlet with a protective ground contact.

- Check the power supply voltage.

This instrument operates on the power source voltage described in "2.3 Grounding and Power Connections".

Before plugging in the power cord, confirm that the outlet voltage conforms to the rated voltage of this instrument.

- If you think something is wrong, ...

If smoke or an unusual odor or sound comes from this instrument, immediately remove the power cord from the socket and cease use of this instrument.

If any such abnormality occurs, take measures to prevent the use of this instrument until repairs have been completed and promptly contact the NF Corporation or its authorized agent.

- Do not use this product when gas is present.

Operating this instrument in the presence of flammable gases may cause an explosion.

- Do not open the product case.

To prevent exposure to high voltages, never remove the cover of this instrument.

Only technicians certified by the NF Corporation are authorized to inspect or touch anything inside the product case.

- Do not modify this product.

Never modify this product in any way. Modification might create new risks. The NF Corporation may refuse to service an instrument that has an unauthorized modification.

- Do not expose this product to water.

Use of this product when it is wet may result in electrical shock or fire. If this instrument becomes wet, immediately unplug the power cord and contact the NF Corporation or its authorized agent.

- If lightning occurs nearby, turn off the power switch and unplug the power cord.

A lightning strike may cause electrical shock, fire, or instrument malfunction.

- Safety-related symbols

The marks and codes defined below are used in this manual or on this instrument itself to indicate safety information or instructions.



Instruction manual reference symbol

This notifies the user of a potential hazard and indicates that the user must refer to the instruction manual.



Electric shock danger symbol

This symbol indicates a location that presents a risk of electric shock under specific conditions.



Warning symbol

This contains information to avoid risks when handling the equipment that could result in the death or serious injury of the operator.



Caution symbol

This contains information to avoid risks when handling the equipment that could result in minor or moderate injury of the operator or damage to property.

- Other symbols



Indicates that the "ON" position of the power switch



Indicates the "OFF" position of the power switch



Indicates that the outer conductor of the connector is connected to this instrument enclosure.



Indicates that the outer conductor of the connector is isolated from this instrument enclosure. However, safe operation of this instrument requires that the potential difference from the grounding potential is restricted to 42 Vpk or less.

This product is grounded when in use, so the electrical potential of this instrument enclosure is equal to the ground potential.

- Electromagnetic compatibility

This product is a CISPR 11 Group 1 Class A compliant instrument. It should not be used outside industrial environments. Use of this product in ordinary office or residential areas may result in electromagnetic interference with other devices.

- Disposal of this product

To protect the environment, follow the guidelines described below for the disposal of this product.

- a) This device is equipped with a lithium battery. Use the services of an industrial waste disposal contractor to dispose of such batteries.
- b) The LCD backlight module that is used in this product does not contain mercury.
- c) Use the services of an industrial waste disposal contractor for disposal of the entire product.

Contents

	Page
1. Introduction.....	1-1
1.1 Features	1-2
1.2 Applications.....	1-3
1.3 Operating Principle.....	1-4
2. Preparation before Use.....	2-1
2.1 Checking before Use	2-2
2.2 Assembly and Installation.....	2-4
2.3 Grounding and Power Supply Connection	2-10
2.4 Simple Operation Check	2-12
2.5 Calibration	2-13
3. Panel Operations.....	3-1
3.1 Functions and Operations of Panel Parts.....	3-2
3.2 Input and Output Connectors	3-8
3.3 Overview of the Operation Screens.....	3-19
3.4 Operation Tree	3-32
3.5 Setting Screen Reference	3-42
3.6 Initial Settings.....	3-111
4. Basic Operations	4-1
4.1 Display and Operation when Power Is Turned On.....	4-2
4.2 Simple Operation for First Time Use	4-5
4.3 Setting Measurement Signals.....	4-13
4.4 Measurement Controls	4-18
4.5 Setting Sweep Measurement	4-19
4.6 Setting Spot Measurement	4-25
5. Specifications.....	5-1
5.1 Measurement Modes.....	5-2
5.2 Measurement Value Display Ranges	5-3
5.3 Measurement Connectors (Measurement Mode IMPD-EXT)	5-5
5.4 Measurement Connectors (Measurement Mode IMPD-3T).....	5-8
5.5 Measurement Connectors (Measurement Mode IMPD-2T).....	5-11
5.6 Measurement Connectors (Measurement Mode G-PH)	5-14
5.7 Measured Signal Control Section	5-18
5.8 Measurement Accuracy.....	5-20
5.9 Measurement Processing Section.....	5-31
5.10 Display Section.....	5-35

Contents

5.11	Memory	5-36
5.12	External Memory	5-36
5.13	External Input/Output Function	5-37
5.14	Miscellaneous Specifications	5-39

Figures and Tables

	Page
Figure 1-1 Block Diagram	1-4
Figure 2-1 Rack Mount Kit Assembly Drawing (JIS)	2-6
Figure 2-2 Rack Mount Kit Assembly Drawing (EIA)	2-7
Figure 2-3 Rack Mount Dimensions (JIS)	2-8
Figure 2-4 Rack Mount Dimensions (EIA)	2-9
Figure 3-1 Front Panel	3-2
Figure 3-2 Rear Panel	3-3
Figure 3-3 Functions of Measurement Connectors (Measurement Modes IMPD-EXT and G-PH)	3-8
Figure 3-4 Functions of Measurement Connectors (Measurement Mode: IMPD-3T)	3-9
Figure 3-5 Functions of Measurement Connectors (Measurement Mode: IMPD-2T)	3-10
Figure 3-6 Function of DC BIAS OUT Connector	3-11
Figure 3-7 Function of 10 MHz REF IN Connector	3-12
Figure 3-8 Function of 10 MHz REF OUT Connector	3-13
Figure 3-9 Handler Interface Connector Pin Assignment Diagram	3-14
Figure 3-10 Equivalent Circuit of Handler Interface	3-17
Figure 3-11 AUX Connector Pin Assignment Diagram	3-17
Figure 3-12 I/O Connector Equivalent Circuit of AUX Connector	3-18
Figure 3-13 Screen Immediately after Startup	3-19
Figure 3-14 Status Display Area	3-19
Figure 3-15 Measurement Condition Display Area	3-20
Figure 3-16 Basic Menu Operation Area	3-21
Figure 3-17 Marker Display Area	3-21
Figure 3-18 Marker Operation Area	3-21
Figure 3-19 Menu Display Example	3-23
Figure 3-20 Switching Menu (Top Menu)	3-23
Figure 3-21 Menu Layer Operation	3-24
Figure 3-22 Function Keys	3-24
Figure 3-23 Numerical Settings (Immediate Settings)	3-25
Figure 3-24 Numerical Settings	3-26
Figure 3-25 List Operations (Immediate Settings)	3-27
Figure 3-26 Palette Operations (Immediate Settings)	3-27
Figure 3-27 Text Settings (Immediate Settings)	3-28
Figure 3-28 Switching Text Input Palette	3-29
Figure 3-29 Execution Operations (Requiring Confirmation)	3-30

Figure 3-30 Graph Display Styles	3-30
Figure 4-1 Impedance Measurement Connection Example 1 (IMPD-EXT, Measurement of High Voltage).....	4-6
Figure 4-2 Impedance Measurement Connection Example 2 (IMPD-EXT, Measurement of DUT with Grounding).....	4-7
Figure 4-3 Impedance Measurement Connection Example 3 (IMPD-EXT, Measurement of High-Impedance DUT).....	4-7
Figure 4-4 Impedance Measurement Connection Example 4 (IMPD-3T)	4-9
Figure 4-5 How to Check Operation Using 100 Ω RESISTOR (IMPD-3T).....	4-10
Figure 4-6 Impedance Measurement Connection Example 5 (IMPD-2T)	4-11
Figure 4-7 Gain and Phase Measurement Connection Example.....	4-12
Figure 5-1 External dimensions	5-40

Table 2-1 Packing list.....	2-2
Table 3-1 Handler Interface Signal Layout.....	3-14
Table 3-2 Handler Interface Signal Functions	3-15
Table 3-3 AUX Connector Signal Layout	3-17
Table 3-4 Initial Settings (1/12)	3-111
Table 4-1 Display Modes (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T)	4-20
Table 4-2 Display Modes (Measurement Mode: G-PH)	4-21
Table 4-3 Graph Axis Parameters (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T)...	4-21
Table 4-4 Graph Axis Parameters (Measurement Mode: G-PH)	4-22
Table 4-5 Display Parameter Conversion Formulas (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T).....	4-23
Table 4-6 Display Parameter Conversion Formulas (Measurement Mode: G-PH).....	4-24

1. Introduction

1.1	Features	1-2
1.2	Applications.....	1-3
1.3	Operating Principle.....	1-4
1.3.1	Operating Principle	1-4
1.3.2	Measurement Modes	1-6

1.1 Features

The “ZA57630 IMPEDANCE ANALYZER” is an impedance analyzer with a maximum frequency of 36 MHz, maximum signal amplitude of 3 Vrms, maximum DC bias of ± 40 V, and maximum sweep speed of 0.5 ms/point. It has a high basic accuracy of 0.08 % and is capable of measuring impedance in a wide application range that extends to not only the manufacturing and inspection lines of electronic components but also the research of materials.

(1) Measurement frequency of 10 μ Hz to 36 MHz

This instrument can measure at a 10 μ Hz resolution in the entire range. It is also capable of the detailed measurement of the impedance-frequency characteristics of a device under test (DUT) with a sharp resonance.

(2) Maximum signal amplitude of 3 Vrms and maximum DC bias of ± 40 V

The characteristics of a DUT can be measured in wide signal amplitude and bias voltage ranges.

(3) High-speed measurement at 0.5 ms/point

Sweeping is possible at up to 0.5 ms/point (during frequency sweeping). This instrument can thus contribute to the improvement of efficiency in research and development and the shortening of tact time on manufacturing lines.

(4) Two types of measurement ports provided

This instrument is equipped with two types of measurement ports. There are the three-port type (BNC connectors) that can be used with various test fixtures for general-purpose LCR meters and the coaxial-port type (N connector) for performing stable measurement at a high frequency. The port for measurement can be switched depending on the application.

(5) Measurement signals can be amplified using a power amplifier

The impedance characteristics of a DUT can be measured using large signals by amplifying the measurement signal output of this instrument using a power amplifier. This enables impedance characteristics to be measured under conditions close to actual usage conditions for piezoelectric actuators used at high power and inductors, capacitors, and other components for power electronics.

(6) Resonant frequency tracking measurement

The resonance frequency fluctuations of piezoelectric vibrators and other devices can be tracked automatically. Impedance measurement can also be performed while the DUT is driven at the optimum frequency regardless of the variations in load and ambient temperature.

(7) Remote control

This instrument can be incorporated in manufacturing lines and measurement systems because it is equipped with USB, GPIB, RS-232, LAN, and handler interfaces as standard.

(8) Capable of measuring gain and phase characteristics

In addition to impedance characteristics, this instrument can measure the transfer characteristics (gain and phase characteristics) of filters, amplifiers, etc.

1.2 Applications

- Inspection, sorting, and evaluation testing on the manufacturing lines of electronic components such as inductors, capacitors, and sensors.
- Evaluation and research of magnetic materials and dielectrics.
- Evaluation of C-V characteristics of MEMS and semiconductor devices.
- Use in combination with a power amplifier for measurement of the impedance characteristics of inductors and capacitors for power electronics, piezoelectric motors, and piezoelectric vibrators.
- Measurement of the impedance characteristics of electrolytes, dielectric materials, and solutions at micro voltage and current levels by using a high sensitivity voltage preamplifier and current-voltage conversion amplifier.

1.3 Operating Principle

1.3.1 Operating Principle

The ZA57630 applies a sine wave signal from an internal measurement signal source to the device under test (DUT). It then detects current I flowing through the DUT and voltage V applied to the DUT, performs discrete Fourier transform (DFT), and calculates impedance Z ($= V/I$) of each analysis frequency component from the obtained Fourier coefficient obtained through the DFT. Parameters such as inductance L , capacitance C , and resistance R are calculated from the impedance (magnitude and phase angle).

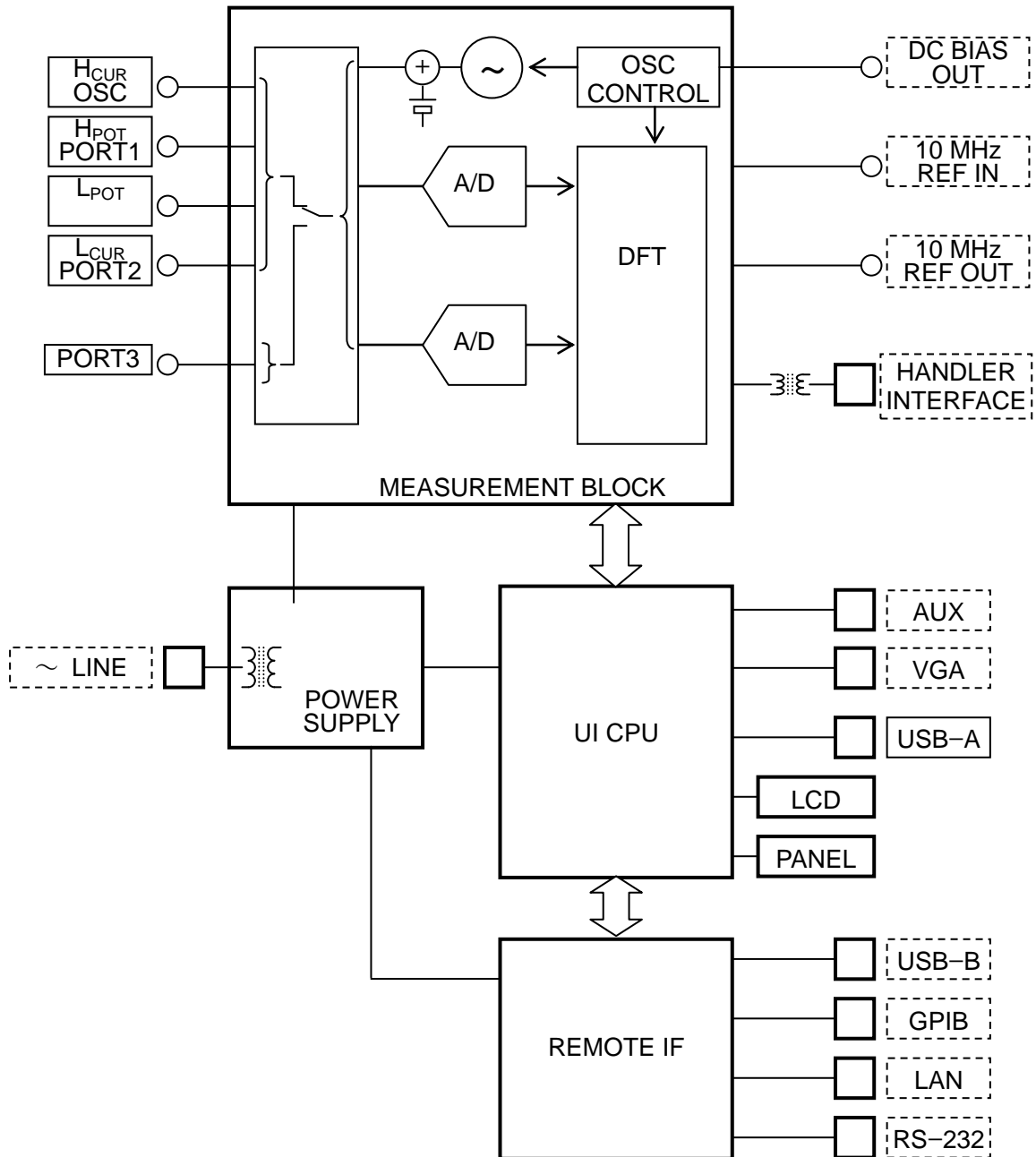


Figure 1-1 Block Diagram

The impedance and phase angle at the measurement frequency are obtained with one measurement. Impedance frequency characteristics like a Bode diagram can be obtained by measuring the gain and phase angle while sweeping the measurement signal source oscillator (OSC) and measurement frequency. This instrument can measure the amplitude dependence and DC bias dependence of each impedance since it can also sweep the AC signal amplitude and DC bias in addition to the frequency.

a) MEASUREMENT BLOCK

The measurement block consists of a signal generation section to supply a signal for measurement to the DUT, voltage detection section, current detection section, and DFT section to calculate impedance.

The signal generation section has a setting resolution of 10 μ Hz for the range of 10 μ Hz to 36 MHz based on the direct digital frequency synthesizer technology.

The current of the L_{CUR} connector is converted to a voltage and then A/D conversion and DFT calculation are performed to calculate the current vector (magnitude and phase angle). The voltage vector is also calculated by performing A/D conversion and DFT calculation for the voltage applied to the DUT. The impedance (magnitude and phase angle) of the DUT is calculated by dividing the voltage vector by the current vector and then various error corrections are made and the result is transferred to the UI CPU section.

b) UI CPU CKT

This displays the measurement data obtained by the measurement block on the LCD in various graph formats. It also outputs measurement commands to the measurement block in accordance with the settings from the front panel or a remote interface. The USB-A connector is located on the front panel and is used for connecting a USB memory device.

c) POWER SUPPLY CKT

This supplies various power required by the measurement block in addition to power for digital section control.

d) REMOTE IF CKT

This performs communication with an external controller, such as outputting various settings and measurement data. It converts between the communication protocols of the GPIB, USB, RS-232, and LAN general interfaces and the internal communication protocol of UI CPU CKT. The USB-B connector is located on the rear panel and is used for connecting with a PC to control this instrument.

1.3.2 Measurement Modes

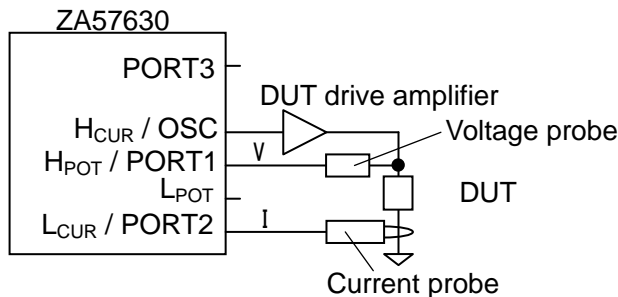
This instrument has four measurement modes to use depending on the measurement purpose.

- Measurement mode IMPD-EXT
 - Impedance measurement mode
 - Current-voltage conversion needs to be performed externally.
 - DUT drive amplifier, probe, etc. can be used.
- Measurement mode IMPD-3T
 - Impedance measurement mode
 - Test fixture and test leads for LCR meters can be used.
- Measurement mode IMPD-2T
 - Impedance measurement mode
 - Stable measurement at high frequency is possible using an N connector.
- Measurement mode G-PH
 - Gain-phase measurement mode
 - For measuring transfer characteristics of filters and amplifiers

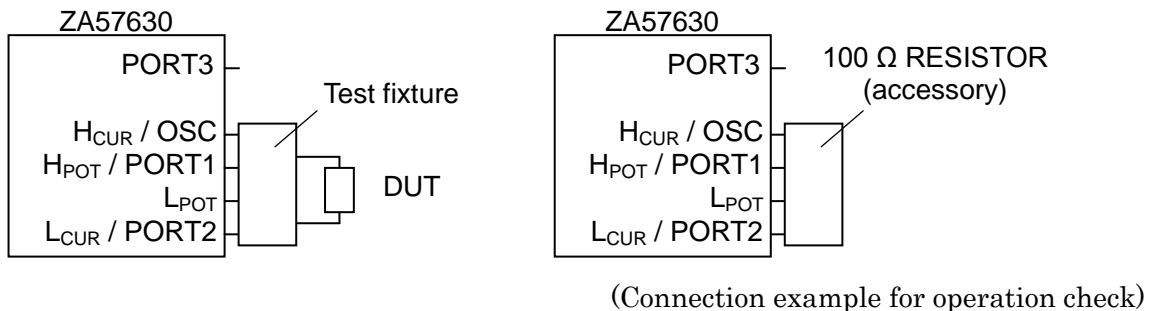
The connector to use for measurement differs depending on the measurement mode setting.

- IMPD-EXT, IMPD-3T, G-PH : H_{CUR}/OSC, H_{POT}/PORT1, L_{CUR}/PORT2
- IMPD-2T : PORT3

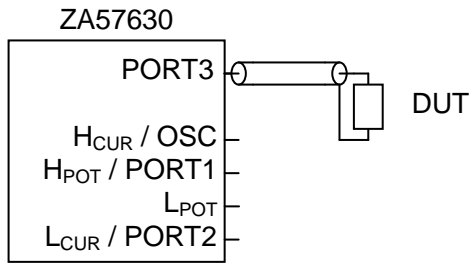
- Connection example for measurement mode IMPD-EXT



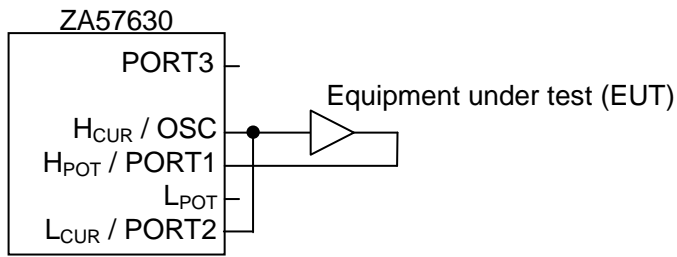
- Connection example for measurement mode IMPD-3T

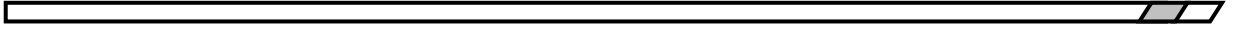


- Connection example for measurement mode IMPD-2T



- Connection example for measurement mode G-PH





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2. Preparation before Use

2.1	Checking before Use	2-2
2.2	Assembly and Installation.....	2-4
2.2.1	General Precautions for Installation	2-4
2.2.2	Installation Conditions	2-4
2.2.3	Rack Mounting	2-5
2.3	Grounding and Power Supply Connection	2-10
2.4	Simple Operation Check	2-12
2.5	Calibration	2-13

2.1 Checking before Use

■ Checking safety

To ensure safety, refer to “Safety Precautions” at the beginning of this instruction manual and carry out safety checks before using this instrument.

In addition, read “2.3 Grounding and Power Supply Connection” before connecting to the power supply and carry out sufficient safety checks before connecting this instrument to a power source.

■ Checking appearance and accessories

If you notice something abnormal on the outside of the cardboard box (such as a scratch or dent), closely check that the product is not affected when you remove it from the box.

When you have removed the contents from the cardboard box, check them.

If you find a scratch on the product or an accessory is missing, report the problem to NF Corporation or its authorized agent.

○ Checking appearance

Check that there is no scratch or dent on the panel surfaces, controls, connectors, etc.

○ Checking accessories

The accessories of this instrument are as follows. Check that the quantities are correct and there is no scratch.

Table 2-1 Packing list

Main unit	1
Accessories	
Instruction Manual (Basics)	1
Instruction Manual (Advanced)	1
Instruction Manual (Remote Control)	1
Power cord set (with 3-pin plug, 2 m)	1
PA-001-3234 CALIBRATION BOX *1	1
PA-001-3233 100 Ω RESISTOR *2	1

*1: This is used when performing self-calibration of this instrument. For the operating procedure, refer to “1.8.1 Self-Calibration” in Instruction Manual (Advanced).

*2: This is used when checking the operation of this instrument in the IMPD-3T measurement mode. For the operating procedure, refer to “4.2.3 Impedance Measurement (Measurement Mode IMPD-3T)”.

- Options / related products

- Test fixtures and test leads

Test fixtures and test leads are not included. Please purchase them separately. The major test fixtures and test leads that can be used in combination with this instrument are as follows.

Model	Product name	Supplementary note	Frequency range
ZM2363	Test fixture	For lead components	DC to 10 MHz
2324	4-terminal alligator clip test leads	————	DC to 100 kHz
2325AL	Kelvin clip test leads	Large sized clips (Replaceable clips)	DC to 100 kHz
2325AM	Kelvin clip test leads	Medium sized clips (Replaceable clips)	DC to 100 kHz
ZM2392	Kelvin clip test leads	Simple type	DC to 20 kHz
ZM2391	3-terminal alligator clip test leads	2 signals, 1 shielded	DC to 20 kHz
2326A	Chip component test leads	Tweezers type	DC to 1.2 MHz
ZM2394	Chip test fixture	For SMD & chip parts	DC to 2 MHz
ZM2394H	Chip test fixture	For SMD & chip parts	DC to 36 MHz

The above table lists the test fixtures and test leads that can be used when this instrument is in the IMPD–3T measurement mode. Any model connected to the DUT by 2 terminals will be affected by the contact resistance and its variations. Even 4-terminal test fixtures and test leads will similarly be affected by contact resistance and its variations because the IMPD–3T measurement mode of this instrument is for a 3-terminal connection. For measurements of approximately 50 Ω or less, we recommend evaluating the measurement value variations due to contact resistance using an actual DUT before use.

- Other options

PA-001-0370 SHUNT RESISTOR

Current-voltage conversion coefficient 1 V/A, rating 1 Arms

For details, refer to the instruction manual.

PA-001-3270 RACK MOUNT KIT (EIA)

This kit is for mounting in an EIA standard rack.

PA-001-3271 RACK MOUNT KIT (JIS)

This kit is for mounting in a JIS standard rack.



There are high voltage parts inside this instrument. Never remove the cover.

No one except trained service technicians who have knowledge of hazard prevention is authorized to check the inside of this device.

2.2 Assembly and Installation

2.2.1 General Precautions for Installation

—  CAUTION —

Observe the following points. Otherwise, this instrument may be damaged.

- This instrument uses forced air cooling by fan. If you notice that the fan is stopped, turn off the power immediately and then contact NF Corporation or its authorized agent.
If you continue to use this instrument with the fan stopped, there is a risk of the expansion of damages and hence difficulty/impossibility of repair.
 - Air inlets and outlets are located on the sides, bottom, and rear of this instrument. Do not block the sides, rear, and bottom.
 - Do not install this instrument on its back or side (upright). There is a risk of it falling over. Install it so that all of the four feet on the bottom sit on the flat surface of a table, etc.
-

2.2.2 Installation Conditions

- Install this instrument in a place that satisfies the following temperature and humidity conditions.
 - Operation: +0 to +40 °C, 5 to 85 % RH (absolute humidity 1 to 25 g/m³, non-condensing)
 - Storage: -10 to +50 °C, 5 to 95 % RH (absolute humidity 1 to 29 g/m³, non-condensing)
- Place this instrument in a location of altitude up to 2,000 m.
- Do not install the instrument in the following locations:
 - Where there is flammable gas
There is a risk of explosion. Never install or use it in such a location.
 - Outdoors, where exposed to direct sunlight, or near fire or a heat source
The performance may not be satisfied, or a failure may occur.
 - Where there are corrosive gases and vapors, a lot of dust and particles, salty air and oily smoke, and metal powder, etc.
 - Where there is a lot of vibration
Malfunction or a failure may occur.
 - Near an electromagnetic field source, high-voltage equipment, power line, or pulse noise source
Malfunction or a failure may occur.
- This instrument may cause interference if used in residential areas. Use in such locations must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

2.2.3 Rack Mounting

This instrument can be mounted in a 19-inch IEC rack, EIA standard rack, or JIS standard rack by attaching a rack mount kit (sold separately). Rack mount kits for a milli rack (JIS) and inch rack (EIA) are available.

First attach the rack mount kit as shown in “Figure 2-1 Rack Mount Assembly Drawing (JIS)” or “Figure 2-2 Rack Mount Assembly Drawing (EIA)”, and then mount this instrument to a rack.

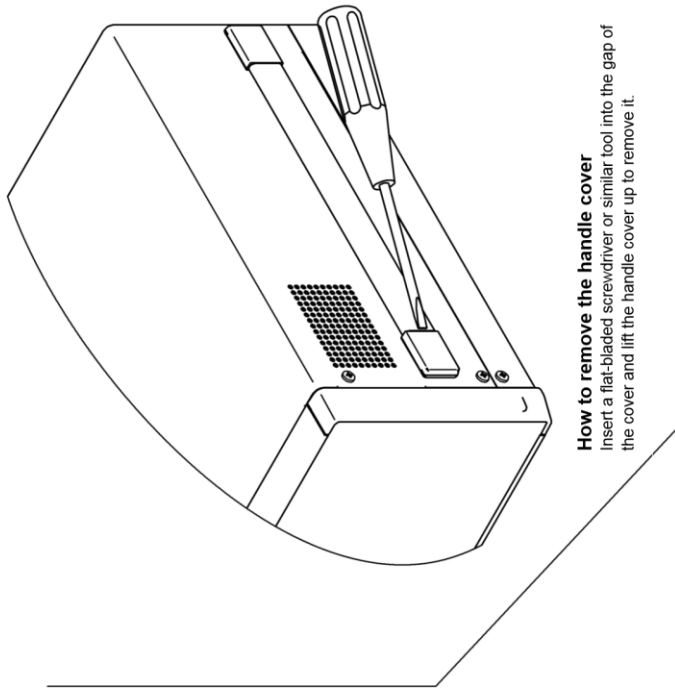
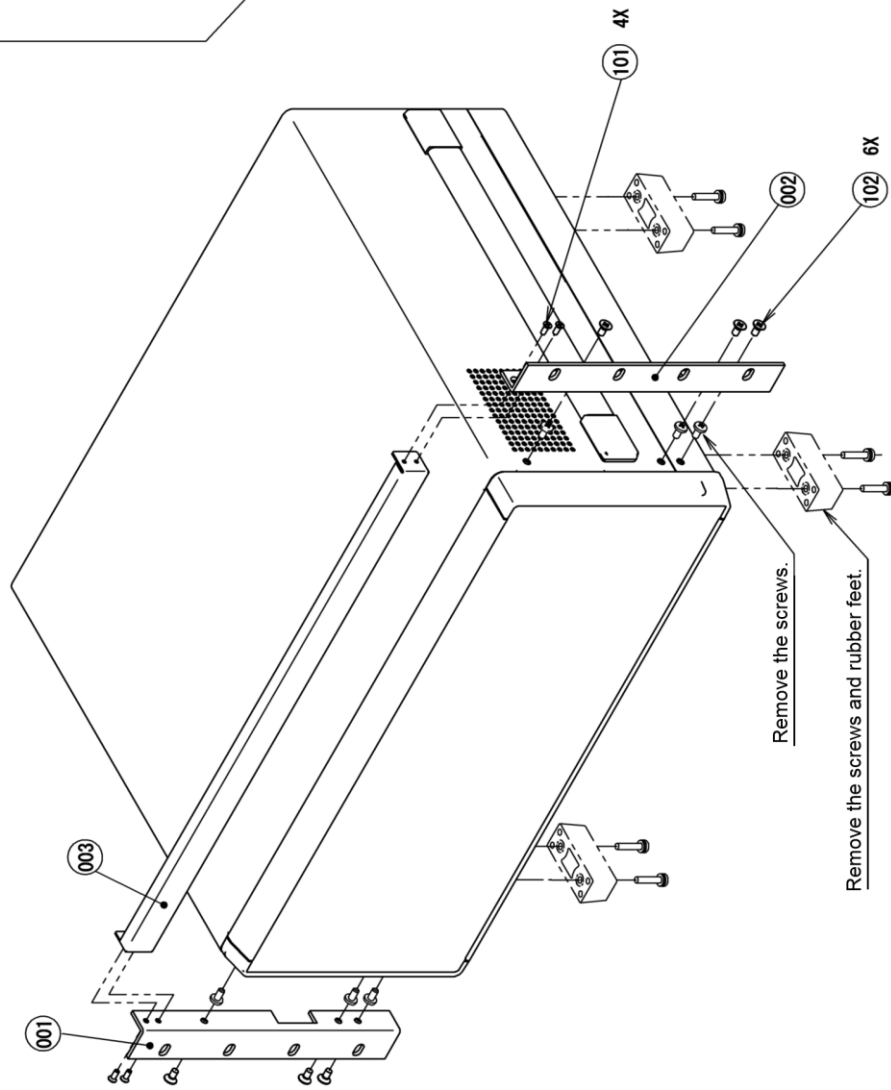
 **WARNING**

When mounting this instrument in a rack, be sure to install rack rails, etc. to support this instrument. Failure to do so, may result in injury or instrument damage due to falling.

 **CAUTION**

- Provide the rack with ventilation holes or a cooling fan for cooling.
 - This instrument has air inlets on both sides and the bottom.
Provide clearance of at least 20 mm from the sides of this instrument and the inner walls of the rack, etc.
 - There is an air outlet on the rear panel.
Provide clearance of at least 50 mm from the rear of this instrument and the inner wall of the rack, etc.
If the ambient temperature exceeds the specified limit or the air inlets and outlets are blocked, the performance may not be able to be maintained or this instrument may be damaged.
-

Part No.	Product Name	Description	Quantity
001	JIS Rack Mount (L)	—	1
002	JIS Rack Mount (R)	—	1
003	JIS Rack Mount Spacer	—	1
101	Small Countersunk Screw	M3x6 iron, nickel-plated	4
102	Small Countersunk Screw	M4x8 iron, nickel-plated	6



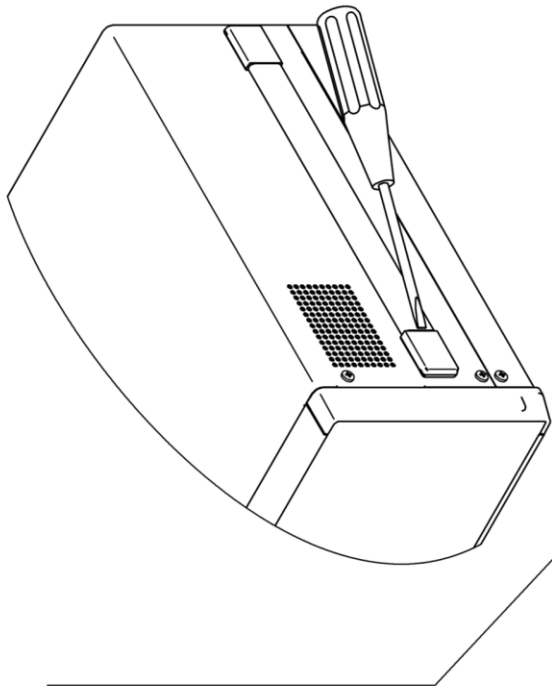
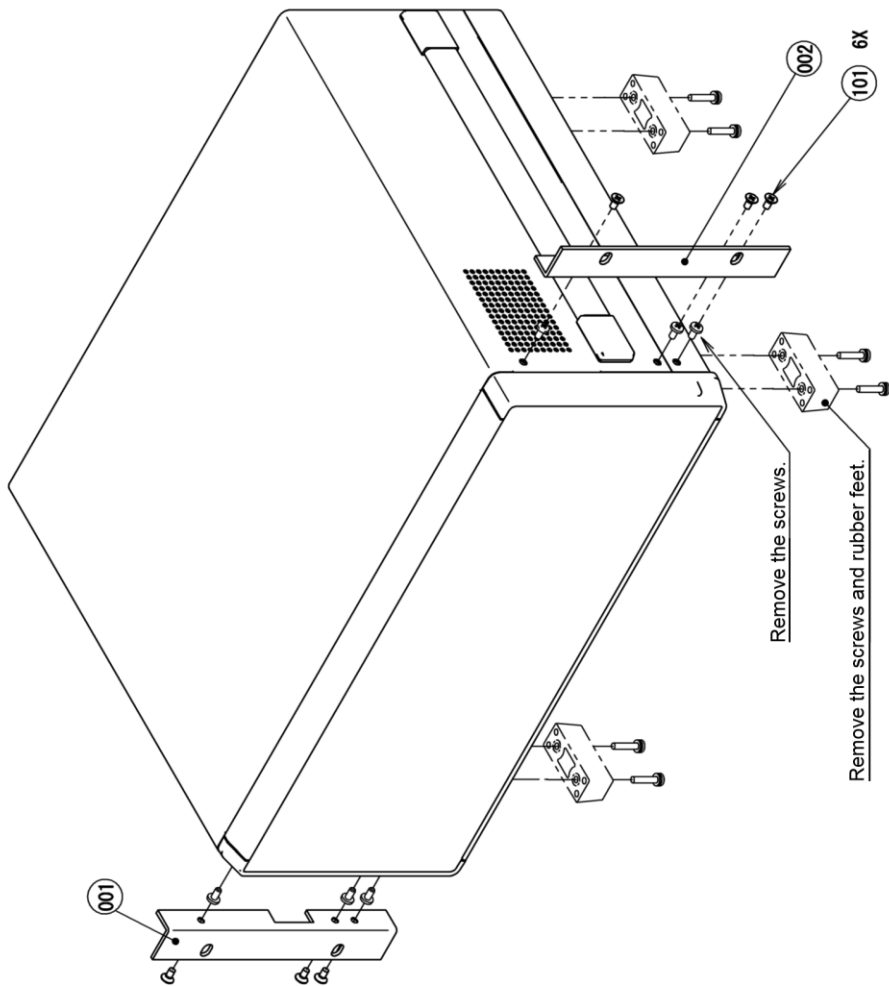
How to remove the handle cover
 Insert a flat-bladed screwdriver or similar tool into the gap of the cover and lift the handle cover up to remove it.

Remove the screws.

Remove the screws and rubber feet.

Figure 2-1 Rack Mount Kit Assembly Drawing (JIS)

Part No.	Product Name	Description	Quantity
001	EIA Rack Mount (L)	—	1
002	EIA Rack Mount (R)	—	1
101	Small Countersunk Screw	M4x8 Iron, nickel-plated	6



How to remove the handle cover
 Insert a flat-bladed screwdriver or similar tool into the gap of the cover and lift the handle cover up to remove it.

Figure 2-2 Rack Mount Kit Assembly Drawing (EIA)

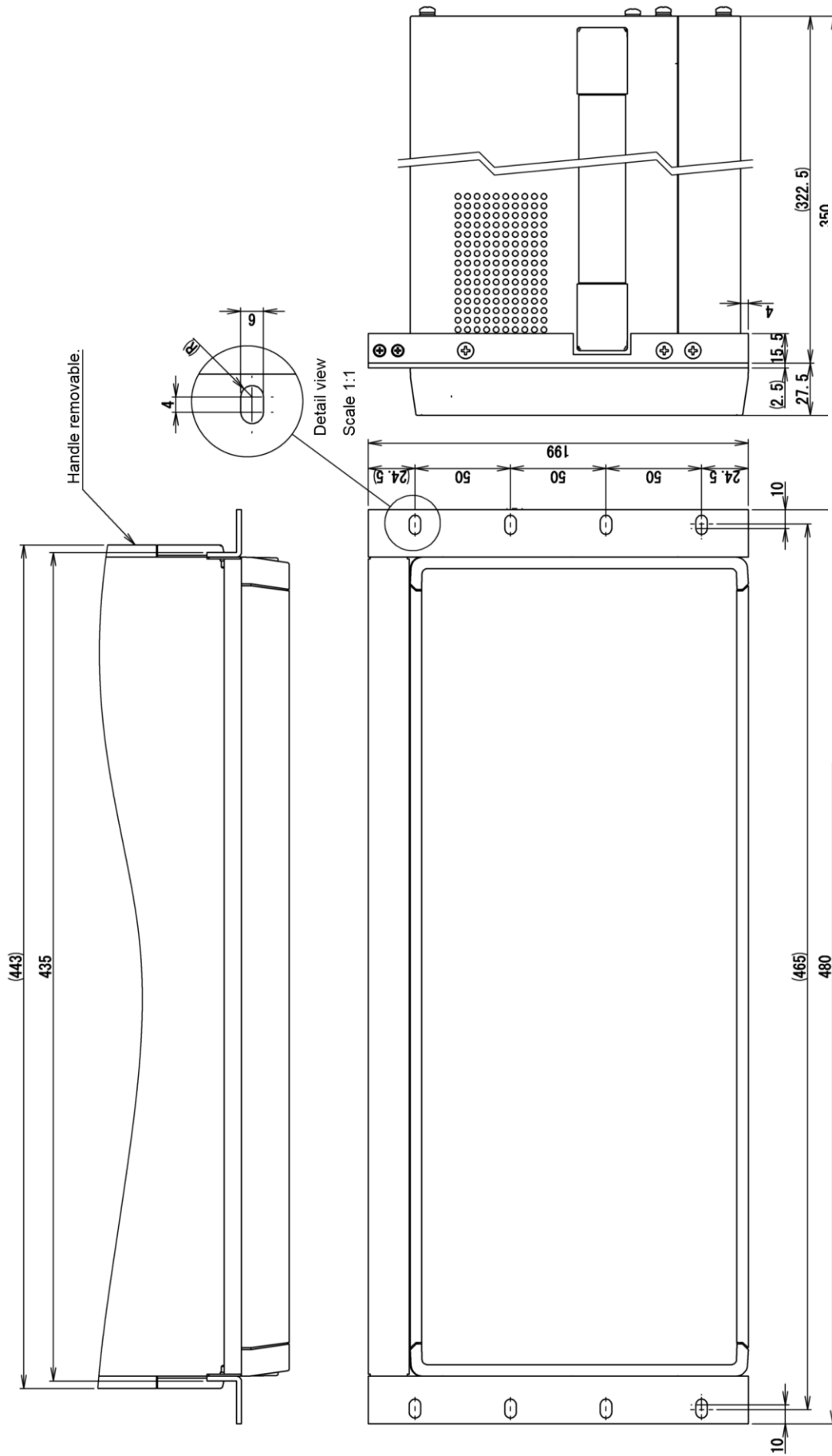


Figure 2-3 Rack Mount Dimensions (JIS)

CAUTION

- When placing the instrument in a rack, do not use only the rack mount adapters to hold it in place. Be sure to install L brackets or a shelf in the rack to hold the instrument in place.
- If the opening of the rack is narrow, remove the handles on the sides.

Rack mount adaptor's case paint: Ultra-light gray (Munsell 6PB9.2/0.1)

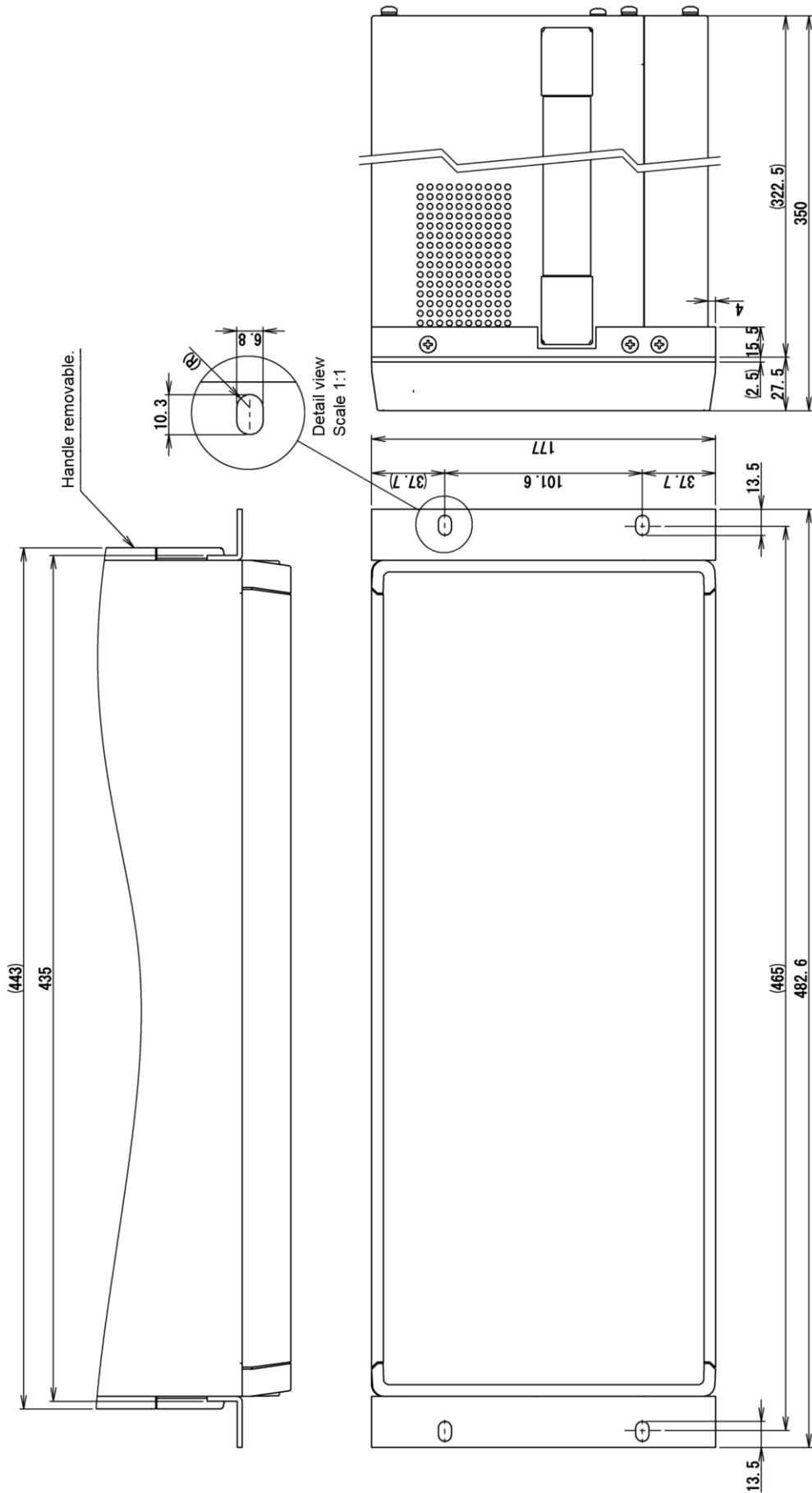


Figure 2-4 Rack Mount Dimensions (EIA)

CAUTION

- When placing the instrument in a rack, do not use only the rack mount adapters to hold it in place. Be sure to install L brackets or a shelf in the rack to hold the instrument in place.
- If the opening of the rack is narrow, remove the handles on the sides.

2.3 Grounding and Power Supply Connection

- Be sure to perform grounding.

⚠ WARNING

This instrument uses a line filter, which may cause electric shock if the product is not grounded. To prevent electrical shock accidents, be sure to connect it to an earth ground so that ground resistance is 100 Ω or less.

This instrument will be automatically grounded if the 3-pin power plug is connected to a power outlet with a protective ground contact.

- The power supply conditions of instrument are as follows.

Voltage range:	100 V to 230 VAC $\pm 10\%$, however 250 V or less
Frequency:	50 Hz / 60 Hz ± 2 Hz
Power consumption:	Max. 100 VA
Overvoltage category:	II

- Perform the following procedure to connect to the power supply.

- 1) Check that the voltage of the commercial power supply to be connected is within the voltage range of this instrument.
- 2) Turn off the power switch of this instrument. The power switch is located on the rear panel.
- 3) Connect the power cord to the power inlet on the rear panel of this instrument.
- 4) Insert the plug of the power cord into a power outlet with a protective ground contact.
- 5) Turn on the power switch on the rear panel. Leave the power switch on during normal operation.

⚠ CAUTION

The power cord set that comes with this instrument is intended for use only with this instrument. The power cord set should not be used with any other product or for any other purpose. When connecting this instrument to the mains, be sure to use only the power cord that is provided with this instrument.

If the power outlet voltage is greater than 125 V AC or you want to use the product in a foreign country, consult with NF Corporation or its authorized agent.

When turning the power off and then back on, wait at least 1 minute before turning the power back on.

- In an emergency, the power cord can be used to disconnect this instrument from the mains.

 **WARNING**

To ensure that the power cord can be disconnected from the inlet of this instrument, provide sufficient space around the inlet, and to ensure that the power plug can be disconnected from the outlet, use an outlet in an easily accessible location and provide sufficient space around the outlet.

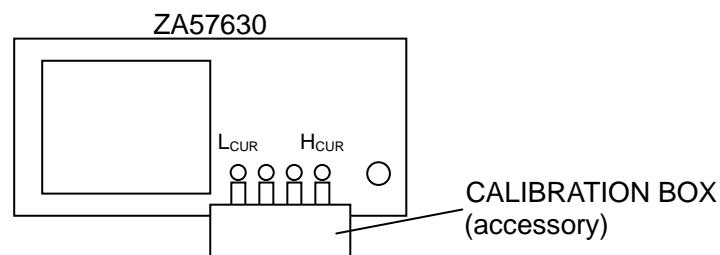
2.4 Simple Operation Check

It is recommended to check the operation of this instrument with the following procedure after purchase or when this instrument has not been used for an extended period of time.

Prepare the CALIBRATION BOX that was included with this instrument.

For the descriptions and operating procedures of keys, screens, and other parts, refer to “3.1 Functions and Operations of Panel Parts” and “3.3 Overview of the Operation Screens”.

1. Connect to the power supply and then press the standby switch on the front panel.
Wait until the system check ends normally.
For details on the display when the power is turned on, refer to “4.1 Display and Operation when Power Is Turned On”.
2. Reset to the factory default settings.
Tap [MENU], select [Other] – [SYSTEM], and tap the [INITIALIZE] function key. A confirmation message appears. Tap [OK].
3. Attach the included CALIBRATION BOX to the H_{CUR} to L_{CUR} connectors on the front panel.



4. Execute self-calibration.
Tap [Calibration] in top menu 2/3. Select [Calibration] – [CALIBRATION] and then tap the [EXEC] function key. A CALIBRATION BOX connection confirmation message appears. Tap [OK] and then wait for self-calibration to finish.
For details on self-calibration, refer to “1.8.1 Self-Calibration” in Instruction Manual (Advanced).
5. Turn on measurement signal output.
Press the ON **AC/DC** key on the front panel to turn on measurement signal output.
Both the AC lamp and DC lamp on the right of the ON **AC/DC** key light.
6. Perform sweep measurement and check that measurement can be performed correctly.
Press the MEASURE START **UP** key on the front panel to perform up-sweep measurement
When measurement finishes, the impedance and phase are displayed in a graph. The measurement results are normal if they are $1.0 \Omega \pm 0.1 \Omega$ or less and $0^\circ \pm 3.0^\circ$ or less.

The simple operation check is now complete.

WARNING

If you notice smoke or a strange odor or sound being emitted from this instrument
Promptly disconnect the power cord from the outlet and put a notice on the product stating that it cannot be used until repairs are completed.

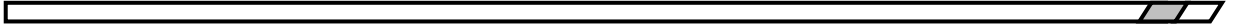
2.5 Calibration

This instrument performance test described in “4.5 Performance Test” in Instruction Manual (Advanced) should be performed. Although the testing interval depends on how often this instrument is used and the conditions under which it is used, the test should be performed at least once a year.

Furthermore, it is recommended to carry out the performance test before using this instrument for important measurements and tests.

The performance test should be carried out by a person who is familiar with measuring instrument specifications and who has general knowledge regarding measuring instruments.

If the performance test results do not satisfy the specifications, NF Corporation will perform adjustment or calibration to restore the original performance. If calibration or adjustment is required, contact NF Corporation or its authorized agent. Charges apply for calibration and adjustment services.



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3. Panel Operations

3.1	Functions and Operations of Panel Parts.....	3-2
3.2	Input and Output Connectors	3-8
3.3	Overview of the Operation Screens	3-19
3.4	Operation Tree	3-32
3.5	Setting Screen Reference	3-42
3.6	Initial Settings.....	3-111

3.1 Functions and Operations of Panel Parts

This section provides an overview of the part names, functions, and operations of the front and rear panels.

3.1.1 Front Panel

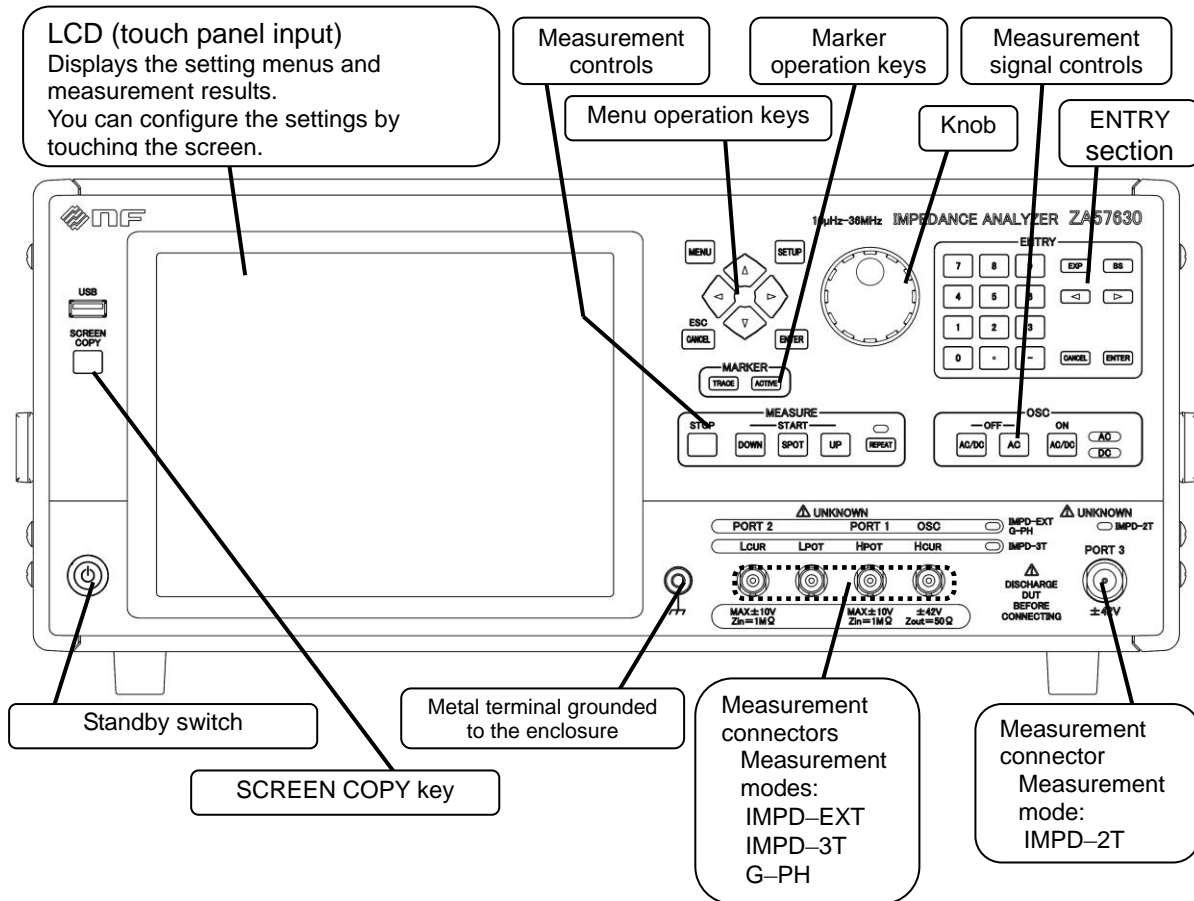


Figure 3-1 Front Panel

3.1.2 Rear Panel

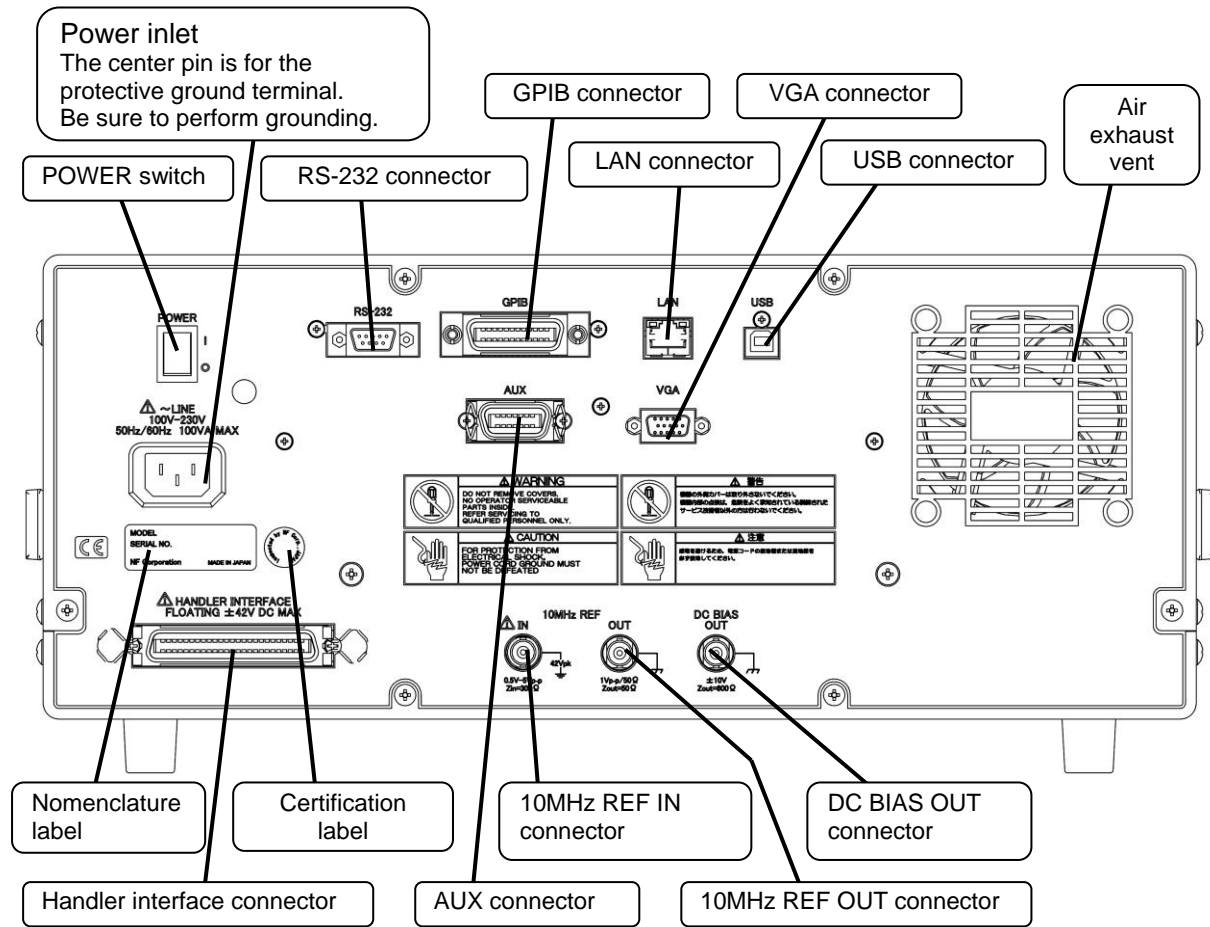


Figure 3-2 Rear Panel

3.1.3 Descriptions of the Screens and Keys

This instrument can be operated with the front panel keys and LCD touch panel. Most operations can be performed using either of them. The input devices are always available so they can be used together to perform operations. For example, when entering numerical values, you can use the LCD touch panel to enter the first digits of the number and then complete the entry by using the keys on the front panel.

This instrument uses a graphical user interface (GUI). Settings and operations can be performed by opening menus and tapping the desired functions. Functions can also be invoked by tapping on the LCD screen button controls.

Key Title

Indicates a key with this name or symbol printed on the key top. Keys that do not have printed labels are identified by the names that appear above them on the panel.

A cursor key indicates the direction by its shape and the title is not printed on it.

Key Title / Secondary Function Name

Indicates a key that has the main function printed on the key top and a secondary function printed near it. When the secondary function is executed in this instruction manual, a notation with "/ secondary function name" added to the key is used. When the main function is executed, "/ secondary function name" is not added.

Lamp Title

Indicates the name of the nearest key or a lamp that displays a title when it is lit.

[[Dialog Title]]

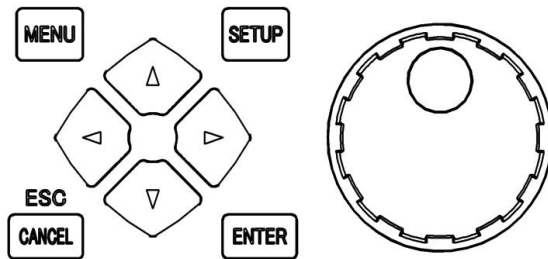
Indicates a GUI dialog box (window) that is displayed on the LCD screen.

[Button Title]

Indicates a GUI button that is displayed on the LCD screen. Input is performed by tapping the button on the screen. GUI buttons also include menus and function keys.

3.1.4 Explanation of Front Panel Keys

• Menu operation keys and knob



- **MENU** : This displays the top menu on the LCD. Pressing this key displays or hides the menu. For details, refer to “■ Menu” in “3.3.1 Menu Operating Procedures”. This has the same function as the [MENU] button displayed at the upper right of the LCD.
- **SETUP** : This displays a shortcut menu for quickly accessing items for which settings are frequently changed. This has the same function as the [SETUP] button displayed at the upper right of the LCD.
- Up/down/left/right keys:

The left and right keys are used to move the menu page and to move the cursor between numerical values or between characters in a text string during editing.

The up and down keys are used to move the focus, move between menus, and increase or decrease numerical values or text values during editing.
- **CANCEL** / ESC: This cancels the editing operation (changing of a setting) and returns the setting to the value before editing.
- **ENTER** : When this is pressed, the item with the focus on it switches to the editing state. When it is pressed during editing, the editing result is applied.
- Knob : This is used to move a marker when markers are displayed in measurement graphs in addition to moving the focus and increasing or decreasing numerical values or text values during editing.

• Marker operation keys

Markers are used for reading the values of data traces displayed on a graph.

Up to eight markers (MARKER1 to MARKER8) can be used, and one of them is a marker that can be moved by knob operation (active marker) and whose read values are displayed on the graph.

Each of the markers can be placed on any of the measurement data trace (MEAS) and eight reference data traces (REF1 to REF8). These markers can be set in [Marker] – [ACTIVE].

The active marker and the data trace indicated by the active marker can be switched with the following keys. A marker or data trace that is not displayed cannot be selected.



- **TRACE** : This switches the data trace indicated by the active marker.
Each press of the button switches the data trace indicated by the active marker in the order of MEAS → REF1 → ... → REF8 → MEAS.
- **ACTIVE:** : This switches the active marker.
Each press of the button switches the marker that is active in the order of MARKER1 → MARKER2 → ... → MARKER8 → MARKER1. However, a hidden marker cannot be made active.

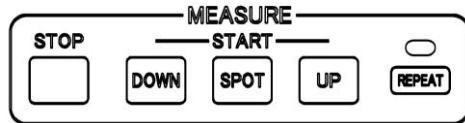
A marker or data trace that is not displayed cannot be selected.

• SCREEN COPY key



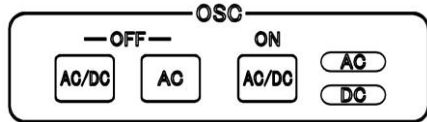
- **SCREEN COPY:** This outputs an image of the current LCD screen.
A file in MS-Windows bitmap format (.bmp) is saved to a USB memory device.

• Measurement controls



- **STOP** : This stops sweep or spot measurement.
- **DOWN** **UP** : These buttons starts sweep measurement. **DOWN** performs the sweep in the direction of upper limit → lower limit, and **UP** in the direction of lower limit → upper limit.
- **SPOT** : This button starts spot measurement. Measurement is performed based on the current settings.
- **REPEAT** : Pressing this button toggles the **REPEAT** lamp above the key on and off. If measurement (sweep or spot) is started while the **REPEAT** lamp is on, measurement is repeated. Spot measurements are repeated with the same settings and sweep measurements are repeated by starting the sweep again after the sweep ends. Pressing the **STOP** key ends the measurements.
If spot measurement is started while the **REPEAT** lamp is off, measurement is performed one time. If sweep measurement is started, the sweep is made one time and then measurement ends.

• Measurement signal controls

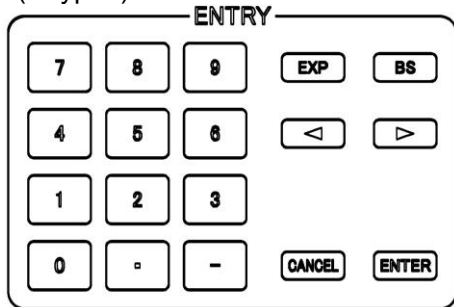


- **AC/DC OFF** : This turns the outputs off. The **AC** lamp and **DC** lamp both go out.
- **AC OFF** : This turns only the AC output off. Only the **AC** lamp goes out.
- **AC/DC ON** : This turns the outputs on. The **AC** lamp and **DC** lamp both light.

Even if the settings are 0 Vrms and 0 V respectively, the **AC** lamp and **DC** lamp light in the output on state.

When the power is turned on, this instrument starts up with both the AC and DC outputs in the off state. Also, the outputs turn off if the settings are reset (RESET) or this instrument is restored to the factory default state (INITIALIZE) (refer to “3.5.14 Other Menu”). The on/off state is not changed by loading measurement conditions (refer to “3.5.9 Storage Menu”).

• ENTRY (Keypad)



This is a set of keys for entering the numeric values of setting parameters.

- **0** to **9** **.** **-** : These enter numeric values.
- **EXP** : This is used to enter numeric values in exponential format.
- **BS** : This is the backspace key.

Pressing this key during numeric input deletes the number that is to the left of the cursor. After deletion, the number string that is to the left of the cursor shifts one character to the right.

- **<** **>** : These keys move the cursor position to the left or right.
- **CANCEL** : This key discards the numerical value being input and returns the value to previous one.
- **ENTER** : This key applies the setting after a numerical value has been entered.

The previous setting is kept until this key is pressed.

• LCD touch panel

The LCD of this instrument is equipped with a touch panel. You can select and set instrument functions and measurement parameters by touching the screen with a fingertip. The touch panel uses a resistive film, so you can use a non-conductive stylus pen or a gloved fingertip to operate it.

The surface of the touch panel is easily scratched, so do not use hard or sharp objects to operate it.

3.2 Input and Output Connectors

The connector to use for measurement differs as follows depending on the measurement mode setting.

Measurement mode	Connector to use
IMPD-EXT, IMPD-3T, G-PH	$L_{CUR}/PORT2$, $H_{POT}/PORT1$, H_{CUR}/OSC
IMPD-2T	: $PORT3$

For the $L_{CUR}/PORT2$, $H_{POT}/PORT1$, and H_{CUR}/OSC measurement connectors, the specifications differ depending on the measurement mode. The L_{POT} measurement connector is not connected (unconnected connector).

3.2.1 Measurement Connectors (Measurement Modes IMPD-EXT and G-PH)

■ Explanation of each connector

(Measurement mode: IMPD-EXT)

OSC	Outputs a signal to drive the DUT.
PORT1	Measures the voltage signal applied to the DUT.
PORT2	Measures the signal resulting from converting the current flowing to the DUT to voltage.

(Measurement mode: G-PH)

OSC	Outputs a signal to drive the EUT.
PORT1	Measures the output signal of the EUT.
PORT2	Measures the input signal of the EUT.

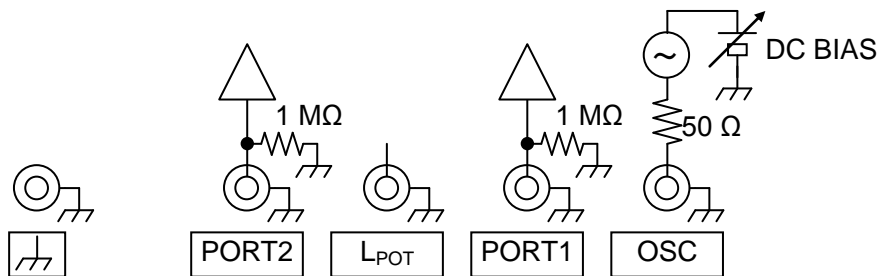


Figure 3-3 Functions of Measurement Connectors (Measurement Modes IMPD-EXT and G-PH)

■ Specifications of each connector

The major specifications of the measurement connectors are as follows. The specifications are common in the IMPD-EXT and G-PH measurement modes.

PORT1, PORT2

Connector	: BNC connector
Input voltage	: Max. 7 V_{rms} (± 11 V)
Input Impedance	: 1 $M\Omega \pm 2\%$, 25 pF ± 5 pF (PORT1) in parallel 1 $M\Omega \pm 2\%$, 30 pF ± 5 pF (PORT2) in parallel

OSC

Connector : BNC connector

Output amplitude : Max. 3 Vrms

DC bias : Max. ± 5 V

(However, it is restricted to a maximum of ± 5 V along with the measurement signal amplitude.)

Output impedance : 50 Ω (nominal value)

■ Measurement connectors when power is off

The measurement connectors are connected to the internal circuits even when the power is off.

—  CAUTION —

- Do not apply a large external signal to the measurement connectors. Even when the power is off, do not apply an external signal. There is a risk of damage to this instrument.
- Do not connect a charged capacitor. If there is a possibility that the DUT may be charged, discharge the DUT sufficiently before connecting it. If the DUT is discharged to the measurement connectors, this instrument may be damaged.

3.2.2 Measurement Connectors (Measurement Mode: IMPD-3T)

■ Explanation of each connector

H_{CUR} Outputs a signal to drive the DUT.

H_{POT} Measures the voltage signal applied to the DUT.

L_{CUR} Measures the current flowing to the DUT.

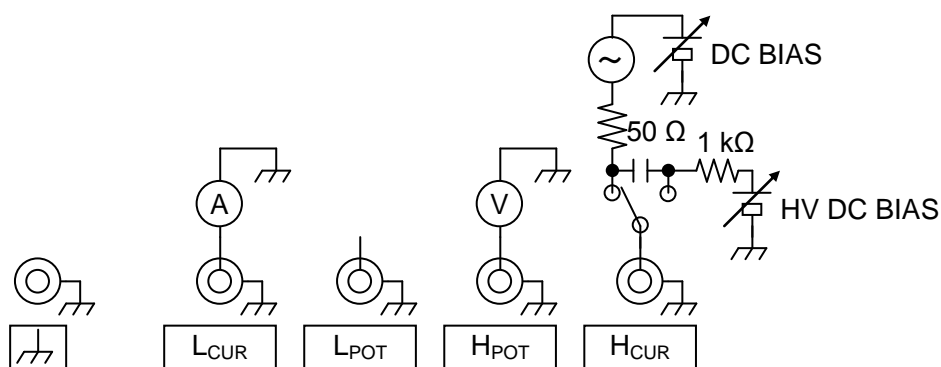


Figure 3-4 Functions of Measurement Connectors (Measurement Mode: IMPD-3T)

■ Measurement signals

The major specifications of the measurement signals are as follows.

Connector : BNC connector

Signal amplitude : Max. 3 Vrms

DC bias : When using normal DC bias ± 5 V

When using HV DC bias ± 40 V

Maximum driving current

: 60 mArms (depends on the measurement range, frequency etc.)

Output impedance: 50 Ω

(When HV DC bias is used, approximately 1 k Ω at approximately 100 Hz or less.)

■ Measurement connectors when power is off

The measurement connectors are connected to the internal circuits even when the power is off.

⚠ CAUTION

- Do not apply a large external signal to the measurement connectors. Even when the power is off, do not apply an external signal. There is a risk of damage to this instrument.
- Do not connect a charged capacitor. If there is a possibility that the DUT may be charged, discharge the DUT sufficiently before connecting it. If the DUT is discharged to the measurement connectors, this instrument may be damaged.

3.2.3 Measurement Connectors (Measurement Mode: IMPD-2T)

■ Explanation of connector

PORT3 This is connected to the DUT.

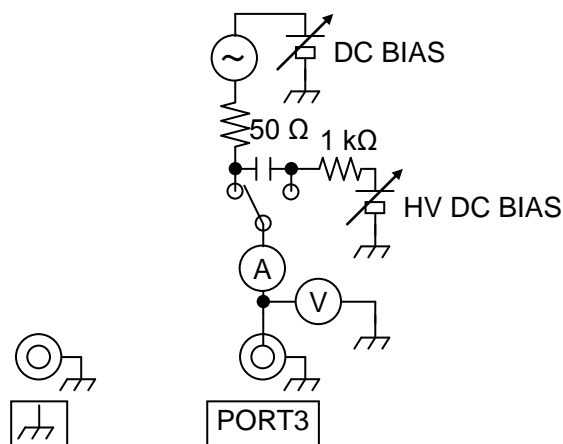


Figure 3-5 Functions of Measurement Connectors (Measurement Mode: IMPD-2T)

■ Measurement signals

The major specifications of the measurement signals are as follows.

Connector : N connector

Signal amplitude : Max. 3 Vrms

DC bias : When using normal DC bias ± 5 V

When using HV DC bias ± 40 V

Maximum driving current : 60 mA rms (depends on the measurement range, frequency etc.)

Output impedance : 50 Ω

(When HV DC bias is used, approximately 1 k Ω at approximately 100 Hz or less.)

■ Measurement connectors when power is off

The measurement connectors are connected to the internal circuits even when the power is off.

⚠ CAUTION

- Do not apply a large external signal to the measurement connectors. Even when the power is off, do not apply an external signal. There is a risk of damage to this instrument.
- Do not connect a charged capacitor. If there is a possibility that the DUT may be charged, discharge the DUT sufficiently before connecting it. If the DUT is discharged to the measurement connectors, this instrument may be damaged.

3.2.4 DC BIAS OUT

This is an output connector for supplying DC bias to the DUT/EUT.

■ Signal specifications

Maximum output voltage : ± 10 V

Output impedance : 600 Ω (nominal value)

Connector : Rear panel, BNC connector

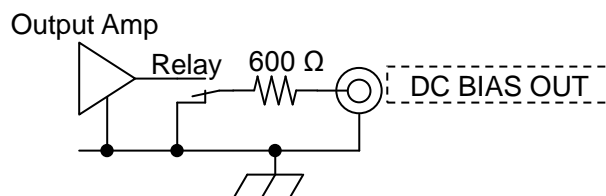


Figure 3-6 Function of DC BIAS OUT Connector

When the connector to output DC bias is set to the DC BIAS OUT connector on the rear panel, DC bias (DC voltage) is output from this connector. Only the AC component will be output by the OSC connector on the front panel at that time.

For details on how to set the DC bias, refer to “4.3 Setting Measurement Signals”.

The output impedance is 600 Ω whether output is on or off. The relay is always connected to the internal output amplifier (the relay is always maintained in the on state) even when the DC bias is set to OFF. Therefore, the output impedance is not changed by performing the output on/off operation.

Output voltage setting is a voltage at no load (open load). When a $600\ \Omega$ load is connected, a voltage that is half of the set value is output.

■ Connectors when power is off

When the power is off, the relay is also off and the output amplifier is separated from the DC BIAS OUT connector on the rear panel. The output impedance is $600\ \Omega$ even in this state. However, when the power is turned on or off, the output impedance will become temporarily unstable.

⚠ CAUTION

Applying an external signal to the DC BIAS OUT connector will damage the internal circuits. Never apply a signal.

3.2.5 10 MHz REF IN

If a clock signal is input to this connector, it replaces the internal reference clock of this instrument and this instrument will operate using the external clock. The accuracy of the measurement frequency is determined by the accuracy of the clock frequency that is input. Furthermore, frequency-synchronized measurement across multiple instruments is possible by using a common reference clock.

■ Signal specifications

- Input voltage : $0.5\ \text{Vp-p}$ to $5\ \text{Vp-p}$
- Input waveform : Sinusoidal or square
- Input impedance : $300\ \Omega$ (nominal value), AC coupling
- Maximum non-destructive input voltage : $10\ \text{Vp-p}$
- Signal grounding : Isolated from the enclosure, max. $42\ \text{Vpk}$ (DC + ACpk)
- Connector : Rear panel, BNC connector

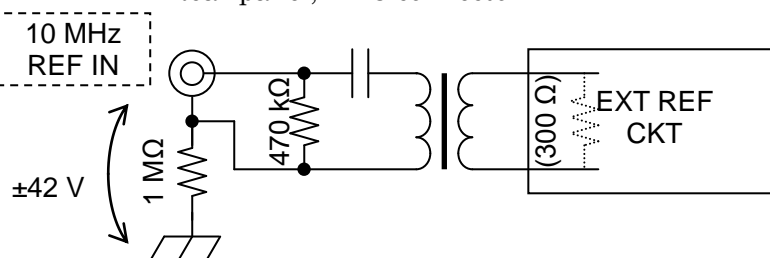


Figure 3-7 Function of 10 MHz REF IN Connector

⚠ WARNING

Do not apply a voltage exceeding the rated isolation voltage. Doing so may result in insulation breakdown and risk of electrical shock or damage to this instrument.

3.2.6 10 MHz REF OUT

This connector outputs the clock signal that is actually used as the reference clock by this instrument. When this instrument is operating with an external 10 MHz reference clock (input to 10 MHz REF IN), the frequency that is output is the same as that of the external reference clock.

■ Signal specifications

- Output voltage : 1 V_{p-p} / 50 Ω
 Output waveform : Square
 Output impedance : 50 Ω (nominal value), AC coupling
 Connector : Rear panel, BNC connector

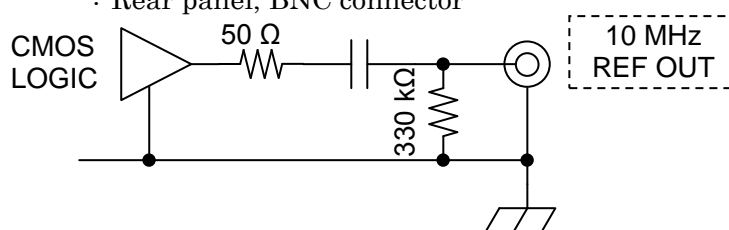


Figure 3-8 Function of 10 MHz REF OUT Connector

⚠ CAUTION

- Applying an external signal to the 10 MHz REF OUT connector will damage the internal circuits. Never apply a signal.
- The BNC ground of the 10 MHz REF OUT connector is connected to the enclosure. Do not connect signals for which there is a difference in potential relative to the enclosure. Doing so may damage this instrument.

3.2.7 HANDLER INTERFACE

The comparator results can be output into the handler interface connector on the rear panel of this instrument. Connecting to the part handler allows an auto part sorting system to be configured.

For details on the comparator, refer to “1.15.1 Comparator” in Instruction Manual (Advanced).

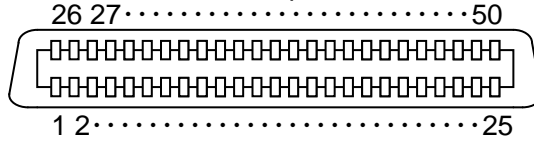


Figure 3-9 Handler Interface Connector Pin Assignment Diagram

Table 3-1 Handler Interface Signal Layout

Pin No.	I/O	Signal name		
		When BIN sorting	When LIMIT comparison	When ZONE comparison
1	IN	TRIG, /TRIG		
26	IN	/RCL0		
2	IN	/RCL1		
27	IN	/RCL2		
3	IN	/RCL3		
28	IN	/RCL4		
4	IN	/RCL5		
29	IN	/RCL6		
5	IN	/RCL-VALID		
30	OUT	/BIN1	/P-HI	/Y1-OUT
6	OUT	/BIN2	/P-IN	/Y1-IN
31	OUT	/BIN3	/P-LO	/Y1-NA
7	OUT	/BIN4	/S-HI	/Y2-OUT
32	OUT	/BIN5	/S-IN	/Y2-IN
8	OUT	/BIN6	/S-LO	/Y2-NA
33	OUT	/BIN7	/IN	
9	OUT	/BIN8	(Not used, fixed to H)	
34	OUT	/BIN9	(Not used, fixed to H)	/NA
10	OUT	/BIN10	(Not used, fixed to H)	
35	OUT	/BIN11	(Not used, fixed to H)	
11	OUT	/BIN12	(Not used, fixed to H)	
36	OUT	/BIN13	(Not used, fixed to H)	
12	OUT	/BIN14	(Not used, fixed to H)	
37	OUT	/OUT_OF_BINS	/OUT	
13	OUT	/INDEX		
38	OUT	/EOM		
14	OUT	/ERR		
39	OUT	(reserved)		
15	OUT	(reserved)		
40	- - -	(N.C)		
16 to 20	IN	EXT_DCV		
21 to 25	IN	EXT_COM		
41 to 45	OUT	INT_DCV		
46 to 50	OUT	INT_COM		

Table 3-2 Handler Interface Signal Functions

Pin No.	I/O	Signal name	Description
1	IN	TRIG, /TRIG	External trigger signal (rising edge). Can be switched to falling edge.
26	IN	/RCL0 (LSB)	Setting/correction memory selection signal (binary) If the trigger signal of pin no.1 is received when /RCL-VALID is the low level and trigger source is the handler, the setting and correction data is recalled from the memory specified by these signals and measurement is conducted under those conditions. Recalling of a memory number out of the range will result in an error.
2	IN	/RCL1	
27	IN	/RCL2	
3	IN	/RCL3	
28	IN	/RCL4	
4	IN	/RCL5	
29	IN	/RCL6 (MSB)	
5	IN	/RCL-VALID	Indicates that the memory selection signal is valid.
30	OUT	/BIN1, /P-HI, /Y1-OUT	<ul style="list-style-type: none"> ○ When BIN sorting /BIN1 to /BIN14: BIN sorting result signals /OUT OF BINS: Fail signal ○ When LIMIT comparison /P-HI, /P-IN, /P-LO : Primary parameter comparison result signal /S-HI, /S-IN, /S-LO : Secondary parameter comparison result signal /IN: Signal for when both the primary and secondary parameters pass /OUT: Signal for when at least one of the primary and secondary parameters fails. ○ When ZONE comparison /Y1-OUT, /Y1-IN: Y1 comparison result signals /Y2-OUT, /Y2-IN: Y2 comparison result signals /Y1-NA, /Y2-NA, /NA: Comparison not possible signals /IN: Signal for when both the Y1 and Y2 parameters pass /OUT: Signal for when at least one of the Y1 and Y2 parameters fails.
6	OUT	/BIN2, /P-IN, /Y1-IN	
31	OUT	/BIN3, /P-LO, /Y1-NA	
7	OUT	/BIN4, /S-HI, /Y2-OUT	
32	OUT	/BIN5, /S-IN, /Y2-IN	
8	OUT	/BIN6, /S-LO, /Y2-NA	
33	OUT	/BIN7, /IN, /IN	
9	OUT	/BIN8, (NU), (NU)	
34	OUT	/BIN9, (NU), /NA	
10	OUT	/BIN10, (NU), (NU)	
35	OUT	/BIN11, (NU), (NU)	
11	OUT	/BIN12, (NU), (NU)	
36	OUT	/BIN13, (NU), (NU)	
12	OUT	/BIN14, (NU), (NU)	
37	OUT	/OUT_OF_BINS, /OUT, /OUT	
13	OUT	/INDEX	Signal acquisition end signal. When it becomes the low level, it is possible to switch to next DUT.
38	OUT	/EOM	End of measurement signal. When it becomes the low level, the comparison result becomes valid and reading becomes possible.
14	OUT	/ERR	Measurement error signal. It indicates an excessive voltage or current, ALC failure, or other error.
39	OUT	(reserved)	Not used. Do not connect anything.
15	IN	(reserved)	Not used. Do not connect anything.
40	- - -	N.C	Not used. Do not connect anything.
16 to 20	IN	EXT_DCV	External DC power input (+5 V to +24 V)

3.2 Input and Output Connectors

21 to 25	IN	EXT_COM	External DC power input (common) Each signal of the handler interface is isolated from the enclosure and operates with external DC power.
41 to 45	OUT	INT_DCV	Internal DC power output (+5 V)
46 to 50	OUT	INT_COM	Internal DC power output (common) This is connected to the enclosure. To operate the handler interface by the internal DC power source, connect between EXT COM and INT COM and between EXT DCV and INT DCV.

* (NU): Not used, unused signal. H level is always output.

* When /ERR output, other comparison result signals will not be output.

* The “/” at the beginning of the signal name indicates negative logic (1 at low level).

■ Signal specifications

External DC power : Rated voltage +5 to +24 V, operating range +4.5 to +26.4 V
Maximum current consumption 45 mA (5 V) / 100 mA (12 V) / 180 mA (24 V)

Internal DC power : +5 V typ., 70 mA max., connected to the enclosure
Also output during standby.

Isolation : 42 Vpk (each signal, common) vs. enclosure
When the internal DC power output connector and the external DC power input are connected, isolation is not provided.

Output Characteristics

Output low level : 0.5 V max. (power voltage 5 V, sink current 6 mA)
1.2 V max. (power voltage 12 V, sink current 8 mA)
2.4 V max. (power voltage 24 V, sink current 10 mA)

Output high level : 5 to 24 V (depends on the power voltage)

Input characteristics (excluding trigger)

Input low level : (Power voltage – 4.1 V) max.
Input high level : (Power voltage – 1.1 V) min.

Input characteristics (trigger)

Input low level : (Power voltage × 0.3 V) max.
Input high level : (Power voltage × 0.7 V) min.

Connector : DDK 57 series 50-pin or equivalent



Do not apply a voltage more than 42 Vpk between the signals or common of the handler interface and the enclosure. There is a risk of an electric shock.

CAUTION

Do not apply a voltage more than 42 Vpk between the signals or common of the handler interface and the enclosure. There is a risk of damage to this instrument.

■ Handler interface I/O equivalent circuit

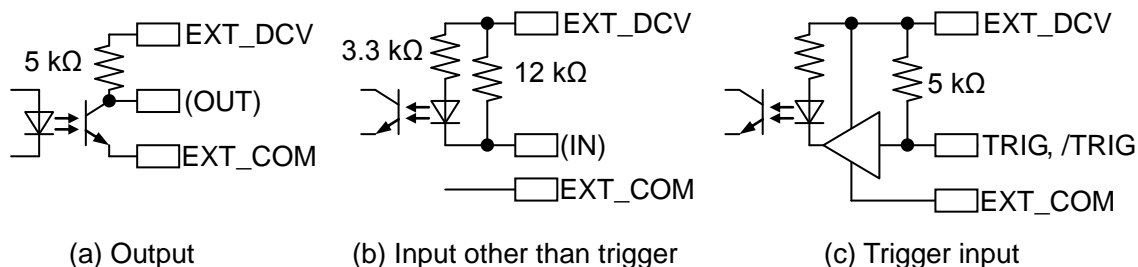


Figure 3-10 Equivalent Circuit of Handler Interface

■ Cable length of handler interface

A cable length of 5 m or less is recommended. The maximum length is 15 m. Use a shielded cable.

3.2.8 AUX

This includes signals to indicate the measurement signal output on/off state of this instrument and the 4-bit logic output and 3-bit logic input, and can be used for external device control. When a sequence sweep is performed, a 4-bit logic pattern that differs in each sequence can be output. The logic input pin state can be read using a remote interface.

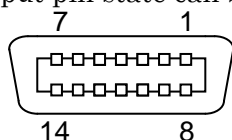


Figure 3-11 AUX Connector Pin Assignment Diagram

Table 3-3 AUX Connector Signal Layout

Pin No.	I/O	Function
1	(Reserved)	
2	(Reserved)	(+24 V)
3	GND	
4	IN	PIN0
5	OUT	D2
6	OUT	D0(LSB)
7	OUT	/ON
8	GND	
9	GND	
10	(Reserved)	(-24 V)
11	IN	PIN1
12	OUT	D3(MSB)
13	OUT	D1
14	IN	PIN2

⚠ CAUTION

+24 V is output from pin 2 and -24 V is output from pin 10, but do not connect a device other than one specified by NF Corporation. If other than a specified device is connected, there is a risk that this product may become unstable.

■ Signal specifications

Connector	: DDK 57 series 14-pin or equivalent
Input signal level	: TTL level 0 to 5 V (low 0.8 V or less, high 2.6 V or more)
Output signal level	: TTL level 0 to 5 V (nominal value)

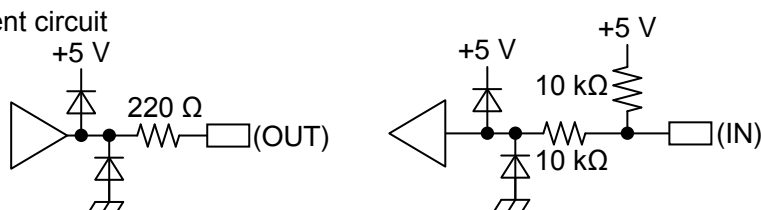
■ I/O equivalent circuit


Figure 3-12 I/O Connector Equivalent Circuit of AUX Connector

■ Connectors when power is off

The connectors are connected to the internal circuits even when the power is off.

3.2.9 VGA

Outputs the same image signal as that of the LCD of instrument to an external monitor or projector.

■ Signal specifications

Connector	: Mini D-sub 15-pin (female), analog RGB component video signal
Signal	: 800 × 600 dot (SVGA) Horizontal scanning frequency = 37.9 kHz, vertical scanning frequency = 60.3 Hz

3.3 Overview of the Operation Screens

3.3.1 Menu Operating Procedures

Most of the settings of this instrument can be configured by tap operation of the menus and dialog boxes (windows). This section describes the basic operations of the menus.

The following figure shows an example of a screen without menus displayed.

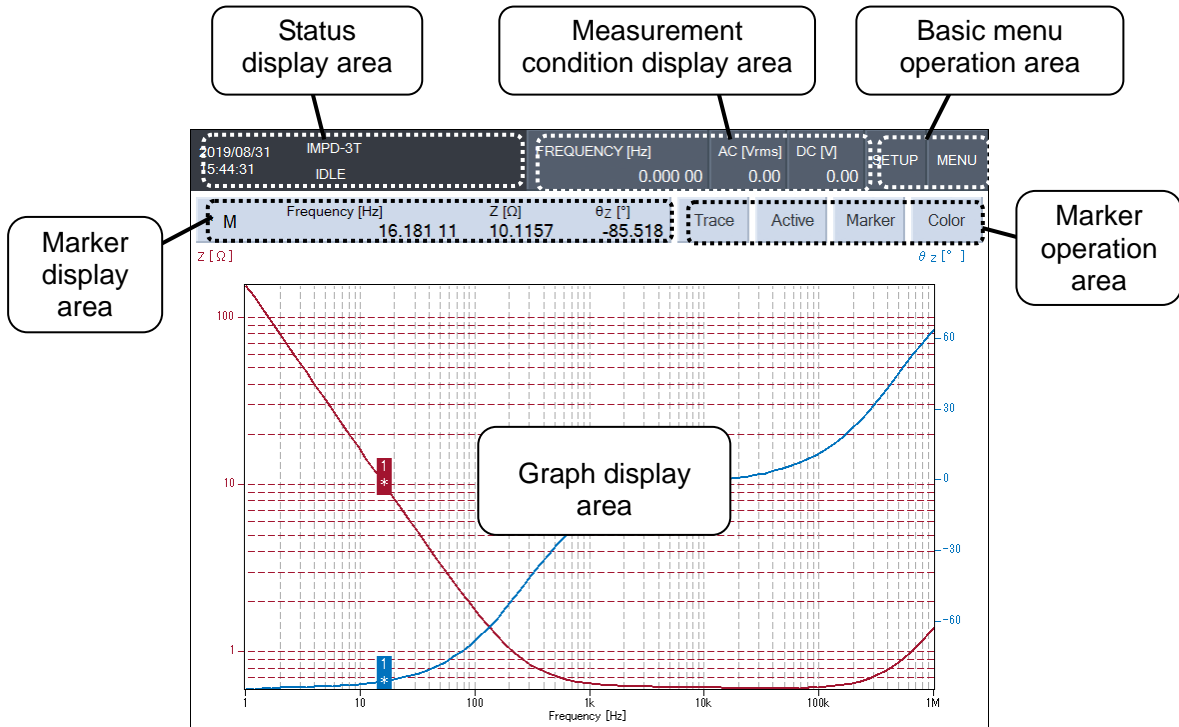


Figure 3-13 Screen Immediately after Startup

■ Status display area

This area displays the remote control status, measurement status, and other statuses of this instrument.

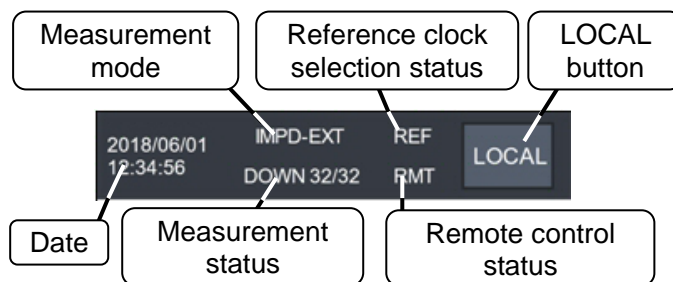


Figure 3-14 Status Display Area

• Measurement modes

- IMPD-EXT : Impedance measurement, uses external current-voltage conversion.
- IMPD-3T : Impedance measurement, uses H_{CUR}, H_{POT}, L_{POT}, and L_{CUR}.
- IMPD-2T : Impedance measurement, uses PORT3 N connector.
- G-PH : Gain-phase measurement.

• Measurement status

- CAL : Self-calibration in progress
- IDLE : Stopped
- SPOT : Spot measurement in progress
- UP *n/m* : Up sweep in progress
- DOWN *n/m* : Down sweep in progress

n: Number of current measurement sequence

m: Total number of sequences

In the single mode (when the **REPEAT** lamp on the front panel is off), this instrument enters the stopped (idle) state when measurement finishes. In the repeat mode (when the **REPEAT** lamp on the front panel is on), the same measurement is repeated even if one round of measurement finishes. For sweep measurements, the sweep measurement is resumed over the same sweep frequency range.

• Reference clock selection status

- (Nothing is displayed) : Operating with the internal reference clock.
- REF : Operating with the external reference clock.
- REF** (flashing) : Operating with the internal reference clock (permission to use an external reference clock is set, but an external clock has not been detected).

• Remote control status

- (Nothing is displayed) : Local control in progress
- RMT : Remote control in progress
- LLO : Remote control is in progress (local lock-out state)

• LOCAL button

The [LOCAL] button is displayed during remote control. When this button is tapped, this instrument enters the local state and operation can be performed from the panel. However, if this instrument is in the local lock-out state, it will not return to the local state.

■ Measurement condition display area

This area displays the major current setting states (measurement conditions).

FREQUENCY [Hz]	AC [Vrms]	DC [V]
100.00m	1.00	0.00

Figure 3-15 Measurement Condition Display Area

- [FREQUENCY] : Measurement signal frequency
- [AC] : AC voltage amplitude (Vrms) or AC current amplitude (Arms)
- [DC] : DC bias voltage (V) or DC bias current (A)

When the output is off, 0 V is displayed for the AC voltage and DC bias.

Each display area can also be used as a setting button, as tapping opens the setting change menu.

■ Basic menu operation area

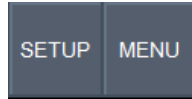


Figure 3-16 Basic Menu Operation Area

- [SETUP] : This displays a shortcut menu for quickly accessing items for which settings are frequently changed on this instrument. This has the same function as the **SETUP** key on the front panel.
- [MENU] : This displays the top menu on the LCD. This has the same function as the **MENU** key on the front panel.

■ Marker display area

This area displays marker values for reading measurement data.

* M	Frequency [Hz]	Z [Ω]	θ_Z [$^\circ$]
	16.181 11	10.1157	-85.518

Figure 3-17 Marker Display Area

For the operating procedures and other details, refer to “3.5.6 Marker Menu” in this instruction manual and “1.7 Marker Operation” in Instruction Manual (Advanced).

■ Marker operation area

This area is used to perform the basic operations of markers for reading measurement data.

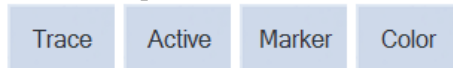


Figure 3-18 Marker Operation Area

- [Trace] : This switches the data trace indicated by the active marker. Each tap of the button switches the data trace indicated by the active marker in the order of MEAS → REF1 → REF2 ... → REF8 → MEAS. This has the same function as the **TRACE** key on the front panel.
- [Active] : This switches the active marker. Each tap of the button switches the marker that is active in the order of MARKER1 → MARKER2 → ... → MARKER8 → MARKER1. This has the same function as the **ACTIVE** key on the front panel.
- [Marker] : This displays a list of all markers (MARKER1 to MARKER8).
- [Color] : This opens a menu for changing the color of a trace.

The active marker is one of up to eight markers and is the marker that can be moved by knob operation and whose values are displayed in the LCD marker display area. For the detailed

operating procedures and function details, refer to “3.5.6 Marker Menu” in this instruction manual and “1.7 Marker Operation” in Instruction Manual (Advanced).

■ Menus

Pressing the **MENU** key or tapping the [MENU] button displays a menu (refer to “Figure 3-19 Menu Display Example”). The menus have a hierarchical structure and the menu at the very top layer of the hierarchy is called the top menu.

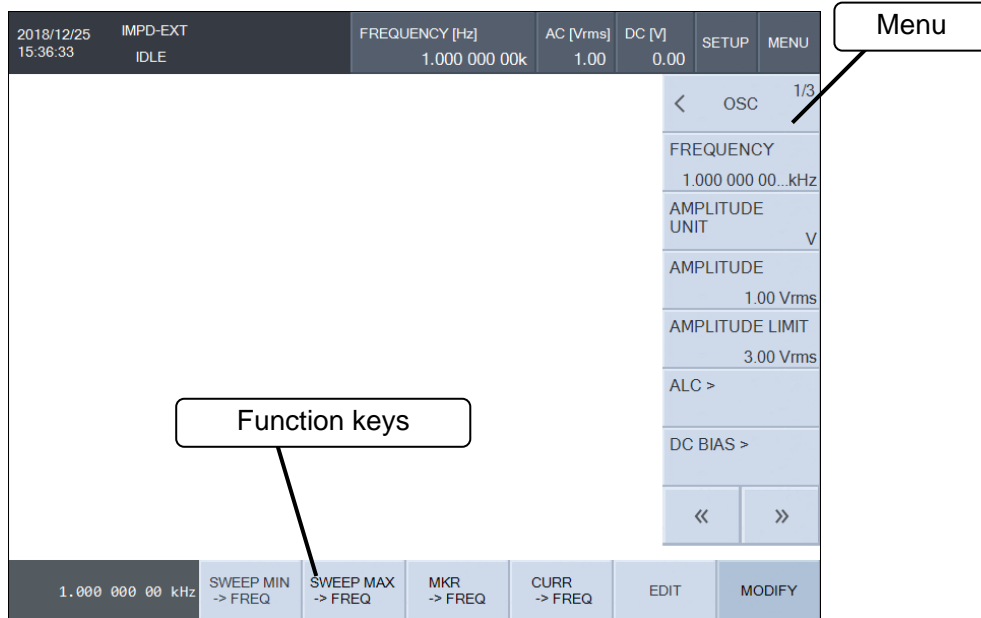


Figure 3-19 Menu Display Example

Pressing the **MENU** key or tapping the [MENU] button toggles between displaying and hiding a menu.

The top menu has three pages and the page number is displayed at the very top of the top menu (1/3, 2/3, or 3/3). Tapping the [<<] or [>>] button at the bottom of the menu switches the menu display in the order of 1/3 ⇔ 2/3 ⇔ 3/3 ⇔ 1/3.

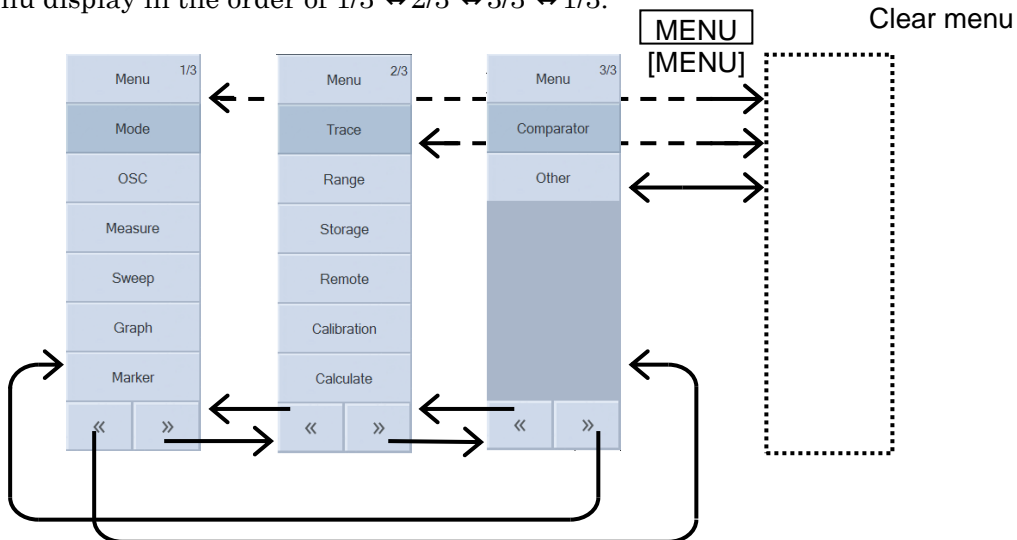


Figure 3-20 Switching Menu (Top Menu)

■ Menu Layer Navigation and Selection

A menu with “>” after the menu name has another menu in a layer below. Tapping that button displays the menu of the layer below.

To return to the menu of the layer above, tap the button at the top of the menu. A menu with a layer above has “<” displayed on the left of the title of the button at the very top of the menu. Pressing the **CANCEL** key also returns to the menu one layer above.

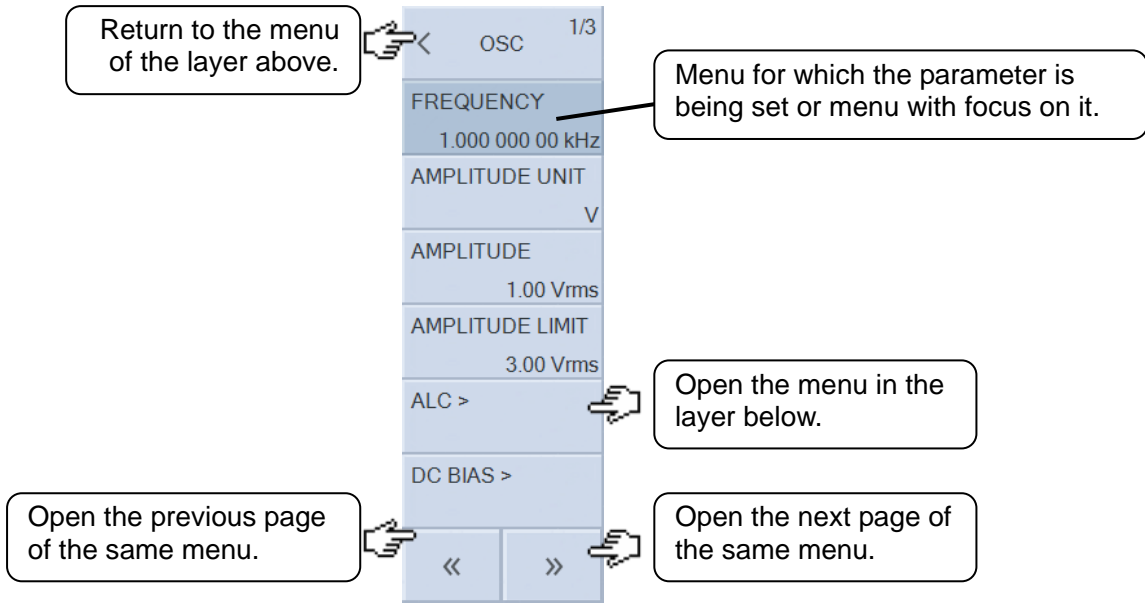


Figure 3-21 Menu Layer Operation

The menu currently being set is displayed darker. Even if a menu is not being set, it will be displayed darker if the focus is on it. Pressing the **ENTER** key performs the same operation as tapping the menu with the focus on it, and that menu becomes the target for parameter editing.

■ Function keys

The display changes depending on the open menu. Tapping a button executes or inputs that function. The parameter of the selected menu is displayed on the left end of the function keys.

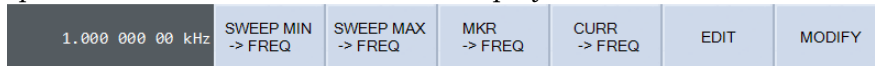


Figure 3-22 Function Keys

A confirmation dialog box may be displayed before execution depending on the function key. A confirmation dialog box is displayed in the case of a modification (execution) that will result in significant changes being made, such as when all of the settings will be reset or self-calibration will be performed.

■ Numerical settings (immediate settings)

When the function keys are displayed, tapping [MODIFY] enables modification of the parameters. Move to the digit you wish to modify with the left/right key or left/right button. The digit that can be modified is displayed highlighted.

Use the up/down key, up/down button, or knob to increase or decrease the numerical value of the selected digit. Pressing the up key or [▲] button or turning the knob clockwise changes the value in the order of 0 → 1 → 2 → ... 9 → 0 → 1 →. Pressing the down key or [▼] button or turning the knob counterclockwise changes the value in the opposite order.

The result of the change is applied immediately.

The modification operation is not possible if the setting range is exceeded.

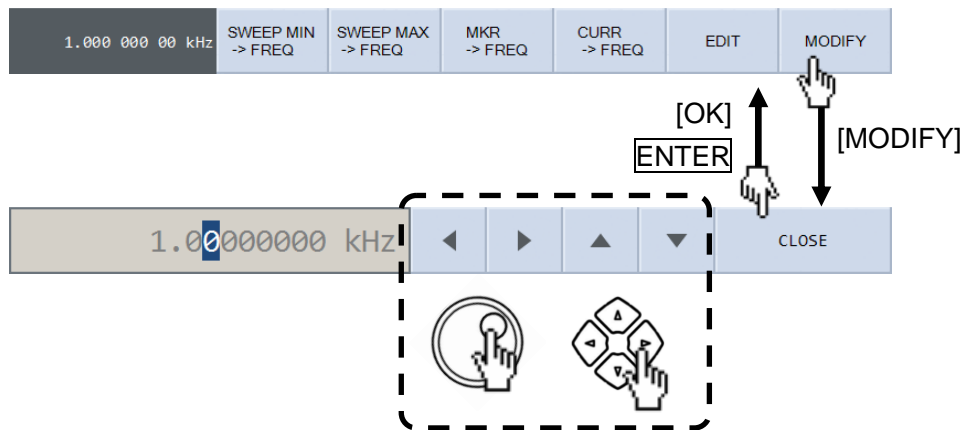


Figure 3-23 Numerical Settings (Immediate Settings)

Press **ENTER**, **CANCEL**, or **CLOSE** to end the parameter modification state and display the normal function keys. The last changed values will be applied.

■ Numerical settings (requiring confirmation)

The procedure is the same as for “Numerical settings (immediate settings)” above, but these settings are not applied until you press **ENTER** or tap **[OK]**.

A range check is performed when **ENTER** is pressed or **[OK]** is tapped, and if a value is outside of the setting range, an error message is displayed and the setting is returned to the original one.

Pressing **CANCEL** discards the numerical value modification operations performed up until that point in time and returns the parameter values to the original ones.

■ Numerical settings

When the function keys are displayed, tapping [EDIT] displays the numerical input palette. Enter a numerical value in the ENTRY section on the front panel or the palette and press **ENTER** or tap [OK] to apply the setting.

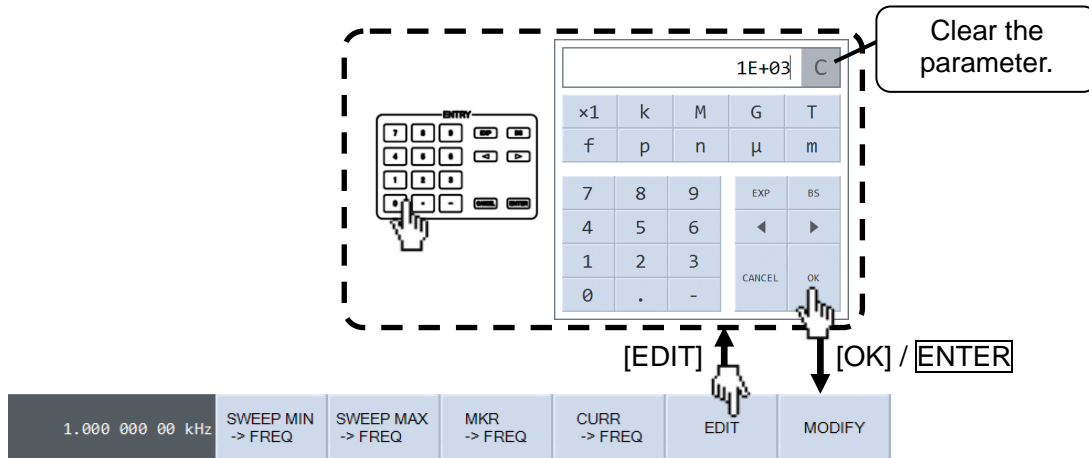


Figure 3-24 Numerical Settings

Use the left and right keys to move the cursor position when editing numerical values. Use the **BS** key or [BS] button to delete the digit to the left (higher order digit) of the cursor (backspace operation).

The **EXP** key (or [EXP] button) displays “E” in the numerical value input area to represent the exponent (power of 10). For example, pressing **1**, **2**, **.**, **3**, **EXP**, **-**, **1**, **2**, and **ENTER** results in 12.3×10^{-12} .

Pressing the **CANCEL** key ([CANCEL] button) discards the entered value and returns the value to that before input.

Depending on the item to be set, buttons for metric prefixes are displayed in the numerical input palette. You can set the exponent portion by tapping an metric prefix button such as [m] or [k] instead of directly entering it with the **EXP** key.

If you tap the **C** button at the top right (right side of the numerical value display area) of the numerical input palette, the value being edited becomes 0 (display is blank). This button is convenient when you wish to set a new numerical value. If you tap it by mistake, tap the [CANCEL] button to close the numerical input palette. The original value will be retained.

■ List operations (immediate settings)

List operations allow you to set a setting by selecting from multiple items, such as measurement mode settings.

When you open the setting target menu, the selection items are displayed in the menu. The button of the currently selected item has a check mark (✓) displayed. Tapping the button of the item to which you wish to change the setting moves the check mark (✓) to the tapped button and applies the setting.

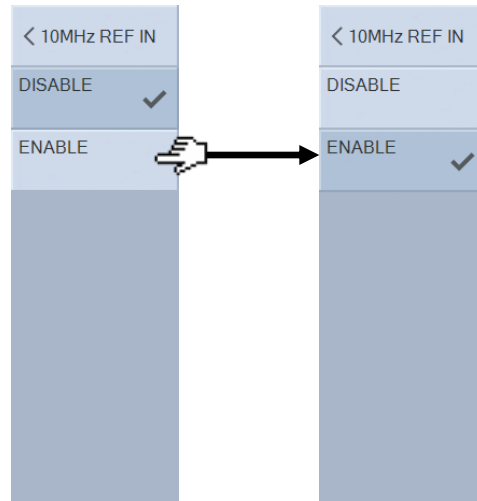


Figure 3-25 List Operations (Immediate Settings)

■ List operations (requiring confirmation)

The procedure is the same as for “■ List operations (immediate settings)” above, but a setting confirmation dialog box is displayed at the end and the setting is not applied until you actually press **ENTER** or tap **[OK]**. Pressing **CANCEL** discards the operation until that point in time and returns the value to the original setting.

■ Palette operations (immediate settings)

List operations allow you to set a setting by selecting from many items, such as graph axis display items.

When you open the setting target menu, a palette containing the selection items is displayed. Tapping the item to which you wish to change the setting selects that item and applies that setting.

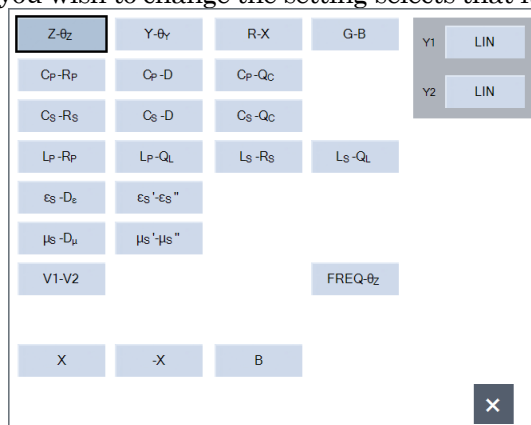


Figure 3-26 Palette Operations (Immediate Settings)

■ Text settings (immediate settings)

The procedure is the same as for “■ Numerical settings (immediate settings)” above, but alphabet letters and symbols can also be handled in addition to numerical values. When the function keys are displayed, tapping [EDIT] displays the text input palette.

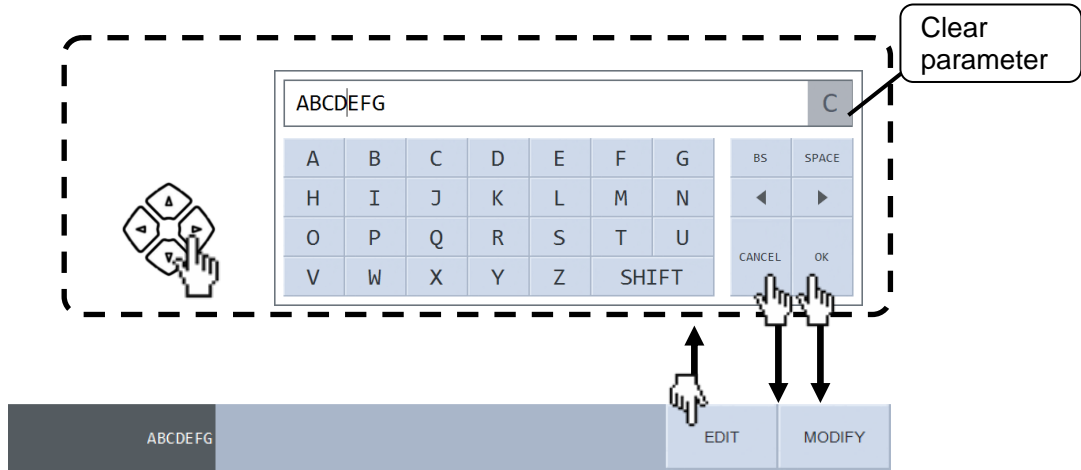


Figure 3-27 Text Settings (Immediate Settings)

The editing mode can be ended with [OK] / **[ENTER]** or [CANCEL] / **[CANCEL]**. Even if you cancel editing, the text entered (edited) up until that point in time will be applied. The characters that can be handled by this instrument are shown below. However, there are some characters that cannot be entered for some items, such as file names.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9 ! " # \$ % & ' () - = ^ ~ \ | @
` [] { } ; : + * , . < > / ? _ (space)

■ Text settings (requiring confirmation)

The procedure is the same as for “■ Text settings (immediate settings)” above, but the input must be confirmed with [OK] / **[ENTER]**. [CANCEL] / **[CANCEL]** key input discards the setting and returns the text to that before editing started.

If you tap the [SHIFT] button in the text input palette, the character set of the palette changes.

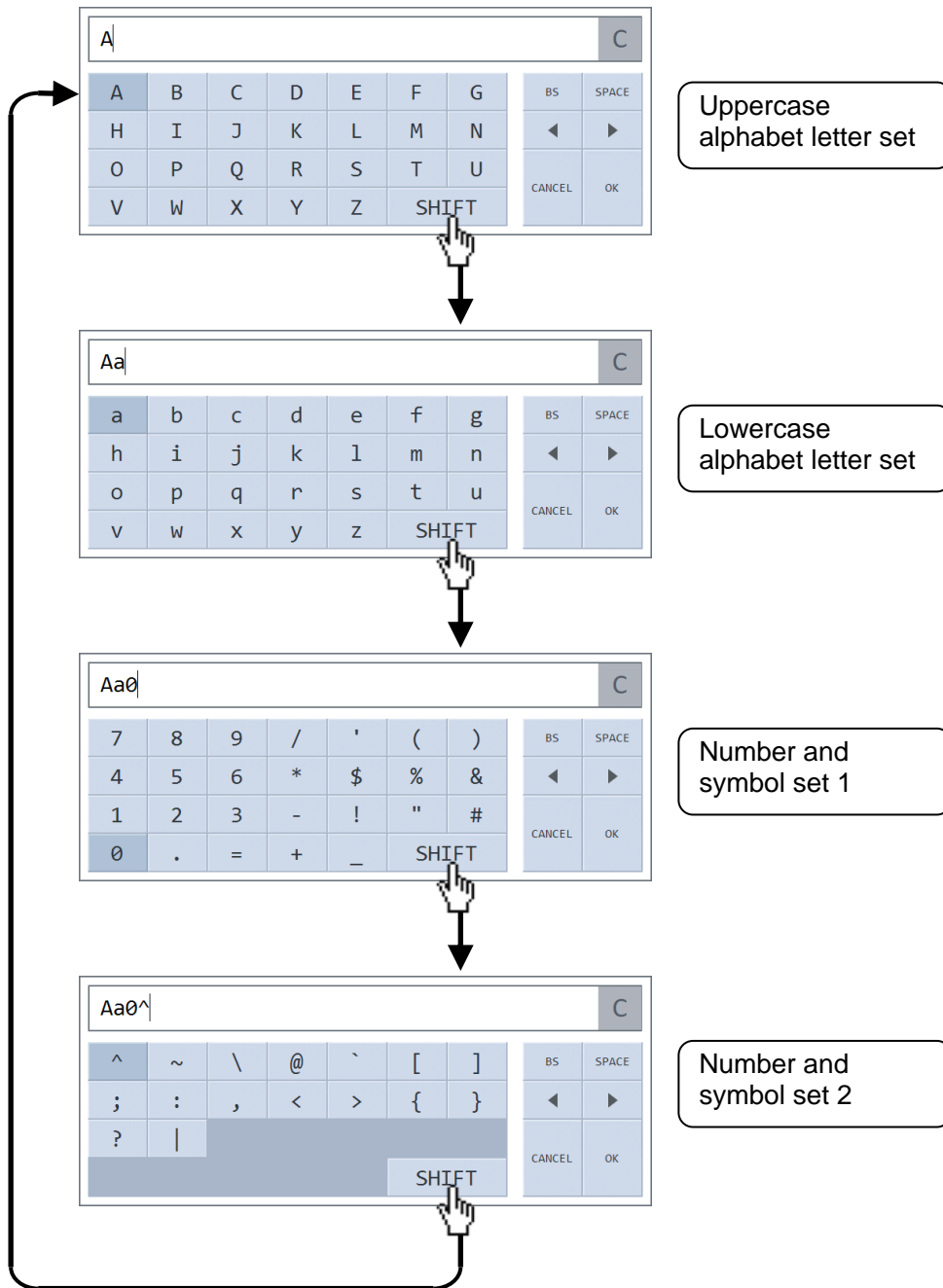


Figure 3-28 Switching Text Input Palette

■ Execution operations (requiring confirmation)

Tapping the target menu or function key displays an execution confirmation dialog box. The operation is executed if you tap [OK] and the operation is canceled if you tap [CANCEL] in the confirmation dialog box. A confirmation dialog box is displayed in the case of a modification (execution) that will result in significant changes being made, such as when all of the settings will be reset.

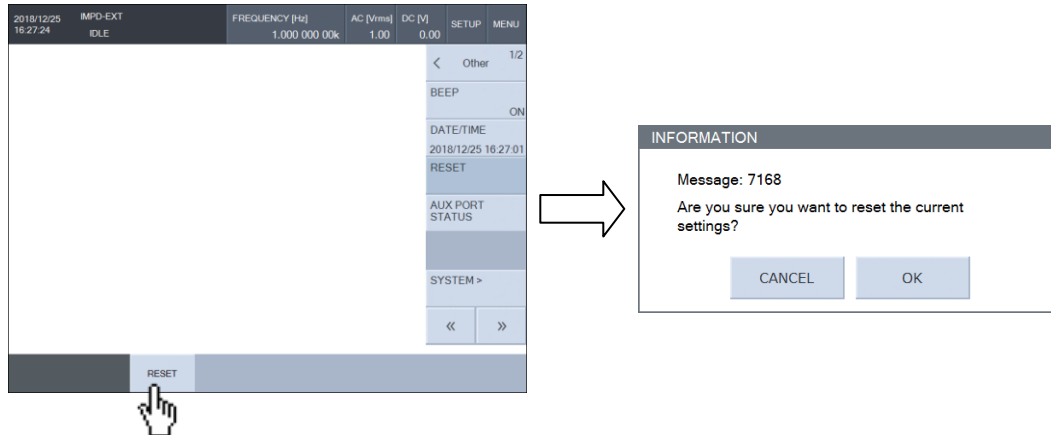


Figure 3-29 Execution Operations (Requiring Confirmation)

■ Execution operations (immediate execution)

The procedure is the same as for “■ Execution operations (requiring confirmation),” but an execution confirmation dialog box is not displayed. Tapping the execution target menu or function key executes the function immediately.

3.3.2 Overview of Graph Display

■ Graph axes

The graphs that display the measurement data of this instrument have three axes: X-axis, Y1-axis, and Y2-axis. Furthermore, they have two display styles (single and split), which can be set in [Graph] menu – [STYLE].

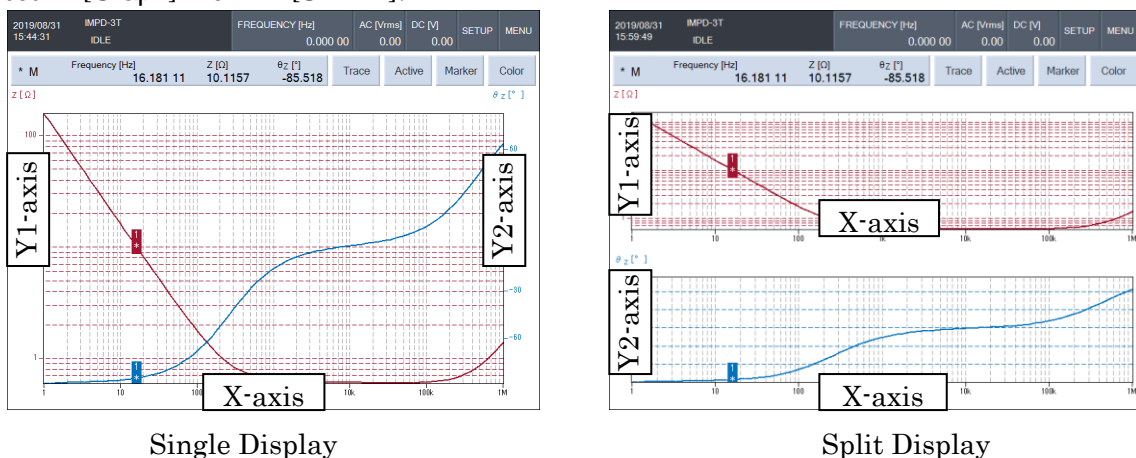


Figure 3-30 Graph Display Styles

In the single display style, the vertical axis on the left side is called the Y1-axis and the vertical axis on the right side is called the Y2-axis. In the split display style, the vertical axis of the upper graph is called the Y1-axis, the vertical axis of the lower graph is called the Y2-axis, and the X-axis is common for both graphs.

■ Data display types

The measurement data that is displayed on graphs is measurement data (MEAS) and up to eight reference data (REF1 to REF8). The results of sweep measurement is always MEAS. As sweep measurement is performed, MEAS is updated successively. REF1 to REF8 can be updated by copying MEAS.

Each of MEAS and REF1 to REF8 can be set to be displayed or hidden on the graphs.

■ Markers

There are markers for reading the X, Y1, and Y2 values of data traces on graphs. There are up to eight markers (MARKER1 to MARKER8), and MARKER1 can be used as the normal marker and MARKER2 to MARKER8 can be used as normal markers, Δ markers, or Δ TRKG markers. A Δ marker is a marker to read the information of the X, Y1, and Y2 axis difference information relative to MARKER1. The display of a Δ TRKG marker is the same as that of a Δ marker, but the marker is moved to keep the X-axis interval constant if MARKER1 is moved.

One of the eight displayed markers becomes the active marker, and the position of the active marker can be moved by knob operation and its read values are displayed in the marker display area above the graph. The active marker can be selected with ACTIVE or [ACTIVE]. A normal marker is displayed as “*,” a Δ marker is displayed as “ Δ ” and a Δ TRKG marker is displayed as “T” on the graph. The marker numbers (1 to 8) are displayed as numerical values directly above the markers. The marker displayed enclosed in a frame is the current active marker.

The data that is reference by the markers can be set to the measurement data (MEAS) and reference data (REF1 to REF8) by using the TRACE key or [TRACE] button.

3.4 Operation Tree

The following shows the operation tree for operating this instrument from the panel. For the descriptions of keys and screens, refer to “3.1 Functions and Operations of Panel Parts”.

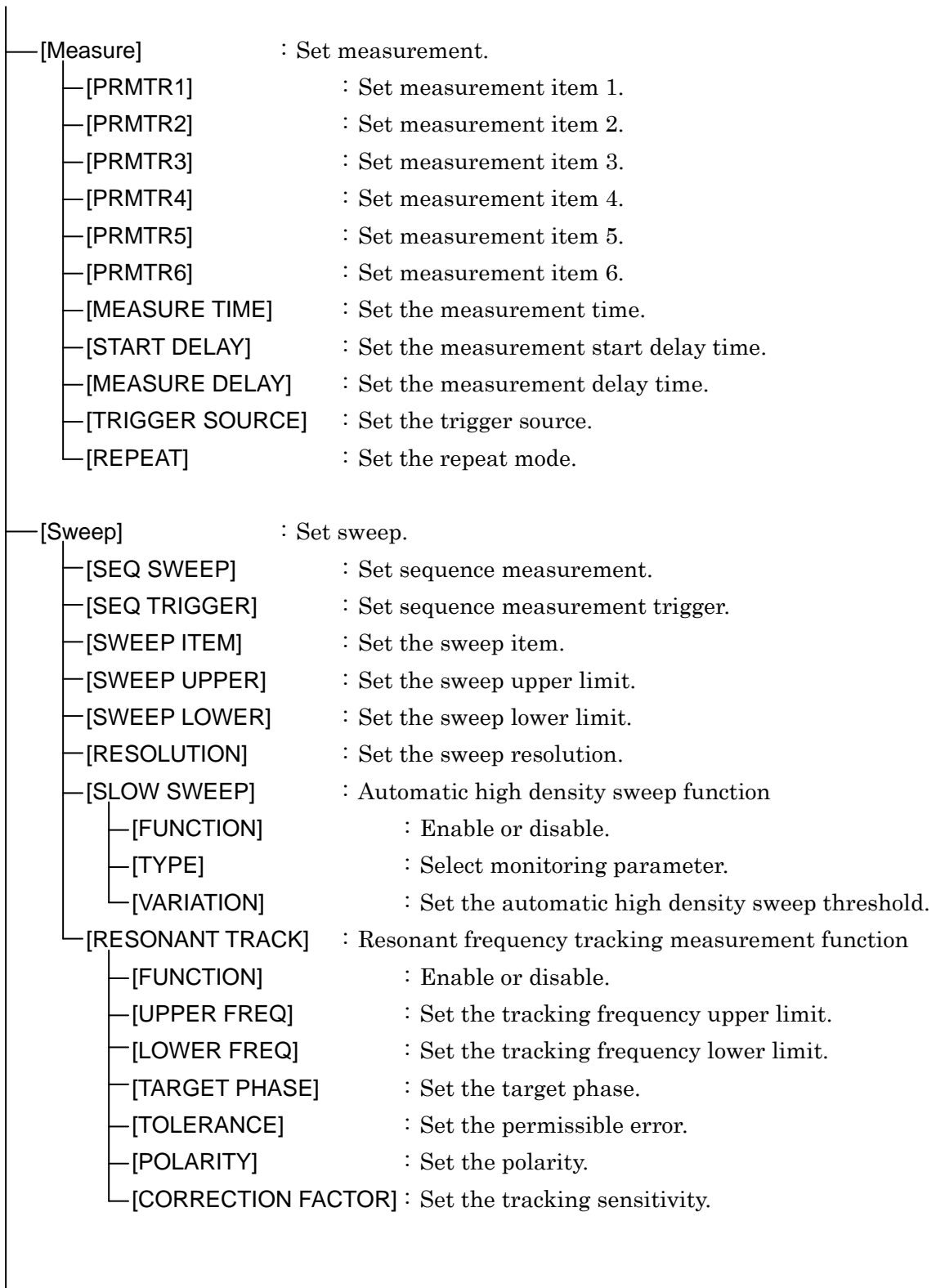
Front Panel

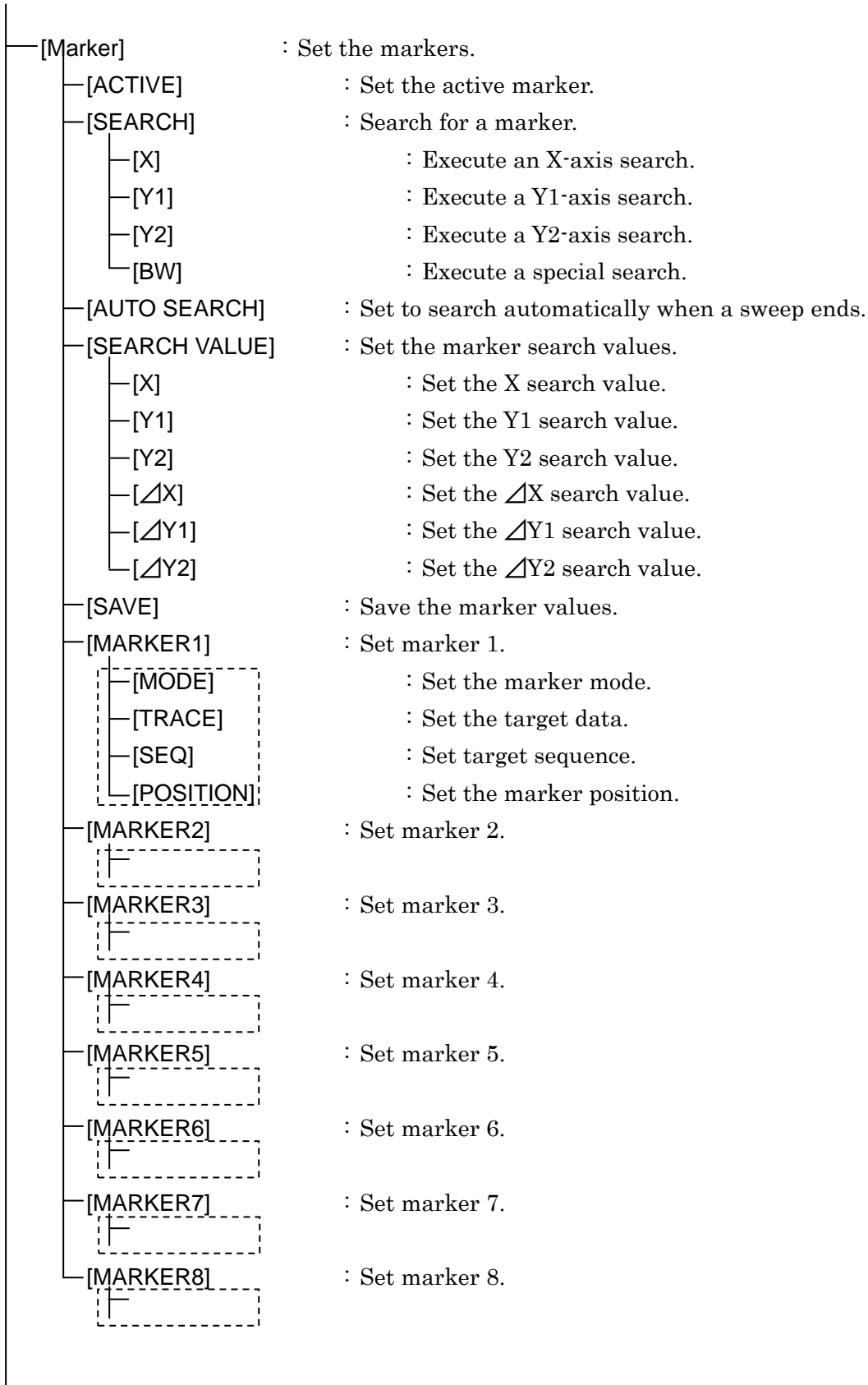
MENU key	: Displays/hides the menu.
SETUP key	: Open a list of frequently set parameters.
[DISPLAY MODE Y]	: Set the measurement item.
[SWEEP ITEM]	: Set the sweep item.
[SWEEP UPPER]	: Set the sweep upper limit.
[SWEEP LOWER]	: Set the sweep lower limit.
[SETTING VIEW]	: Display a list of setting items.
CANCEL/ESC	: Discard the settings.
ENTER key	: Confirm the settings.
Up/down/left/right keys	: Move the cursor and change numerical values.
Modify knob	: Select menus, change parameters, move markers, etc.
SCREEN COPY key	: Execute an LCD screen copy.
(Marker operation keys)	
TRACE key	: Switch the marker target data.
ACTIVE key	: Switch the active marker.
(Measurement control keys)	
STOP key	: Stop measurement.
DOWN key	: Start down-sweep measurement.
SPOT key	: Start spot measurement.
UP key	: Start up-sweep measurement.
REPEAT key	: Switch between single measurement and repeat measurement.
REPEAT lamp	: Lit during repeat measurement.
(Measurement signal control keys)	
AC/DC OFF key	: Turn off both AC and DC.
AC OFF key	: Turn off only AC.
AC/DC ON key	: Turn on both AC and DC.
AC lamp	: Lit when AC output.
DC lamp	: Lit when DC output.

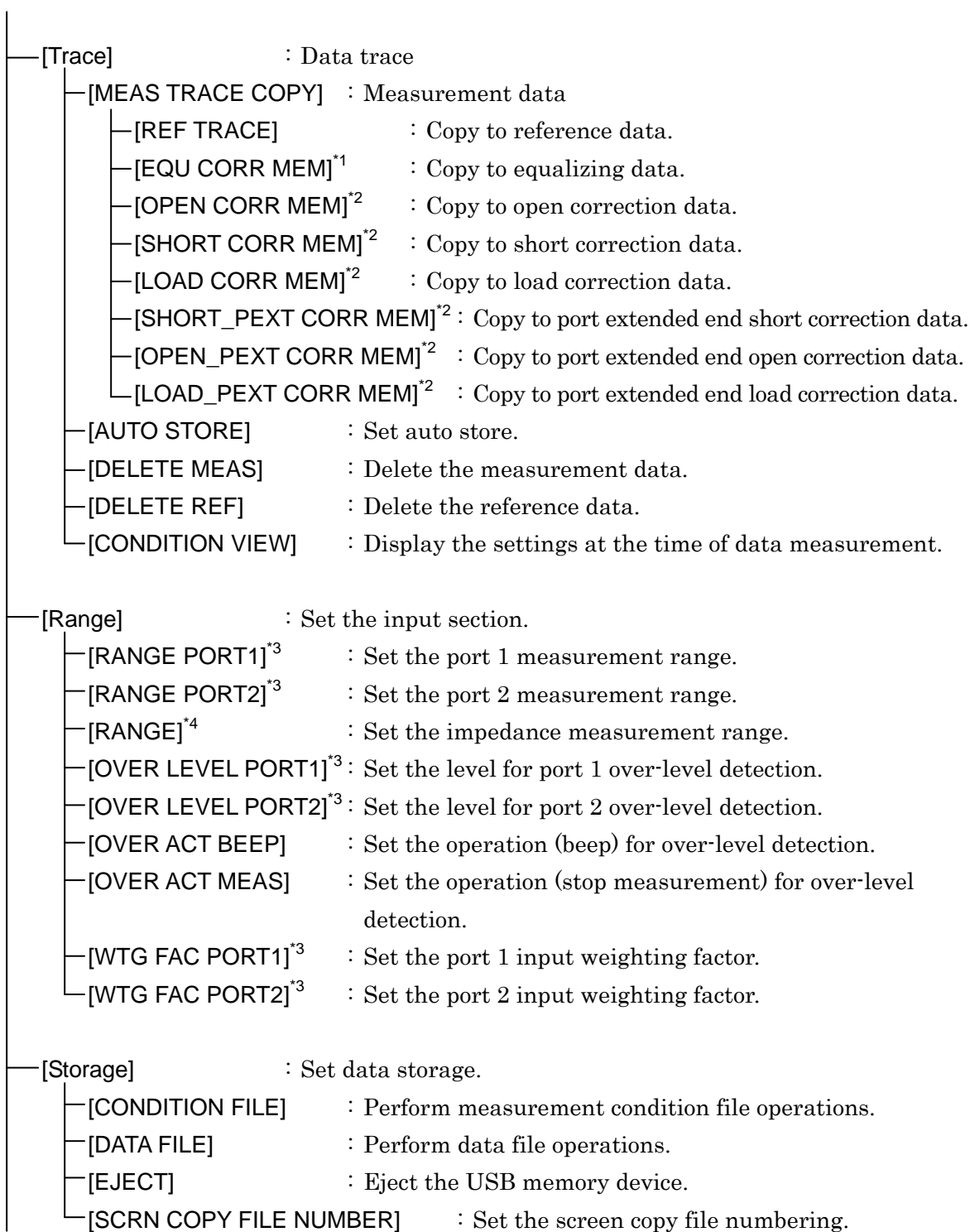
(Keypad)	
[0] to [9], [.] key	: Numerical and decimal point keys
[-] key	: Minus key
[EXP] key	: Exponent key (power of 10)
[BS] key	: Backspace key
[<], [>] key	: Move the cursor.
[CANCEL] key	: Discard the setting.
[ENTER] key	: Confirm the setting.

Top menu

[Mode]	: Set the mode.
[OSC]	: Set the measurement signal.
[FREQUENCY]	: Set the frequency.
[AMPLITUDE UNIT]	: Select the measurement signal setting unit (voltage/current).
[AMPLITUDE]	: Set the measurement signal amplitude.
[AMPLITUDE LIMIT]	: Set the measurement signal amplitude limit.
[ALC]	: Set the automatic level control.
[ALC]	: Enable or disable.
[TOLERANCE]	: Set the permissible error.
[RETRY TIMES]	: Set the maximum number of retries.
[CORRECTION FACTOR]	: Set the control sensitivity.
[DC BIAS]	: DC bias
[DC BIAS]	: Set the DC bias.
[HV BIAS]	: Set the HV DC bias.
[OUTPUT CONNECTOR]	: Set the DC bias output connector.
[POWER AMP GAIN]	: Set the DUT drive amplifier gain.
[AUX PORT SET]	: Set the expansion connector port.
[ON/OFF SYNC]	: Turn measurement synchronous driving on or off.
[ON/OFF MODE]	: Set the ON/OFF mode.
[FREQ CHNG MODE]	: Set the phase for when the frequency changes.
[10MHz REF IN]	: Set the reference clock input.
[10MHz REF OUT]	: Set the reference clock output.





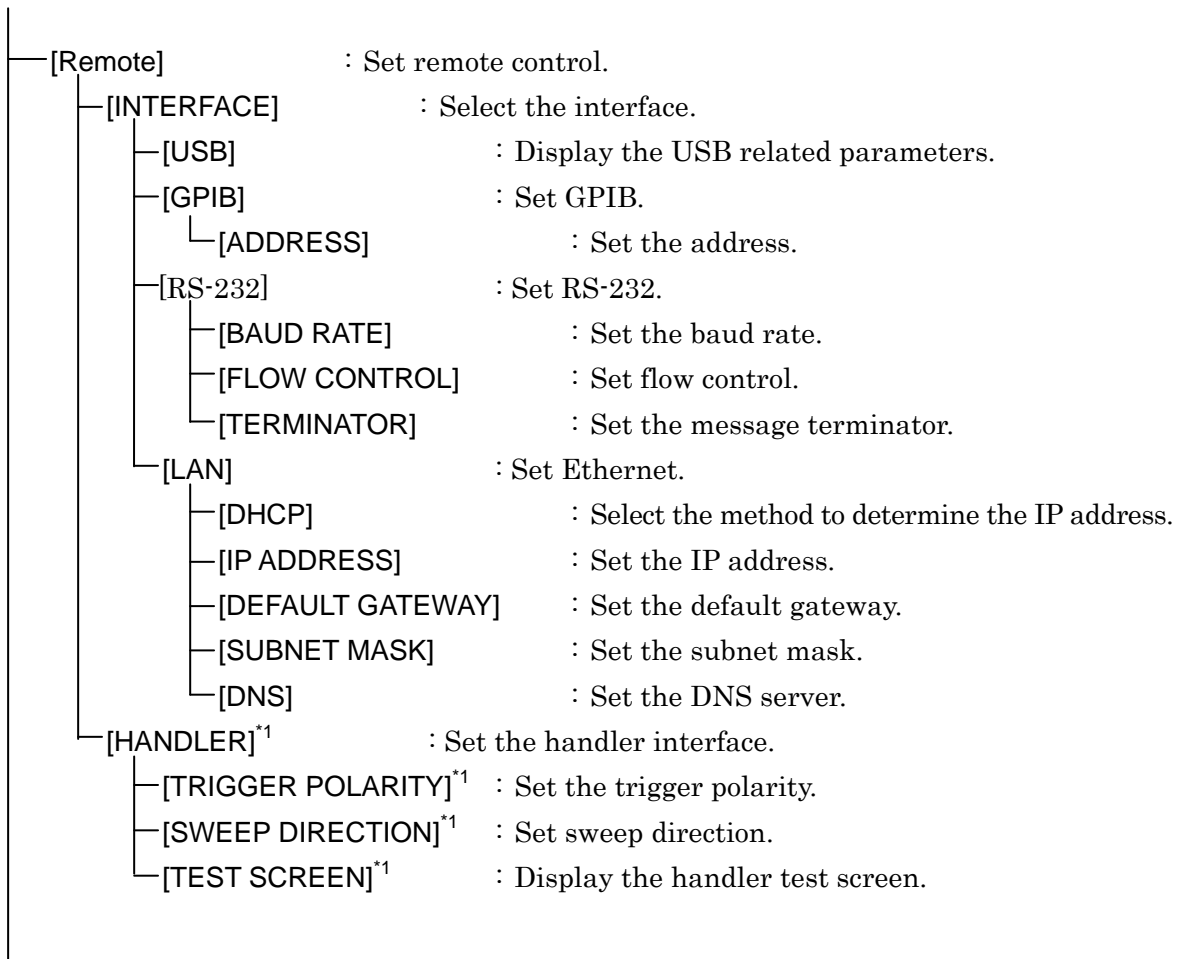


*1: Displayed only in the G-PH measurement mode.

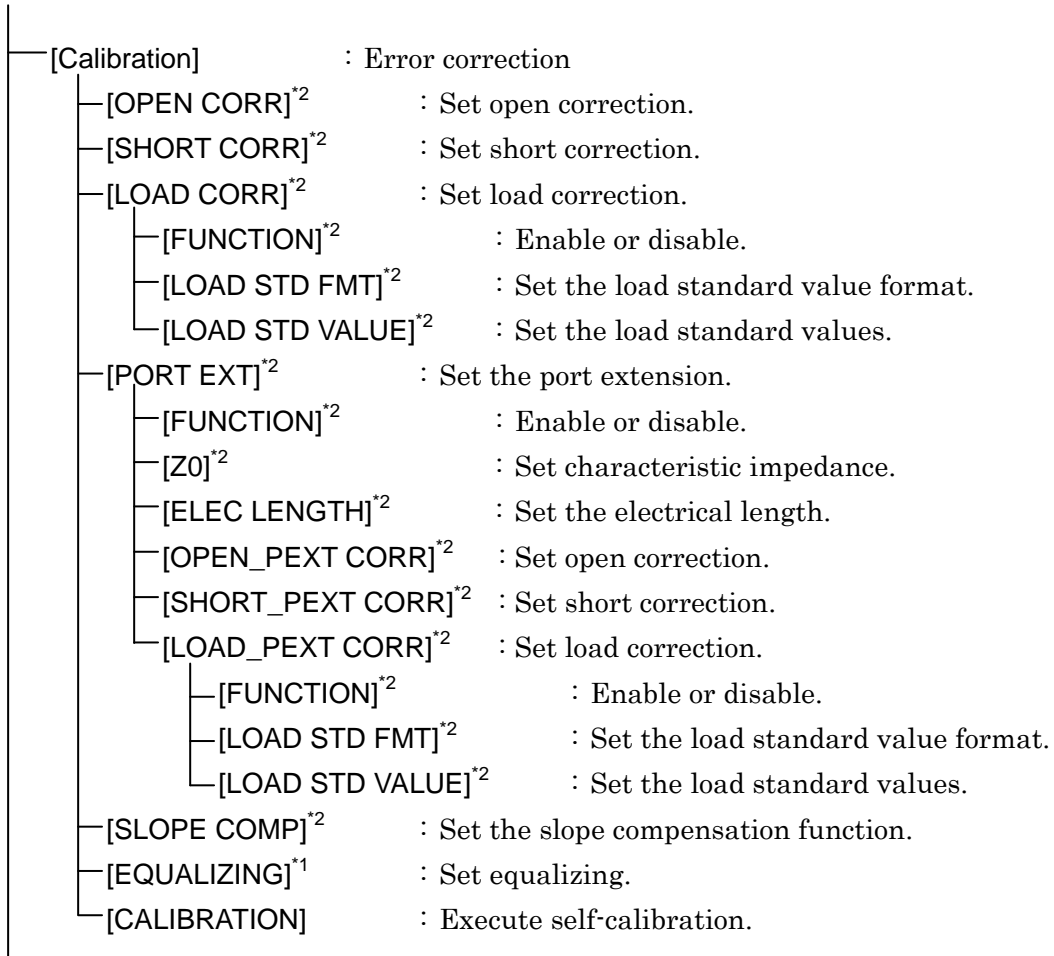
*2: Displayed only in the IMPD-EXT, IMPD-3T, and IMPD-2T measurement modes.

*3: Displayed only in the IMPD-EXT and G-PH measurement modes.

*4: Displayed only in the IMPD-3T and IMPD-2T measurement modes.

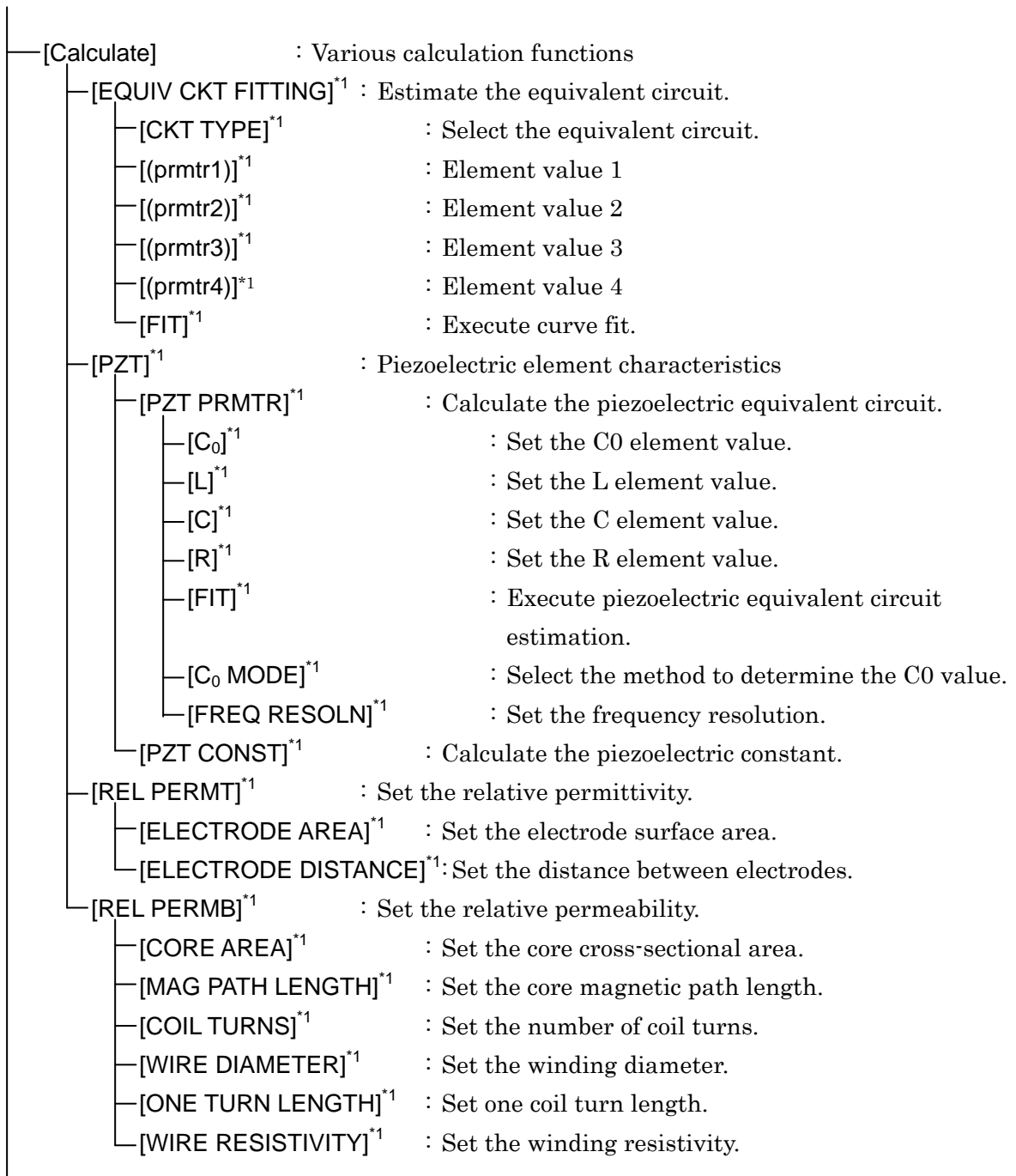


*1: Displayed only in the IMPD-EXT, IMPD-3T, and IMPD-2T measurement modes.



*1: Displayed only in the G-PH measurement mode.

*2: Displayed only in the IMPD-EXT, IMPD-3T, and IMPD-2T measurement modes.



*1: Displayed only in the IMPD-EXT, IMPD-3T, and IMPD-2T measurement modes.

3.5 Setting Screen Reference

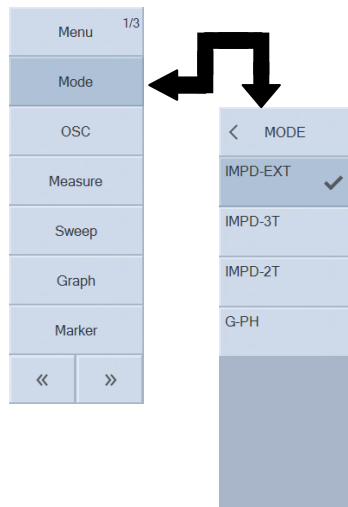
This section describes each setting screen.

In the menu explanations that begin from the next page, the procedures for setting and changing parameters are presented in the formats shown below.

- <Numerical settings (immediate settings)>
- <Numerical settings (requiring confirmation)>
- <Numerical settings>
- <List operations (immediate settings)>
- <List operations (requiring confirmation)>
- <Palette operations (immediate settings)>
- <Text settings (immediate settings)>
- <Text settings (requiring confirmation)>
- <Text settings>
- <Execution operations (requiring confirmation)>
- <Execution operations (immediate execution)>

The procedures correspond to the setting procedures in “3.3.1 Menu Operating Procedures,” so please also refer to that section.

3.5.1 Mode Menu



This menu sets the measurement mode of this instrument.

○ Setting procedure

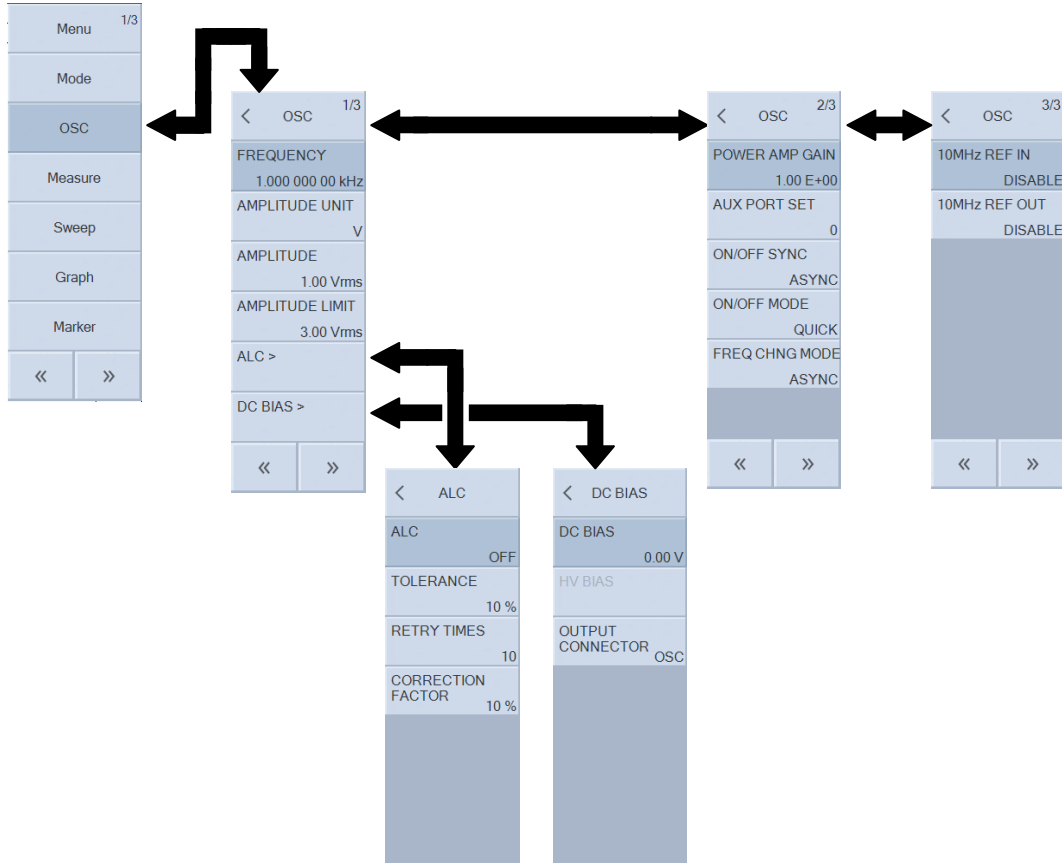
<List operations (requiring confirmation)>

- IMPD-EXT: Measure the impedance. Current-voltage conversion needs to be performed outside of this instrument.
The OSC, PORT1, and PORT2 connectors are used.
- IMPD-3T : Measure the impedance. Measurement is performed using a test fixture for an LCR meter.
The H_{CUR}, H_{POT}, L_{POT}, and L_{CUR} connectors are used.
- IMPD-2T : Measure the impedance. Measure a DUT with a coaxial structure.
The PORT3 connector is used.
- G-PH : Measure the gain and phase.
The OSC, PORT1, and PORT2 connectors are used.

(Supplementary explanation)

When the measurement mode is changed, the frequency, amplitude, and other measurement parameters are initialized.

3.5.2 OSC Menu



■ [FREQUENCY]: Set the frequency.

This sets the frequency for performing spot measurement.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [SWEEP MIN -> FREQ]* : Copy the sweep lower frequency limit to FREQUENCY.
- [SWEEP MAX -> FREQ]* : Copy the sweep upper frequency limit to FREQUENCY.
- [MKR -> FREQ]* : Copy the frequency of the active marker to FREQUENCY.
- [CURR -> FREQ] : Copy the current measurement signal frequency to FREQUENCY.
- [EDIT] : Set the frequency with the numerical input palette.
- [MODIFY] : Modify the frequency setting with the knob or cursor keys.

*: Displayed when frequency sweep.

■ [AMPLITUDE UNIT]: Set the measurement signal amplitude unit.

This selects the unit (voltage/current) for setting the measurement signal amplitude and DC bias.

○ Setting procedure

<List operations (immediate settings)>

○ Functions list

- [V] : Set with voltage (Vrms, V).

- [A] : Set with current (Arms, A).

■ [AMPLITUDE] : Set the measurement signal amplitude.

This sets the measurement signal amplitude for performing spot measurement.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [SWEEP MIN -> AMPTD]* : Copy the sweep lower amplitude limit to AMPLITUDE.
- [SWEEP MAX -> AMPTD]* : Copy the sweep upper amplitude limit to AMPLITUDE.
- [MKR -> AMPTD]* : Copy the amplitude of the active marker to AMPLITUDE.
- [CURR -> AMPTD] : Copy the current output amplitude to AMPLITUDE.
- [EDIT] : Set the amplitude with the numerical input palette.
- [MODIFY] : Modify the amplitude setting with the knob or cursor keys.

*: Displayed when measurement signal amplitude sweep.

■ [AMPLITUDE LIMIT] : Set the amplitude limit.

This function is to prevent excessive output due to an incorrect measurement signal amplitude setting and prevent excessive output when ALC is enabled. An measurement signal amplitude above that set here will not be output even when ALC is enabled.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [SWEEP MAX -> LIMIT]* : Copy the sweep upper amplitude limit to AMPLITUDE LIMIT.
- [MKR -> LIMIT]* : Copy the amplitude of the active marker to AMPLITUDE LIMIT.
- [EDIT] : Set the amplitude limit with the numerical input palette.
- [MODIFY] : Modify the amplitude limit with the knob or cursor keys.

*: Displayed when measurement signal amplitude sweep.

■ [ALC] : Set automatic level control.

This is used to automatically adjust the measurement signal output amplitude for supplying a constant amplitude to the DUT. For details, refer to “1.4.4 ALC” in Instruction Manual (Advanced).

■ [ALC]—[ALC] : Enable or disable.

This sets whether or not to perform the ALC operation.

○ Setting procedure

<List operations (immediate settings)>

- OFF : Disable the ALC.
- CV1^{*1} : Control the amplitude so that the PORT1 input amplitude becomes constant.
- CV2^{*1} : Control the amplitude so that the PORT2 input amplitude becomes constant.
- ON^{*2} : Enable the amplitude compression function (constant voltage or constant current).

*1: Displayed only in the IMPD—EXT and G—PH measurement modes.

*2: Displayed only in the IMPD-3T and IMPD-2T measurement modes.

(Supplementary explanation)

When the measurement mode is IMPD-3T and IMPD-2T, the operation when this is set to "ON" is in accordance with the "AMPLITUDE UNIT" setting for the amplitude unit (constant voltage operation with the voltage unit and constant current operation with the current unit).

■ [ALC]—[TOLERANCE]: Set the permissible error.

This sets the permissible error for the signal amplitude and the measured amplitude.

Measurement is repeated while changing the OSC amplitude until the amplitude comes within the permissible error set here.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 1% to 100% and the setting resolution is 1%.

○ Functions of function keys

- [EDIT] : Set the permissible error with the numerical input palette.
- [MODIFY] : Modify the permissible error with the knob or cursor keys.

■ [ALC]—[RETRY TIMES]: Set the maximum number of retries.

This sets the maximum number of retries (number of retry measurements) for ALC.

Amplitude adjustment stops when the maximum number of retries set here is reached even if the amplitude does not come within the permissible error.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 1 to 100 times and the setting resolution is 1.

○ Functions of function keys

- [EDIT] : Set the maximum number of retries with the numerical input palette.
- [MODIFY] : Modify the maximum number of retries with the knob or cursor keys.

■ [ALC]—[CORRECTION FACTOR]: Set the correction factor.

This sets the correction factor (control sensitivity) for ALC. Usually, 100% is no problem, but control may be unstable depending on the DUT. If instability is observed, reduce the correction factor.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 1% to 100% and the setting resolution is 1%.

○ Functions of function keys

- [EDIT] : Set the correction factor with the numerical input palette.
- [MODIFY] : Modify the correction factor with the knob or cursor keys.

■ [DC BIAS]: Set the DC bias.

This sets the bias for performing spot measurement.

■ [DC BIAS]—[DC BIAS]: Set the DC bias.

This sets the DC bias value.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [SWEEP MIN -> DC BIAS]* : Copy the sweep lower bias value limit to DC BIAS.
- [SWEEP MAX -> DC BIAS]* : Copy the sweep upper bias value limit to DC BIAS.
- [MKR -> DC BIAS]* : Copy the bias value of the active marker to DC BIAS.
- [CURR -> DC BIAS] : Copy the current output bias value to DC BIAS.
- [EDIT] : Set the bias with the numerical input palette.
- [MODIFY] : Modify the bias setting with the knob or cursor keys.

*: Displayed when DC bias sweep.

■ [DC BIAS]—[HV BIAS]: Set the HV DC bias.

This enables or disables high voltage bias (HV bias).

○ Setting procedure

<List operations (immediate settings)>

- OFF : Disable HV bias.
- ON : Enable HV bias.

(Supplementary explanation)

- The HV DC bias can be set only when the measurement mode is IMPD-3T and IMPD-2T. This menu is not displayed when in another measurement mode (IMPD-EXT and G-PH).
- The HV DC bias is output from either the H_{CUR}/OSC connector on the front panel (when IMPD-3T) or PORT3 connector on the front panel (when IMPD-2T). The HV DC bias cannot be output from the rear panel DC BIAS OUT connector.

■ [DC BIAS]—[OUTPUT CONNECTOR]: Set the DC bias output connector.

This sets the connector to output the DC bias.

○ Setting procedure

<List operations (immediate settings)>

- FRONT : Output the bias from the OSC connector on the front panel.
- REAR : Output the bias from the DC BIAS OUT connector on the rear panel.

■ [POWER AMP GAIN]: Set the DUT drive amplifier gain.

This sets the DUT drive amplifier gain (amplification factor) for amplifying the signal output from the OSC connector.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is $\pm(1.00E-12$ to $1.00E+12)$ and the setting resolution is 3 digits.

○ Functions of function keys

- [EDIT] : Set the gain with the numerical input palette.
- [MODIFY] : Modify the gain with the knob or cursor keys.

(Supplementary explanation)

- This setting is enabled when the measurement mode is IMPD-EXT and G-PH. When the measurement mode is IMPD-3T and IMPD-2T, operation is performed as if +1.00 is set.
- When the DUT drive amplifier gain is set, the amplitude and DC bias set on this instrument become not the levels output from the OSC connector of this instrument but the levels actually applied to the DUT.
- If a DUT drive amplifier will not be used, use this instrument with this set to 1.00.

■ [AUX PORT SET]: Set the AUX connector port.

This sets the digital output port value that is output from the AUX connector on the rear panel.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 0 to 15 and the setting resolution is 1.

○ Functions of function keys

- [EDIT] : Set the output value with the numerical input palette.
- [MODIFY] : Modify the output value with the knob or cursor keys.

(Supplementary explanation)

For details on the AUX connector, refer to “1.19 Setting AUX Port” in Instruction Manual (Advanced).

■ [ON/OFF SYNC]: Set measurement synchronous driving.

Measurement synchronous driving is a function to output a signal only during measurement.

Use this when you wish to apply a signal to the DUT only during measurement. Output turns on when measurement starts and turns off automatically when measurement ends.

○ Setting procedure

<List operations (immediate settings)>

- ASYNC : Turn measurement synchronous driving off. Output on/off control is not performed in synchronization with measurement.
- SYNC(AC+DC) : Turn measurement synchronous driving on. The AC and DC outputs are both turned on when measurement starts, and are both turned off when measurement ends.

- SYNC(AC) : Turn measurement synchronous driving on. Only the AC output is turned on when measurement starts and only the AC output is turned off when measurement ends. DC on/off control is not performed.

If repeat measurement is performed while measurement synchronous driving is on, the output is turned off each time for each measurement is completed for either spot measurement or sweep measurement.

■ [ON/OFF MODE]: Set the ON/OFF mode.

This sets the state for when measurement signal output is turned on/off. This is used to avoid sudden signal changes such as when the device under test is a mechanical system.

○ Setting procedure

<List operations (immediate settings)>

- QUICK : Turn on/off instantly. When this is on, oscillation starts with a phase of 0°.
- SLOW : Turn the output on/off slowly over a period of about 10 seconds.
- 0° SYNC : Turn output off after waiting until the 0° phase. When this is on, oscillation starts with a phase of 0°.

When 0° SYNC is set, it takes up to one cycle of the signal at the longest from the time the output off operation is performed to the time the output is actually turned off. Please note that at 10 μ Hz it takes up to 10⁵ seconds (about 27.8 hours) at the longest.

■ [FREQ CHNG MODE]: Set the phase for when the frequency changes.

This sets whether to change the frequency instantly or to wait until the 0° phase when changing the frequency. When performing measurement such as electrochemical impedance measurement, the total charge transfer to the DUT can be made zero because the areas of the positive and negative sides of an AC sinusoidal signal match.

○ Setting procedure

<List operations (immediate settings)>

- ASYNC : Change the frequency instantly.
- 0° SYNC : Change the frequency after waiting until the 0° phase.

When 0° SYNC is set, it takes up to one cycle of the measurement signal at the longest until the frequency is changed (including when a sweep is in progress). Please note that at 10 μ Hz it takes up to 10⁵ seconds (about 27.8 hours) at the longest.

■ [10MHz REF IN]: Set the reference clock input.

This is used to improve the frequency accuracy and stability by using an external reference clock that is more accurate than the internal reference clock of this instrument. This is also used to make the frequency accuracy common among multiple devices.

○ Setting procedure

<List operations (immediate settings)>

- DISABLE : Use the internal reference clock.

- **ENABLE** : Use an external reference clock if an external reference clock is available.

Even if **ENABLE** is set, the internal reference clock of this instrument will be used if an external reference clock is not detected or if the frequency differs from the specified frequency. The reference clock with which this instrument is currently operating is indicated by the status display in the upper part of the LCD screen.



(Nothing is displayed): Operating with the internal reference clock.
REF: Operating with the external reference clock.
REF (flashing): Operating with the internal reference clock. (An external reference clock has not been detected.)

- **[10MHz REF OUT]**: Set the reference clock output.

This is set when the reference clock with which this instrument is operating is output from the 10MHz REF OUT connector on the rear panel. This is used to make the frequency accuracy common among this instrument and other devices.

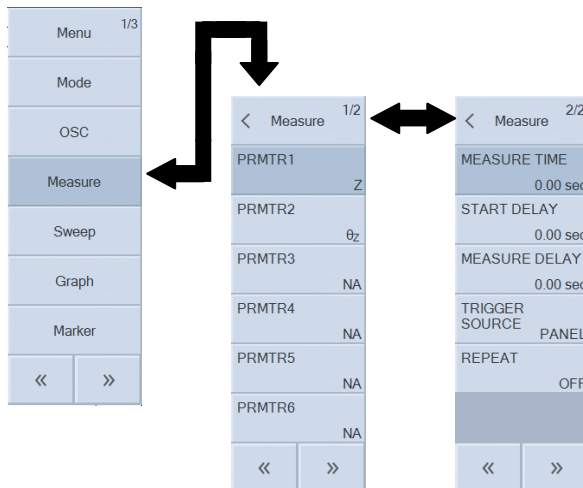
- **Setting procedure**

<List operations (immediate settings)>

- **DISABLE** : Do not output the reference clock.
- **ENABLE** : Output the reference clock.

When this instrument is operating with an external reference clock, the same frequency as that reference clock is output.

3.5.3 Measure Menu



- [PRMTR1] to [PRMTR6]: Set the spot measurement item.

This sets the measurement item (display item) for spot measurement.

- Setting procedure

<Palette operations (immediate settings)>

(Measurement modes: IMPD-EXT, IMPD-3T, and IMPD-2T)

- Z : Magnitude of impedance (Ω)
- θ_z : Phase of impedance ($^\circ$)
- Y : Magnitude of admittance (S)
- θ_y : Phase of admittance ($^\circ$)
- R : Resistance (Ω)
- X : Reactance (Ω)
- G : Conductance (S)
- B : Susceptance (S)
- C_S : Series capacitance (F)
- C_P : Parallel capacitance (F)
- D : Dissipation factor (unitless number)
- Q_C : Quality coefficient of capacitor (unitless number)
- L_S : Series inductance (H)
- L_P : Parallel inductance (H)
- Q_L : Quality coefficient of inductor (unitless number)
- R_S : Series resistance (Ω)
- R_P : Parallel resistance (Ω)
- V1 : PORT1 amplitude (V_{rms}) When measurement mode is IMPD-EXT
- V2 : PORT2 amplitude (V_{rms}) When measurement mode is IMPD-EXT
- V : Voltage amplitude (V_{rms}) When measurement mode is IMPD-3T and IMPD-2T
- I : Current amplitude (A_{rms}) When measurement mode is IMPD-3T and IMPD-2T
- ϵ_S : Relative permittivity (unitless number)
- ϵ_S' : Real part of relative permittivity (unitless number)

- ϵ_s'' : Imaginary part of relative permittivity (unitless number)
- D_ϵ : Dissipation factor of relative permittivity (unitless number)
- μ_s : Relative permeability (unitless number)
- μ_s' : Real part of relative permeability (unitless number)
- μ_s'' : Imaginary part of relative permeability (unitless number)
- D_μ : Dissipation factor of relative permeability (unitless number)
- FREQUENCY : Frequency (Hz)
- STATUS : Status information of measurement range, etc.
- NA : (No display)

(Measurement mode: G-PH)

- dBR : Gain (dB)
- R : Gain (unitless number)
- a : Real part of gain (unitless number)
- b : Imaginary part of gain (unitless number)
- θ : Phase ($^\circ$)
- V1 : PORT1 amplitude (V_{rms})
- V2 : PORT2 amplitude (V_{rms})
- FREQUENCY : Frequency (Hz)
- STATUS : Status information of measurement range, etc.
- NA : (No display)

The measurement item list palette is displayed. Tap to select the items to measure/display. If you select "NA," that item will be hidden.

For details on each of the parameters, refer to "4.6 Setting Spot Measurement".

(Supplementary explanation)

The V1, V2, V, and I measurement items are the voltage and current amplitude values measured by this instrument. The impedance and gain are calculated and displayed based on these measurement values, but the $(V \div I)$ and Z and the $(V1 \div V2)$ and R do not match exactly because various error processing is performed inside this instrument. In particular, please note that the difference between both of them will be extremely large when open/short/load correction, port extension, and equalizing are performed.

■ [MEASURE TIME]: Set the measurement time.

This sets the time per measurement. Increasing the time results in more measurement data being averaged to reduce noise and obtain cleaner measurement results, but measurement will become longer. For details on the averaging operation, refer to "1.1 Setting Measurement Time" in Instruction Manual (Advanced).

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 0 to 9,990 seconds and the setting resolution is 3 digits or 0.1 ms, whichever is the largest. Even if 0 second is set, measurement is performed for a time equivalent to 1 cycle of the measurement frequency (= 1 / frequency).

- Functions of function keys

- [EDIT] : Set the measurement time with the numerical input palette.
- [MODIFY] : Modify the measurement time with the knob or cursor keys.

- [START DELAY]: Set the measurement start delay time.

This sets the delay time for when sweep measurement starts and spot measurement starts.

Set this for when a transient response is generated in the circuit under test due to a large change in the frequency, measurement signal amplitude, or DC bias. For details on the delay, refer to “1.2 Setting Delay” in Instruction Manual (Advanced).

- Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 0 to 9,990 seconds and the setting resolution is 3 digits or 0.1 ms, whichever is the largest.

- Functions of function keys

- [EDIT] : Set the measurement start delay time with the numerical input palette.
- [MODIFY] : Modify the measurement start delay time with the knob or cursor keys.

- [MEASURE DELAY]: Set the measurement delay time.

This sets the delay time until measurement starts after a parameter (frequency, measurement signal amplitude, or DC bias) changes during a sweep. Set this in particular when measuring a DUT with abrupt changes in frequency characteristics. For details on the delay, refer to “1.2 Setting Delay” in Instruction Manual (Advanced).

- Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 0 to 9,990 seconds and the setting resolution is 3 digits or 0.1 ms, whichever is the largest.

- Functions of function keys

- [EDIT] : Set the measurement delay time with the numerical input palette.
- [MODIFY] : Modify the measurement delay time with the knob or cursor keys.

■ [TRIGGER SOURCE]: Select the trigger source.

This selects the measurement start (trigger) source. If this is not selected, a trigger from a trigger source will be disabled.

○ Setting procedure

<List operations (immediate settings)>

- PANEL : The MEASURE START **UP**, **DOWN**, and **SPOT** keys on the front panel are trigger sources.
- REMOTE : The remote interfaces (USB, GPIB, RS-232, and LAN) are trigger sources.
- HANDLER : The handler interface is a trigger source.

(Supplementary explanation)

- When the measurement mode is G-PH, the handler interface cannot be set to the trigger source.

■ [REPEAT]: Set the repeat mode.

If repeat is on, the measurement is repeated. For sweep measurement, the sweep measurement is started again. The measurement is repeated until the **STOP** key is pressed.

If repeat is off, the measurement is performed one time and then ends.

○ Setting procedure

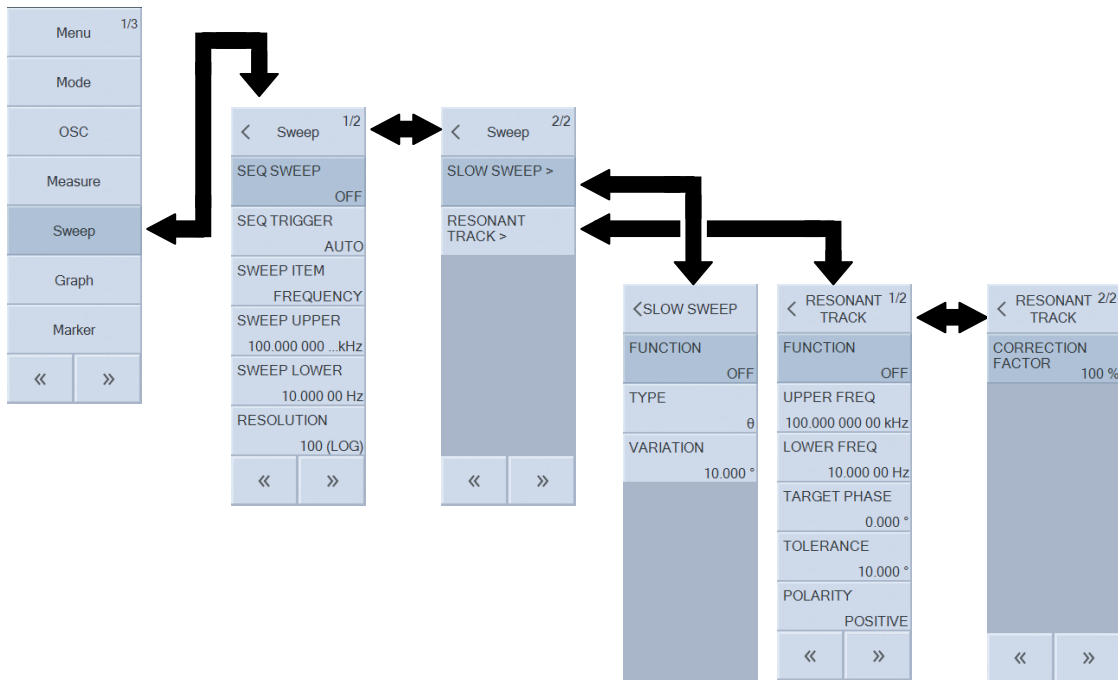
<List operations (immediate settings)>

- OFF : Turn repeat off.
- ON : Turn repeat on.

(Supplementary explanation)

- Repeat can be set to ON only when the trigger source setting is set to PANEL. Refer to “**■ [TRIGGER SOURCE]**” in “3.5.3 Measure Menu”.
- This has the same function as the **REPEAT** key on the front panel.

3.5.4 Sweep Menu



■ [SEQ SWEEP]: Set sequence measurement.

This function performs measurements in the order set in the setting memory of this instrument. It allows, for example, dividing the sweep range to perform measurement with different conditions. For details on sequence measurement, refer to “1.9 Sequence Measurement” in Instruction Manual (Advanced).

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is OFF and 1 to 32 and the setting resolution is 1.

○ Functions of function keys

- [OFF] : Do not perform sequence measurement.
- [EDIT] : Set the maximum sequence number with the numerical input palette.
- [MODIFY] : Modify the maximum sequence number with the knob or cursor keys.

■ [SEQ TRIGGER]: Set the trigger for sequence measurement.

If AUTO is set, measurement is performed automatically for one cycle of the entire sequence with one press of the SWEEP **UP** or SWEEP **DOWN** key. If STEP is set, this instrument enters the wait state each time one setting memory is loaded. Pressing the SWEEP **UP** or SWEEP **DOWN** key again will perform measurement with that setting memory. Use this, for example, when changing the external device connection for each sequence.

○ Setting procedure

<List operations (immediate settings)>

- AUTO : Auto trigger (Execute the entire sequences automatically.)
- STEP : Step trigger (Wait at every sequence step.)

- [SWEEP ITEM]: Set the sweep item.

This selects the parameter to sweep. The parameter set here becomes the X-axis of the graph.

- Setting procedure

<List operations (immediate settings)>

- FREQUENCY : Sweep the frequency.
- AMPLITUDE : Sweep the measurement signal amplitude.
- DC BIAS : Sweep the DC bias.
- ZERO-SPAN : Keep the measurement conditions constant (zero-span sweep).

- [SWEEP UPPER]: Set the sweep upper limit.

- [SWEEP LOWER]: Set the sweep lower limit.

This sets the upper and lower limits of the range for performing sweep measurements.

- Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

When a frequency sweep is performed, the range is 10 μ Hz to 36 MHz (resolution of 10 μ Hz). When an measurement signal amplitude sweep or a DC bias sweep is performed, the setting range differs depending on the DUT drive amplifier gain setting (set based on the AC amplitude or DC bias applied to the DUT). Furthermore, there is the limitation of lower limit < upper limit. When a zero-span sweep is performed, this setting is not applied (it is disabled).

- Functions of function keys

- [MKR -> SWEEP] : Set the smaller and larger of MARKER1 and MARKER2 to LOWER and UPPER, respectively.
- [GRAPH -> SWEEP] : Set the current graph X-axis range to the sweep range.
- [MKR -> UPPER] : Set the value of the active marker as the sweep upper limit.
- [MKR -> LOWER] : Set the value of the active marker as the sweep lower limit.
- [EDIT] : Set the sweep upper limit and lower limit with the numerical input palette.
- [MODIFY] : Modify the sweep upper limit and lower limit with the knob or cursor keys.

■ [RESOLUTION]: Set the sweep resolution.

This sets the sweep resolution. The number of data points obtained in a sweep measurement is the resolution value set here + 1.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 3 to 2,000 and the setting resolution is 1. Either linear sweep or log sweep can be selected. When the sweep item is DC bias or zero span, log sweep cannot be selected.

○ Functions of function keys

- [LOG] : Log sweep
- [LIN] : Linear sweep
- [EDIT] : Set the sweep resolution with the numerical input palette.
- [MODIFY] : Modify the sweep resolution with the knob or cursor keys.

■ [SLOW SWEEP]: Automatic high density sweep

■ [SLOW SWEEP]—[FUNCTION]: Enable or disable the automatic high density sweep

This sets whether or not to perform an automatic high density sweep. For details on automatic high density sweep, refer to “1.5 Automatic High Density Sweep” in Instruction Manual (Advanced).

○ Setting procedure

<List operations (immediate settings)>

- OFF : Disable the automatic high density sweep function.
- ON : Enable the automatic high density sweep function.

Even if this is set to OFF, the parameters related to the automatic high density sweep are not changed.

■ [SLOW SWEEP]—[TYPE]: Select the monitoring parameter type.

This sets the parameter type to monitor for sudden changes in characteristics when performing an automatic high density sweep.

○ Setting procedure

<List operations (immediate settings)>

(Measurement modes: IMPD-EXT, IMPD-3T, and IMPD-2T)

- Z : Monitor sudden changes in the magnitude of impedance ($|Z|$).
- Y : Monitor sudden changes in the magnitude of admittance ($|Y|$).
- θ : Monitor sudden changes in the phase ($^{\circ}$).

(Measurement mode: G-PH)

- dBR : Monitor sudden changes in the ratio (dB) between PORT1 and PORT2.
- R : Monitor sudden changes in the ratio (unitless number) between PORT1 and PORT2.
- θ : Monitor sudden changes in the phase difference ($^{\circ}$) between PORT1 and PORT2.

- [SLOW SWEEP]–[VARIATION]: Set the threshold value for the amount of change.

This sets the threshold value for the amount of parameter change that is regarded as a sudden change. The value is stored internally for each parameter type that is set in [TYPE].

- Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

- Functions of function keys

- [EDIT] : Set the threshold value with the numerical input palette.
- [MODIFY] : Modify the threshold value with the knob or cursor keys.

The setting range and resolution differ depending on the type of parameter.

TYPE=Z	: The setting range is 1a to 999 GΩ and the resolution is 3 digits or 1 aΩ, whichever is the largest.
Y	: The setting range is 1a to 999 GS and the resolution is 3 digits or 1 aS, whichever is the largest.
θ	: The setting range is 0.001 to 179.999° and the resolution is 0.001°.
dBR	: The setting range is 0.001 to 999.999 dB and the resolution is 0.001 dB.
R	: The setting range is 1a to 999 G and the resolution is 3 digits or 1 a, whichever is the largest.

- [RESONANT TRACK]: Set the resonant frequency tracking.
- [RESONANT TRACK]–[FUNCTION]: Enable or disable resonant frequency tracking measurement.

This sets whether or not to perform resonant frequency tracking measurement. For details on resonant frequency tracking measurement, refer to “1.10 Resonant Frequency Tracking Measurement” in Instruction Manual (Advanced).

- Setting procedure

<List operations (immediate settings)>

- OFF : Disable resonant frequency tracking measurement.
- ON : Enable resonant frequency tracking measurement.

- [RESONANT TRACK]—[UPPER FREQ]: Set the tracking frequency upper limit.
- [RESONANT TRACK]—[LOWER FREQ]: Set the tracking frequency lower limit.

This sets the frequency range for performing resonant frequency tracking.

- Setting procedure
 - <Numerical settings (immediate settings)>, <Numerical settings>
- Functions of function keys
 - [SWEEP -> RANGE] : Set the same range as the frequency sweep measurement setting.
 - [MKR -> RANGE] : Set the smaller and larger of MARKER1 and MARKER2 to LOWER FREQ and UPPER FREQ, respectively.
 - [MKR -> UPPER] : Set the value of the active marker as the tracking frequency upper limit.
 - [MKR -> LOWER] : Set the value of the active marker as the tracking frequency lower limit.
 - [EDIT] : Set the tracking frequency upper and lower limits with the numerical input palette.
 - [MODIFY] : Modify the tracking frequency upper and lower limits with the knob or cursor keys.

- [RESONANT TRACK]—[TARGET PHASE]: Set the phase for resonant frequency.

This sets the phase for resonant frequency. Usually 0° should be used, but you can also set the phase shift portion depending on the measurement system.

- Setting procedure
 - <Numerical settings (immediate settings)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the phase for resonance with the numerical input palette.
 - [MODIFY] : Modify the phase for resonance with the knob or cursor keys.

The setting range is -179.999° to +180.000° and the setting resolution is 0.001°.

- [RESONANT TRACK]—[TOLERANCE]: Set the permissible error.

This sets the permissible error of the phase for tracking. Measurement is repeated while changing the frequency until the frequency comes within the permissible error set here.

- Setting procedure
 - <Numerical settings (immediate settings)>, <Numerical settings>
- The setting range is 0.001° to +179.999° and the setting resolution is 0.001°.
- Functions of function keys
 - [EDIT] : Set the permissible error with the numerical input palette.
 - [MODIFY] : Modify the permissible error with the knob or cursor keys.

- [RESONANT TRACK]–[POLARITY]: Set the phase characteristic polarity of the DUT.

This specifies the slope (polarity) of the DUT phase - frequency characteristic.

- Setting procedure

<List operations (immediate settings)>

- POSITIVE : Increase the phase as the frequency increases.
- NEGATIVE : Decrease the phase as the frequency increases.

- [RESONANT TRACK]–[CORRECTION FACTOR]: Set the correction factor.

This sets the correction factor (tracking sensitivity) for resonant frequency tracking. Usually, 100% is no problem, but tracking control may be unstable depending on the DUT or measurement speed setting. If instability is observed, reduce the correction factor.

- Setting procedure

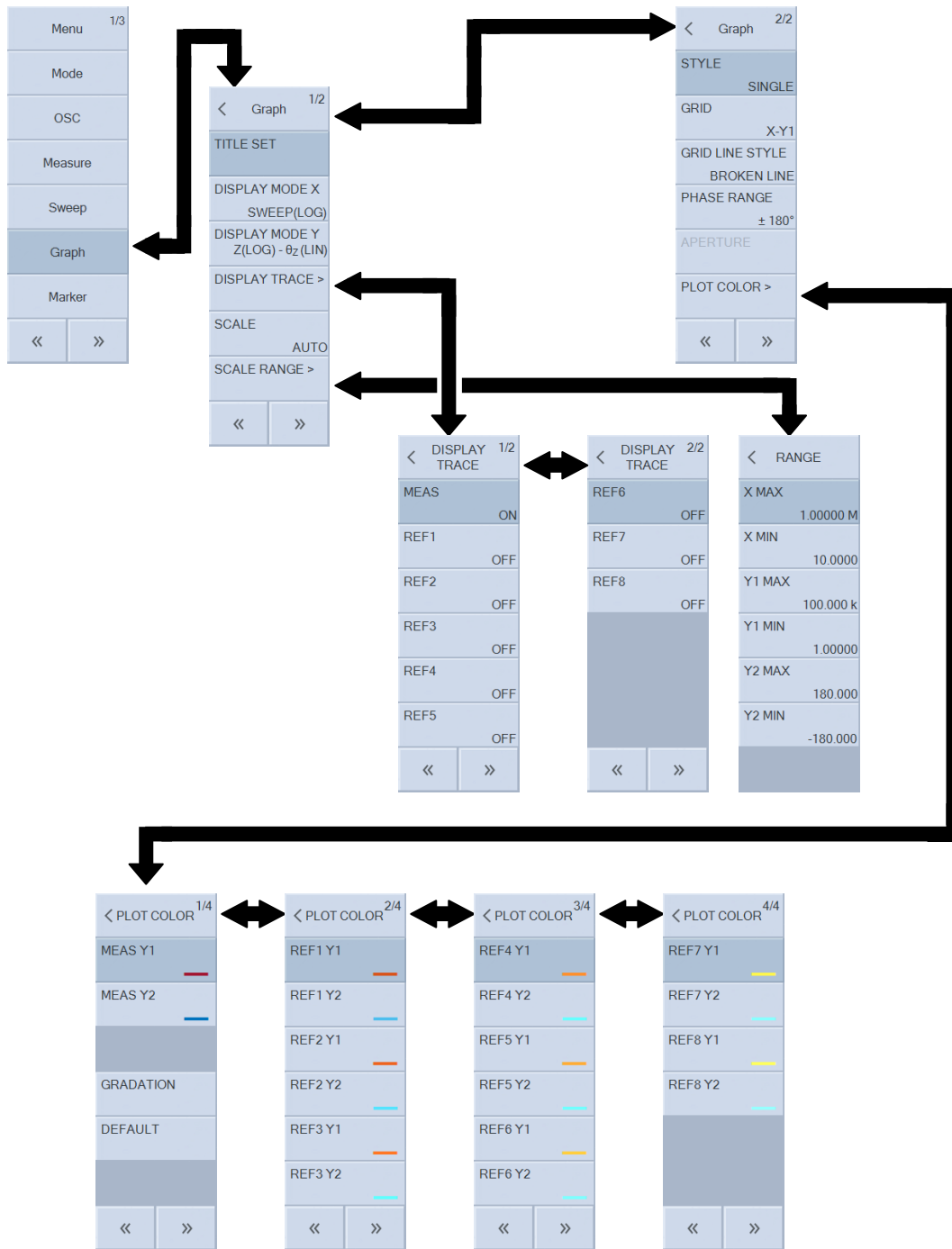
<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 1% to 100% and the setting resolution is 1%.

- Functions of function keys

- [EDIT] : Set the correction factor with the numerical input palette.
- [MODIFY] : Modify the correction factor with the knob or cursor keys.

3.5.5 Graph Menu



■ [TITLE SET]: Set the graph title.

This sets the graph title.

○ Setting procedure

<Text settings (requiring confirmation)>, <Text settings>

Up to 63 characters can be entered.

○ Functions of function keys

- [EDIT] : Set the title with the text input palette.
- [MODIFY] : Modify the title with the knob or cursor keys.

■ [DISPLAY MODE X]: Set the X-axis format.

This sets the format (type) of the X-axis.

○ Setting procedure

<Palette operations (immediate settings)>

There are formats that cannot be selected depending on the setting of the Y-axis format. For details, refer to “4.5 Setting Sweep Measurement”.

(Measurement modes: IMPD-EXT, IMPD-3T, and IMPD-2T)

- SWEEP : The X-axis is a sweep parameter (one of frequency, measurement signal amplitude, DC bias, and time).
- R : The X-axis is resistance.
- G : The X-axis is conductance.

(Measurement mode: G-PH)

- SWEEP : The X-axis is a sweep parameter (one of frequency, measurement signal amplitude, DC bias, and time).
- θ : The X-axis is phase.
- a : The X-axis is real part of gain.

(All measurement modes)

- [LOG] : The X-axis is the logarithmic axis.
- [LIN] : The X-axis is the linear axis.

■ [DISPLAY MODE Y] : Set the Y-axis formats.

This sets the format (type) of the Y1-axis and Y2-axis.

○ Setting procedure

<Palette operations (immediate settings)>

There are formats that cannot be selected depending on the setting of the X-axis format. For details, refer to “4.5 Setting Sweep Measurement”.

(Measurement modes: IMPD-EXT, IMPD-3T, and IMPD-2T)

- Z- θ_z : The Y1-axis is impedance (Ω) and the Y2-axis is phase ($^\circ$) of impedance.
- Y- θ_y : The Y1-axis is admittance (S) and the Y2-axis is phase ($^\circ$) of admittance.
- R-X : The Y1-axis is resistance (Ω) and the Y2-axis is reactance (Ω).
- G-B : The Y1-axis is conductance (S) and the Y2-axis is susceptance (S).
- C_S-R_S : The Y1-axis is series capacitance (F) and the Y2-axis is series resistance (Ω).
- C_S-D : The Y1-axis is series capacitance (F) and the Y2-axis is dissipation factor (unitless number).
- C_S-Q_C : The Y1-axis is series capacitance (F) and the Y2-axis is quality coefficient (unitless number).
- C_P-R_P : The Y1-axis is parallel capacitance (F) and the Y2-axis is parallel resistance (Ω).
- C_P-D : The Y1-axis is parallel capacitance (F) and the Y2-axis is dissipation factor (unitless number).
- C_P-Q_C : The Y1-axis is parallel capacitance (F) and the Y2-axis is quality coefficient (unitless number).

- L_S-R_S : The Y1-axis is series inductance (H) and the Y2-axis is series resistance (Ω).
- L_S-Q_L : The Y1-axis is series inductance (H) and the Y2-axis is quality coefficient (unitless number).
- L_P-R_P : The Y1-axis is parallel inductance (H) and the Y2-axis is parallel resistance (Ω).
- L_P-Q_L : The Y1-axis is parallel inductance (H) and the Y2-axis is quality coefficient (unitless number).
- ϵ_S-D_ϵ : The Y1-axis is relative permittivity (unitless number) and the Y2-axis is dissipation factor (unitless number).
- $\epsilon_S'-\epsilon_S''$: The Y1-axis is real part of relative permittivity (unitless number) and the Y2-axis is imaginary part of relative permittivity (unitless number).
- μ_S-D_μ : The Y1-axis is relative permeability (unitless number) and the Y2-axis is dissipation factor (unitless number).
- $\mu_S'-\mu_S''$: The Y1-axis is real part of relative permeability (unitless number) and the Y2-axis is imaginary part of relative permeability (unitless number).
- $V1-V2$: The Y1-axis is PORT1 amplitude (Vrms) and the Y2-axis is PORT2 amplitude (Vrms).
When the measurement mode is IMPD-EXT
- $V-I$: The Y1-axis is voltage amplitude (Vrms) and the Y2-axis is current amplitude (Arms).
When the measurement mode is IMPD-3T and IMPD-2T
- $FREQUENCY-\theta_Z$: The Y1-axis is frequency (Hz) and the Y2-axis is phase ($^\circ$) of impedance.
- X : The Y1-axis is reactance (Ω) and the Y2-axis is nothing.
- $-X$: The Y1-axis is reactance (Ω) with top and bottom inverted and the Y2-axis is nothing.
The upward direction of the Y1-axis is negative, and the downward direction is positive.
- B : The Y1-axis is susceptance (S) and the Y2-axis is nothing.

(Measurement mode: G-PH)

- $dBR-\theta$: The Y1-axis is gain (dB) and the Y2-axis is phase ($^\circ$).
- $R-\theta$: The Y1-axis is gain (unitless number) and the Y2-axis is the phase ($^\circ$).
- $a-b$: The Y1-axis is real part of gain (unitless number) and the Y2-axis is imaginary part of gain (unitless number).
- $dBR-GD$: The Y1-axis is gain (dB) and the Y2-axis is group delay (s).
- $R-GD$: The Y1-axis is gain (unitless number) and the Y2-axis is group delay (s).
- $V1-V2$: The Y1-axis is PORT1 amplitude (Vrms) and the Y2-axis is PORT2 amplitude (Vrms).
- $FREQUENCY-\theta$: The Y1-axis is frequency (Hz) and the Y2-axis is phase ($^\circ$).
- R : The Y1-axis is gain (unitless number) and the Y2-axis is nothing.
- dBR : The Y1-axis is gain (dB) and the Y2-axis is nothing.
- b : The Y1-axis is imaginary part of gain (unitless number) and the Y2-axis is nothing.

(All measurement modes)

- [Y1 LOG] : The Y1-axis is the logarithmic axis.
- [Y1 LIN] : The Y1-axis is the linear axis.
- [Y2 LOG] : The Y2-axis is the logarithmic axis.
- [Y2 LIN] : The Y2-axis is the linear axis.

(Supplementary explanation)

The V1, V2, V, and I measurement items are the voltage and current amplitude values measured by this instrument. The impedance and gain are calculated and displayed based on these measurement values, but the (V÷I) and Z and the (V1÷V2) and R do not match exactly because various error processing is performed inside this instrument. In particular, please note that the difference between both of them will be extremely large when open/short/load correction, port extension, and equalizing are performed.

- [DISPLAY TRACE]: Set the display of data.
- [DISPLAY TRACE]–[MEAS]: Set the display of measurement data.
- [DISPLAY TRACE]–[REF1]: Set the display of reference data 1.
- [DISPLAY TRACE]–[REF2]: Set the display of reference data 2.
- :
- [DISPLAY TRACE]–[REF8]: Set the display of reference data 8.

This selects the data to display on the graph.

○ Setting procedure

<List operations (immediate settings)>

- ON : Display data.
- OFF : Do not display data.

For details on graph traces, refer to “4.5 Setting Sweep Measurement”.

- [SCALE]: Set the graph axes.

This selects automatic setting or manual setting of the X, Y1, and Y2 axes of a graph.

○ Setting procedure

<List operations (immediate settings)>

- AUTO : Automatically determine (auto scale) the axis ranges so that all of the data is displayed.
- AUTO-R : Auto scale to axis ranges suitable for an Nyquist plot and Cole-cole plot.
The X-axis and Y-axes become the same scale.
- FIX : Fix the graph axis range. This is set manually.

- [SCALE RANGE]: Set the graph axis ranges.
- [SCALE RANGE]—[X MAX]: Set the maximum X-axis value.
- [SCALE RANGE]—[X MIN]: Set the minimum X-axis value.
- [SCALE RANGE]—[Y1 MAX]: Set the maximum Y1-axis value.
- [SCALE RANGE]—[Y1 MIN]: Set the minimum Y1-axis value.
- [SCALE RANGE]—[Y2 MAX]: Set the maximum Y2-axis value.
- [SCALE RANGE]—[Y2 MIN]: Set the minimum Y2-axis value.

This sets the range of each axis.

- Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

- Functions of function keys

- [DATA -> SCALE] : Set the X-, Y1-, and Y2-axis ranges according to the data.
- [X DATA -> SCALE] : Set the X-axis range according to the data.
- [X DATA MAX-> SCALE] : Set the maximum X-axis value according to the data.
- [X DATA MIN-> SCALE] : Set the minimum X-axis value according to the data.
- [Y1 DATA -> SCALE] : Set the Y1-axis range according to the data.
- [Y1 DATA MAX-> SCALE] : Set the maximum Y1-axis value according to the data.
- [Y1 DATA MIN-> SCALE] : Set the minimum Y1-axis value according to the data.
- [Y2 DATA -> SCALE] : Set the Y2-axis range according to the data.
- [Y2 DATA MAX-> SCALE] : Set the maximum Y2-axis value according to the data.
- [Y2 DATA MIN-> SCALE] : Set the minimum Y2-axis value according to the data.
- [EDIT] : Set the axis ranges with the numerical input palette.
- [MODIFY] : Modify the axis ranges with the knob or cursor keys.

- [STYLE]: Set the graph style.

This selects the graph style for displaying measurement data.

- Setting procedure

<List operations (immediate settings)>

- SINGLE : Display one graph.
- SPLIT : Display two graphs, one above the other.

- [GRID]: Set the grid display targets.

This sets the axes for which to display grids.

- Setting procedure

<List operations (immediate settings)>

- OFF : Do not display a grid.
- X : Display a grid for the X-axis only.
- X-Y1 : Display grids for the X-axis and Y1-axis.
- X-Y2 : Display grids for the X-axis and Y2-axis.
- X-Y1-Y2: Display grids for the X-axis, Y1-axis and Y2-axis.

■ [GRID LINE STYLE]: Set the grid lines.

This sets the grid line style.

○ Setting procedure

<List operations (immediate settings)>

- BROKEN LINE : Display a broken-line grid.
- SOLID LINE : Display a solid-line grid.

■ [PHASE RANGE]: Set the phase display range.

This sets the phase display range.

○ Setting procedure

<List operations (immediate settings)>

- $\pm 180^\circ$: Display the phase within the range of $-180^\circ \leq \theta < +180^\circ$.
- 0° to $+360^\circ$: Display the phase within the range of $0^\circ \leq \theta < +360^\circ$.
- -360° to 0° : Display the phase within the range of $-360^\circ \leq \theta < 0^\circ$.
- UNWRAP : Display the unwrapped phase.

○ Functions of function keys

- [+360°] : Display the phase with 360° added.
- [-360°] : Display the phase with 360° subtracted.

(Supplementary explanation)

This function is valid when the phase display range is UNWRAP.

■ [APERTURE]: Set the number of moving average data points (aperture).

This sets the number of moving average phase data points (number of frequency measurement points) for obtaining the group delay characteristic. Although this affects the display of the group delay, it does not affect the display of the phase. The group delay characteristic is smoother when the aperture is increased, but sudden changes are not observed.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is the even values of 2 to 200 and the setting resolution is 2.

○ Functions of function keys

- [EDIT] : Set the aperture with the numerical input palette.
- [MODIFY] : Modify the aperture with the knob or cursor keys.

- [PLOT COLOR]: Set the data trace colors.
- [PLOT COLOR]—[MEAS Y1]: Set the color of Y1 of the measurement data.
- [PLOT COLOR]—[MEAS Y2]: Set the color of Y2 of the measurement data.
- [PLOT COLOR]—[REF1 Y1]: Set color of Y1 of reference data 1.
- [PLOT COLOR]—[REF1 Y2]: Set color of Y2 of reference data 1.

...

- [PLOT COLOR]—[REF8 Y1]: Set color of Y1 of reference data 8.
- [PLOT COLOR]—[REF8 Y2]: Set color of Y2 of reference data 8.

- Functions of function keys

- [(Standard Color 1)] : Standard trace color 1
- [(Standard Color 2)] : Standard trace color 2

...

- [(Standard Color 9)] : Standard trace color 9
- [(Arbitrary Color)] : Display the color selection palette.

- [PLOT COLOR]—[GRADATION]: Automatically set the reference data trace colors by changing the gradation.

This automatically sets the colors of the REF1 to REF8 reference data traces based on the color of the MEAS trace by changing the gradation. The colors are set automatically by making them lighter in the order of REF1 to REF8.

- Setting procedure

<Execution operations (requiring confirmation)>

- Functions of function keys

- [EXEC] : Automatically set the reference data trace colors by changing the gradation.

- [PLOT COLOR]—[DEFAULT]: Return the data trace colors to the initial settings.

This returns the colors of the MEAS and REF1 to REF8 traces to the initial settings (factory default values). Settings other than the trace colors are not changed.

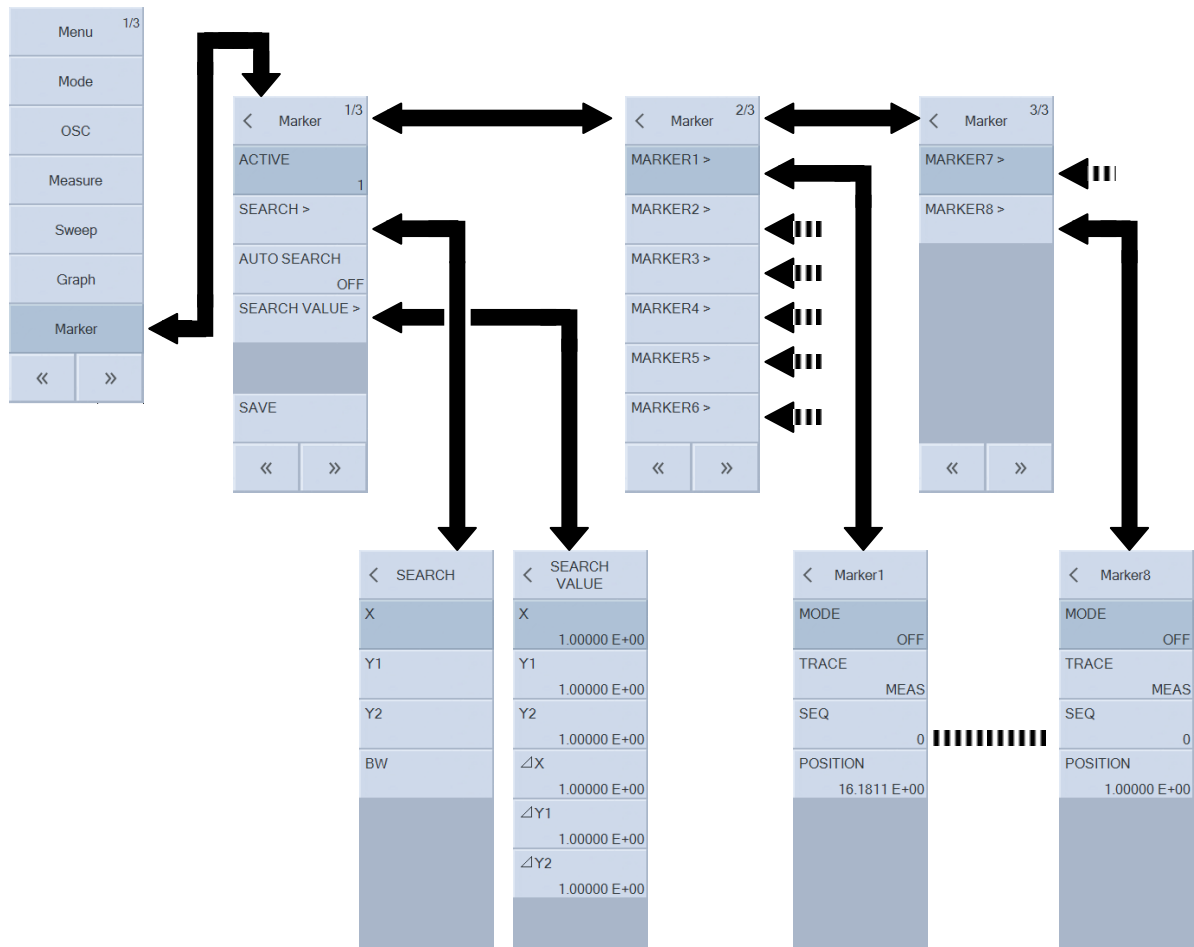
- Setting procedure

<Execution operations (requiring confirmation)>

- Functions of function keys

- [EXEC] : Initialize the data trace colors.

3.5.6 Marker Menu



■ [ACTIVE]: Set the active marker.

This specifies the active marker (move the focus by knob operation to specify the marker for which to display read values on the graph).

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 1 (= MARKER1) to 8 (= MARKER8) and the setting resolution is 1.

○ Functions of function keys

- [EDIT] : Set the active marker with the numerical input palette.
- [MODIFY] : Modify the active marker with the knob or cursor keys.

■ [SEARCH]: Perform a marker search.

This performs a marker search. Select the search method with the function keys. Tapping on a function key begins a search and moves the marker to the data position of the search result. For details on marker operations and searches, refer to “1.7 Marker Operations” in Instruction Manual (Advanced).

■ [SEARCH]—[X]: Execute an X-axis search.

○ Setting procedure

<Execution operations (immediate execution)>

○ Functions of function keys

(When the graph X-axis is SWEEP)

- [X MIN] : Move to the position at which the X value is the minimum.
- [X MAX] : Move to the position at which the X value is the maximum.
- [X] : Move to the position of the X value set by [SEARCH VALUE]—[X].
If there are multiple positions, the marker moves to the position where the Y value is the minimum.
- [Δ X] : Move to the position where the difference from MARKER1 is the value set by [SEARCH VALUE]—[Δ X]. If there are multiple positions, the marker moves to the position where the Y value is the minimum.

(When the graph X-axis is other than SWEEP, the following search functions are also available.)

- [PREV X] : Move to the position of the next smaller Y value.
- [NEXT X] : Move to the position of the next larger Y value.
- [PREV Δ X] : Move to the position of the next smaller Y value of [Δ X].
- [NEXT Δ X] : Move to the position of the next larger Y value of [Δ X].
- [X BOTTOM] : Move to the position where the X value is the minimal. If there are multiple positions, the marker moves to the position where the X value is the minimum.
- [PREV X BOTTOM] : Move to the position of the next larger X value of [X BOTTOM].
- [NEXT X BOTTOM] : Move to the position of the next smaller X value of [X BOTTOM].
- [X PEAK] : Move to the position where the X value is the maximal. If there are multiple positions, the marker moves to the position where the X value is the maximum.
- [PREV X PEAK] : Move to the position of the next smaller X value of [X PEAK].
- [NEXT X PEAK] : Move to the position of the next larger X value of [X PEAK].

(Supplementary explanation)

The marker that moves is the active marker.

■ [SEARCH]—[Y1]: Execute a Y1-axis search.

○ Setting procedure

<Execution operations (immediate execution)>

○ Functions of function keys

- [Y1 MIN] : Move to the position at which the Y1 value is the minimum.
- [Y1 MAX] : Move to the position at which the Y1 value is the maximum.
- [Y1] : Move to the position of the Y1 value set by [SEARCH VALUE]—[Y1]. If there are multiple positions, the marker moves to the position where the X value is the minimum.

- [PREV Y1] : Move to the position of the next smaller X value of [Y1].
- [NEXT Y1] : Move to the position of the next larger X value of [Y1].
- [Δ Y1] : Move to the position where the difference from MARKER1 is the value set by [SEARCH VALUE] – [Δ Y1]. If there are multiple positions, the marker moves to the position where the X value is the minimum.
- [PREV Δ Y1] : Move to the position of the next smaller X value of [Δ Y1].
- [NEXT Δ Y1] : Move to the position of the next larger X value of [Δ Y1].
- [Y1 BOTTOM] : Move to the position where the Y1 value is the minimal. If there are multiple positions, the marker moves to the position where the Y1 value is the minimum.
- [PREV Y1 BOTTOM] : Move to the position of the next smaller Y1 value of [Y1 BOTTOM].
- [NEXT Y1 BOTTOM] : Move to the position of the next larger Y1 value of [Y1 BOTTOM].
- [Y1 PEAK] : Move to the position where the Y1 value is the maximal. If there are multiple positions, the marker moves to the position where the Y1 value is the maximum.
- [PREV Y1 PEAK] : Move to the position of the next smaller Y1 value of [Y1 PEAK].
- [NEXT Y1 PEAK] : Move to the position of the next larger Y1 value of [Y1 PEAK].

(Supplementary explanation)

The marker that moves is the active marker.

■ [SEARCH] – [Y2]: Execute a Y2-axis search.

○ Setting procedure

<Execution operations (immediate execution)>

○ Functions of function keys

(When the graph X-axis is SWEEP)

- [Y2 MIN] : Move to the position at which the Y2 value is the minimum.
- [Y2 MAX] : Move to the position at which the Y2 value is the maximum.
- [Y2] : Move to the position of the Y2 value set by [SEARCH VALUE] – [Y2]. If there are multiple positions, the marker moves to the position where the X value is the minimum.
- [PREV Y2] : Move to the position of the next smaller X value of [Y2].
- [NEXT Y2] : Move to the position of the next larger X value of [Y2].
- [Δ Y2] : Move to the position where the difference from MARKER1 is the value set by [SEARCH VALUE] – [Δ Y2]. If there are multiple positions, the marker moves to the position where the X value is the minimum.
- [PREV Δ Y2] : Move to the position of the next smaller X value of [Δ Y2].
- [NEXT Δ Y2] : Move to the position of the next larger X value of [Δ Y2].
- [Y2 BOTTOM] : Move to the position where the Y2 value is the minimal. If there are multiple positions, the marker moves to the position where

the Y2 value is the minimum.

- [PREV Y2 BOTTOM] : Move to the position of the next smaller Y2 value of [Y2 BOTTOM].
- [NEXT Y2 BOTTOM] : Move to the position of the next larger Y2 value of [Y2 BOTTOM].
- [Y2 PEAK] : Move to the position where the Y2 value is the maximal. If there are multiple positions, the marker moves to the position where the Y2 value is the maximum.
- [PREV Y2 PEAK] : Move to the position of the next smaller Y2 value of [Y2 PEAK].
- [NEXT Y2 PEAK] : Move to the position of the next larger Y2 value of [Y2 PEAK].

(Supplementary explanation)

When the graph X-axis is other than SWEEP, there are no function keys (no Y2-axis search function).

The marker that moves is the active marker.

■ [SEARCH]—[BW]: Execute a special marker search.

○ Setting procedure

<Execution operations (immediate execution)>

○ Functions of function keys

- [BW1] : Execute a marker search for LPF and HPF.
- [BW2] : Execute a marker search for BPF.
- [BW3] : Execute a marker search for BEF.

For details on BW searches, refer to “1.7 Marker Operations” in Instruction Manual (Advanced).

■ [AUTO SEARCH]: Set to search automatically when a sweep ends.

This enables a marker search to be executed automatically when sweep measurement ends.

The search method will be that set in [AUTO SEARCH].

○ Setting procedure

<List operations (immediate settings)>

The following parameters can be set. For explanations on searches, refer to [SEARCH X], [SEARCH Y1], and [SEARCH Y2].

- OFF : Do not search automatically.
- X MAX : Automatically search for the maximum X value.
- X MIN : Automatically search for the minimum X value.
- X PEAK : Automatically search for the maximal X value.
- X BOTTOM : Automatically search for the minimal X value.
- Y1 MAX : Automatically search for the maximum Y1 value.
- Y1 MIN : Automatically search for the minimum Y1 value.
- Y1 PEAK : Automatically search for the maximal Y1 value.
- Y1 BOTTOM : Automatically search for the minimal Y1 value.
- Y2 MAX : Automatically search for the maximum Y2 value.
- Y2 MIN : Automatically search for the minimum Y2 value.

- Y2 PEAK : Automatically search for the maximal Y2 value.
- Y2 BOTTOM : Automatically search for the minimal Y2 value.
- X : Automatically search for the X value.
- Y1 : Automatically search for the Y1 value.
- Y2 : Automatically search for the Y2 value.
- ΔX : Automatically search for the ΔX value.
- $\Delta Y1$: Automatically search for the $\Delta Y1$ value.
- $\Delta Y2$: Automatically search for the $\Delta Y2$ value.
- BW1 : Execute a marker search for LPF and HPF. (MARKER1, MARKER2)
- BW2 : Automatically search for BPF. (MARKER1, MARKER2, MARKER3)
- BW3 : Automatically search for BEF. (MARKER1, MARKER2, MARKER3)

(Supplementary explanation)

The marker that moves is the active marker.

- [SEARCH VALUE] : Set the search values.
- [SEARCH VALUE]—[X] : Set the X search value.
- [SEARCH VALUE]—[Y1] : Set the Y1 search value.
- [SEARCH VALUE]—[Y2] : Set the Y2 search value.
- [SEARCH VALUE]—[ΔX] : Set the ΔX search value.
- [SEARCH VALUE]—[$\Delta Y1$] : Set the $\Delta Y1$ search value.
- [SEARCH VALUE]—[$\Delta Y2$] : Set the $\Delta Y2$ search value.

This sets the values to be searched by marker.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [EDIT] : Set the search values with the numerical input palette.
- [MODIFY] : Modify the search values with the knob or cursor keys.

- [SAVE]: Save the marker values to a USB memory device.

○ Setting procedure

<Text settings (requiring confirmation)>, <Text settings>

Input of the extension (.MKR.CSV) is not required.

○ Functions of function keys

- [SAVE] : Save the marker information to a USB memory device.

- [MARKER1] to [MARKER8]: Set the markers.

- [MARKER1]—[MODE]: Set the marker 1 mode.

This sets the display mode of marker 1.

○ Setting procedure

<List operations (immediate settings)>

- OFF : Hide the marker.

- ON : Display the marker as a normal marker.

■ [MARKER*n*]—[MODE]: Set the marker *n* mode. *n*: 2 to 8

This sets the display mode of markers 2 to 8.

○ Setting procedure

<List operations (immediate settings)>

- OFF : Hide the marker.
- NORMAL : Display the marker as a normal marker.
- \triangleleft : Display the information of the difference from MARKER1.
- \triangleleft TRKG : Display the information of the difference from MARKER1. If MARKER1 is moved, the marker is moved to follow MARKER1 so that the SWEEP value difference is kept constant.

■ [MARKER*n*]—[TRACE]: Set the marker *n* target data. *n*: 1 to 8

This sets the data trace (target) to be read by marker.

○ Setting procedure

<List operations (immediate settings)>

- MEAS : Read the values of the measurement data trace.
- REF1 : Read the values of reference data trace 1.
- REF2 : Read the values of reference data trace 2.
- :
- REF8 : Read the values of reference data trace 8.

■ [MARKER*n*]—[SEQ]: Set marker *n* target sequence number. *n*: 1 to 8

This sets the sequence number (1 to 32) of the data (target) to be read by marker.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [EDIT] : Set the target sequence number with the numerical input palette.
- [MODIFY] : Modify the target sequence number with the knob or cursor keys.

■ [MARKER*n*]—[POSITION]: Set the marker *n* SWEEP values. *n*: 1 to 8

This places the target marker at the nearest SWEEP value of the set values.

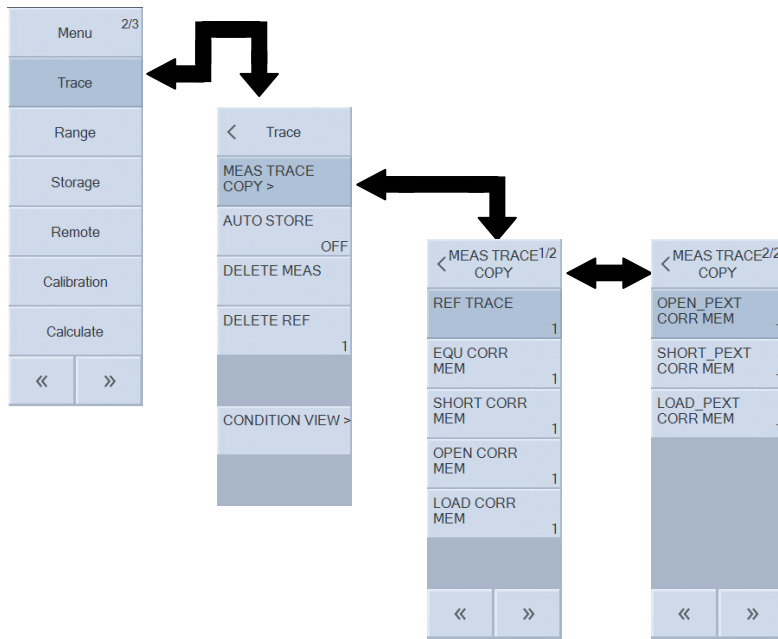
○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

○ Functions of function keys

- [MKR1 -> POSITION] : Move the target marker to the current MARKER1 position.
This is not displayed when the marker is a \triangleleft marker or \triangleleft TRKG marker.
- [EDIT] : Set the marker position with the numerical input palette.
- [MODIFY] : Modify the marker position with the knob or cursor keys.

3.5.7 Trace Menu



■ [MEAS TRACE COPY]: Select the storage location for measurement data.
This copies the measurement data (MEAS DATA).

■ [MEAS TRACE COPY]–[REF TRACE]: Copy to reference data.

○ Setting procedure

<Execution operations (immediate execution)>, <Numerical settings (requiring confirmation)>, <Numerical settings>

The setting range is 1 (= REF1) to 8 (= REF8) and the setting resolution is 1.

○ Functions of function keys

- [COPY] : Copy to the specified reference data.
- [EDIT] : Set the reference data copy destination with the numerical input palette.
- [MODIFY] : Modify the reference data copy destination with the knob or cursor keys.

■ [MEAS TRACE COPY]–[EQU CORR MEM]: Copy to equalizing data.

This can be set only when the measurement mode is G–PH.

○ Setting procedure

<Execution operations (immediate execution)>

○ Functions of function keys

- [COPY] : Copy to the specified equalizing data.

The equalizing data number (1 to 32) of the copy destination is the number specified in [Calibration]–[EQUALIZING].

■ [MEAS TRACE COPY]–[SHORT CORR MEM]: Copy to short correction data.

■ [MEAS TRACE COPY]–[OPEN CORR MEM]: Copy to open correction data.

■ [MEAS TRACE COPY]–[LOAD CORR MEM]: Copy to load correction data.

- [MEAS TRACE COPY]—[OPEN_PEXT CORR MEM]:
Copy to port extended end open correction data.
- [MEAS TRACE COPY]—[SHORT_PEXT CORR MEM]:
Copy to port extended end short correction data.
- [MEAS TRACE COPY]—[LOAD_PEXT CORR MEM]:
Copy to port extended end load correction data.

This can be set only when the measurement mode is IMPD-EXT, IMPD-3T, and IMPD-2T.

- Setting procedure
<Execution operations (immediate execution)>
- Functions of function keys
 - [COPY] : Copy to the corresponding specified correction data.

The copy destination correction data numbers (1 to 32) are the numbers specified in the following.

- [Calibration]—[OPEN CORR] ; Open correction data
- [Calibration]—[SHORT CORR] ; Short correction data
- [Calibration]—[LOAD CORR] ; Load correction data
- [Calibration]—[PORT EXT]—[OPEN_PEXT CORR];
Port extended end open correction data
- [Calibration]—[PORT EXT]—[SHORT_PEXT CORR];
Port extended end short correction data
- [Calibration]—[PORT EXT]—[LOAD_PEXT CORR];
Port extended end load correction data

For the equalizing, open correction, short correction, and load correction operating procedures, refer to “1.8 Error Correction” in Instruction Manual (Advanced).

- [AUTO STORE]: Set automatically copying of the measurement data to the reference data. This is a function to automatically copy the MEAS data to the REF1 data, the original REF1 data to the REF2 data, the original REF2 data to the REF3 data, and so on every time one sweep finishes. The last REF_n data is discarded.
- Setting procedure
<Numerical settings (immediate execution)>, <Numerical settings>
- Functions of function keys
 - [ON] / [OFF] : Set the automatic copy function to ON or OFF.
 - [EDIT] : Set the last reference data copy destination with the numerical input palette.
 - [MODIFY] : Modify the last reference data copy destination with the knob or cursor keys.

The setting range is 1 to 8 and OFF. Specify the last REF data number to copy data. If OFF is specified, the automatic copy function will turn off.

- [DELETE MEAS]: Delete the measurement data.

This deletes the measurement data (MEAS DATA) from memory. The graph traces are also deleted. The data cannot be recovered after deletion, so save the data to a USB memory

device or other external storage device if necessary.

- Setting procedure
 - <Execution operations (requiring confirmation)>
- Functions of function keys
 - [DELETE] : Delete the measurement data.

■ [DELETE REF]: Delete the reference data.

This deletes the reference data (REF DATA) from memory. The graph traces are also deleted. The data cannot be recovered after deletion, so save the data to a USB memory device or other external storage device if necessary.

- Setting procedure
 - <Execution operations (requiring confirmation)>, <Numerical settings (requiring confirmation)>, <Numerical settings>

The setting range is 1 (= REF1) to 8 (= REF8) and the setting resolution is 1.

- Functions of function keys
 - [DELETE] : Delete the specified reference data.
 - [EDIT] : Set the reference data to delete with the numerical input palette.
 - [MODIFY] : Modify the reference data to delete with the knob or cursor keys.

■ [CONDITION VIEW]: Display the settings at the time of data measurement.

This displays the conditions (excerpt) set at the time the current active data (MEAS DATA or REF DATA) was measured. Please note that the displayed setting conditions are not the current settings of this instrument.

- Setting procedure
 - <Execution operations (immediate execution)>

For sequence measurement data, the measurement conditions for each measurement memory number are displayed. The memory number for which to display measurement conditions can be changed with the function keys.

- Functions of function keys
 - [PREV] : Display the measurement conditions for the previous memory number.
(This is enabled for sequence measurement data.)
 - [NEXT] : Display the measurement conditions for the next memory number.
(This is enabled for sequence measurement data.)

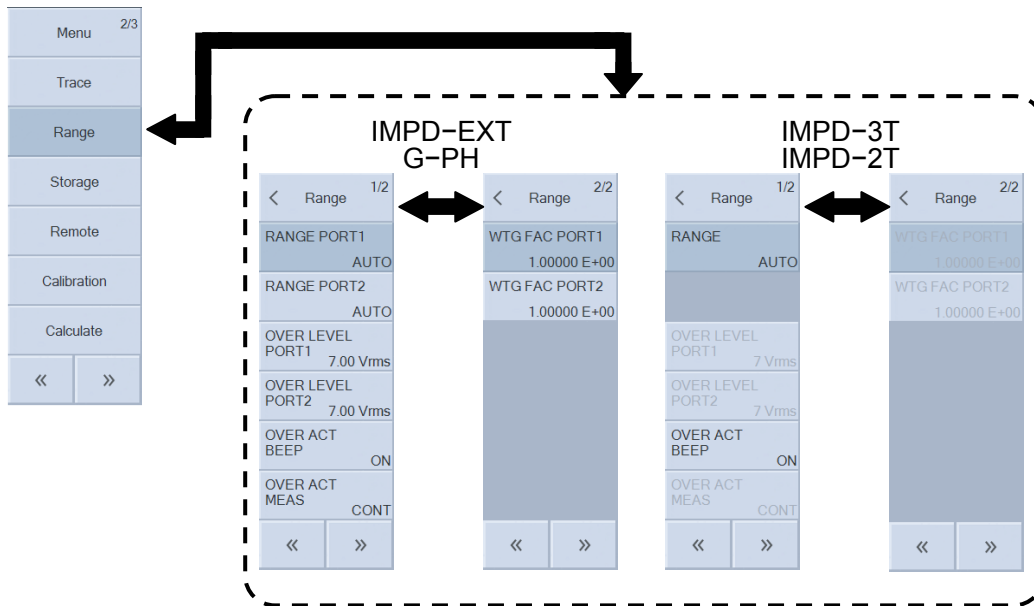
(Supplementary explanation)

- FREQUENCY / AMPLITUDE / DC BIAS displayed in CONDITION VIEW indicate the values set at the time of measurement even if signal output (OSC) was off at the time of measurement.
- FREQUENCY of the frequency sweep data is not the frequency at the time of measurement. Likewise, AMPLITUDE in the measurement signal amplitude sweep data and DC BIAS in the DC bias sweep data are not the conditions at the time of

measurement.

- Some measurement conditions are indicated as “NaN” (Not a Number) depending on the data. For example, MEASURE TIME is indicated as “NaN” for the data of equivalent circuit estimation results (refer to “1.11 Equivalent Circuit Estimation” in Instruction Manual (Advanced)).

3.5.8 Range Menu



- [RANGE PORT1]: Set the port 1 measurement range.
- [RANGE PORT2]: Set the port 2 measurement range.

This sets the measurement range. (When measurement mode is IMPD-EXT and G-PH)

- Setting procedure

<List operations (immediate settings)>

- AUTO : Set auto range.
- 10 mVrms to 7 Vrms: Set a fixed range.

- [RANGE]: Set the measurement range.

This sets the measurement range. (When measurement mode is IMPD-3T and IMPD-2T)

- Setting procedure

<List operations (immediate settings)>

- AUTO : Set auto range.
- 10 Ω to 1 M Ω : Set a fixed range.

When the measurement mode is IMPD-2T, the setting range is AUTO and 1 Ω to 1 k Ω .

- [OVER LEVEL PORT1]: Set the level for port 1 over-level detection.
- [OVER LEVEL PORT2]: Set the level for port 2 over-level detection.

This sets the level for over-level detection. It can be set when the measurement mode is IMPD-EXT and G-PH.

- Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

- Functions of function keys

- [EDIT] : Set the detection level with the numerical input palette.
- [MODIFY] : Modify the detection level with the knob or cursor keys.

The setting range is 0 to 7 Vrms and the setting resolution is 3 digits or 1 μ Vrms, whichever

is the largest.

- [OVER ACT BEEP]: Set the beep operation for over-level detection.

This sets the beep operation for over-level detection.

- Setting procedure

<List operations (immediate settings)>

- ON : Sound a beep upon over-level detection.
- OFF : Do not sound a beep upon over-level detection.

- [OVER ACT MEAS]: Set the measurement operation for when over-level detection.

This sets the measurement operation for when over-level detection.

- Setting procedure

<List operations (immediate settings)>

- CONT : Continue measurement even when over-level detection.
- STOP : Stop measurement upon over-level detection.

If you set this to STOP and also set [OSC]-[ON/OFF SYNC] to SYNC(AC+DC) or SYNC(AC), measurement signal output turns off automatically upon over-level detection.

- [WTG FAC PORT1]: Set the PORT1 weighting factor.

- [WTG FAC PORT2]: Set the PORT2 weighting factor.

This value serves as a multiplier for the measurement result. It can be used as a simple correction factor for when a probe, amplifier, or shunt resistor is connected to the DUT. This can be set when the measurement mode is IMPD-EXT and G-PH.

- Setting procedure

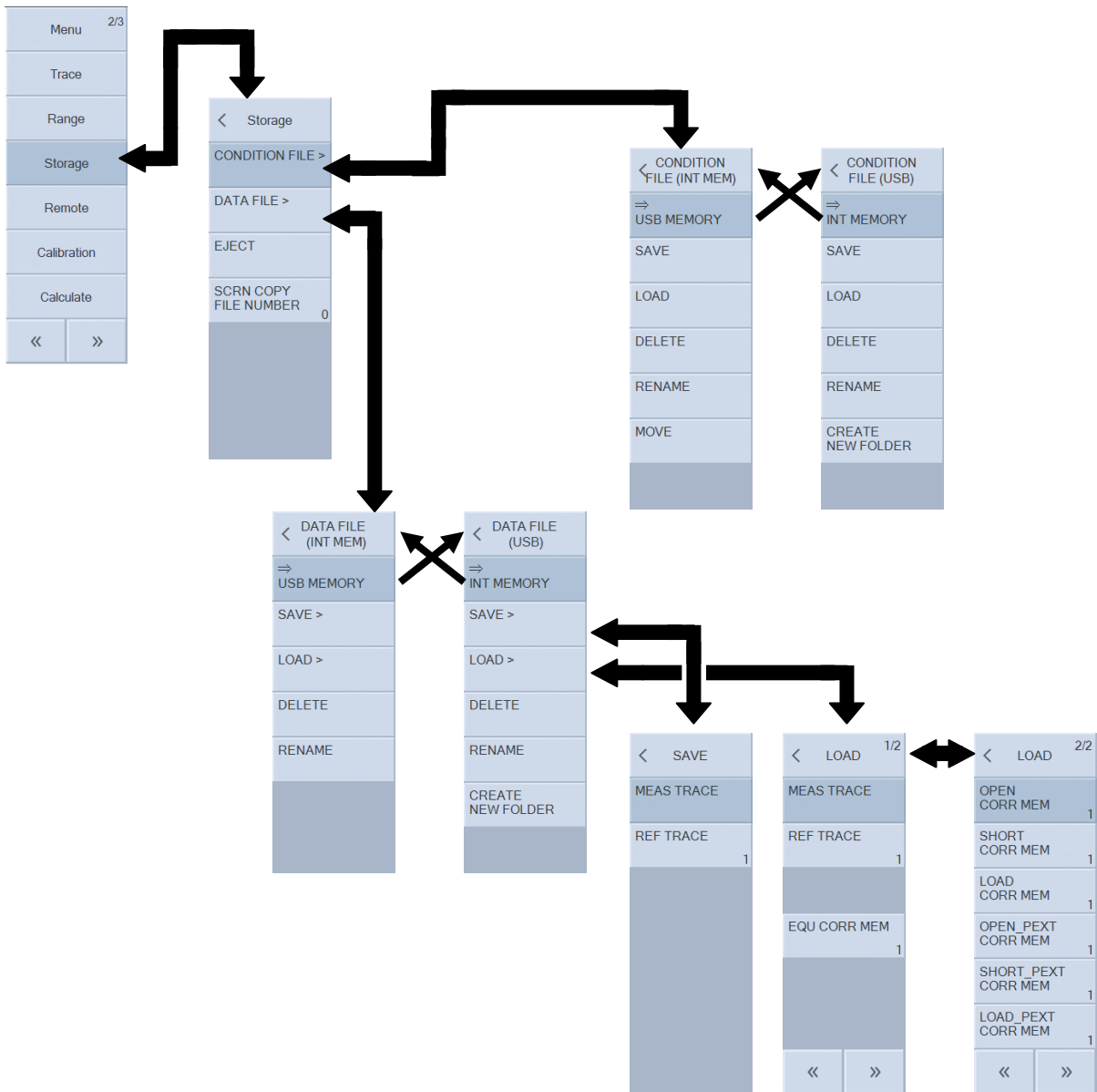
<Numerical settings (immediate settings)>, <Numerical settings>

- Functions of function keys

- [EDIT] : Set the weighting value with the numerical input palette.
- [MODIFY] : Modify the weighting value with the knob or cursor keys.

The setting range is $\pm(1.00000E-15$ to $999.999E+9)$ and the setting resolution is 6 digits or $1E-15$, whichever is the largest.

3.5.9 Storage Menu



For details on operations, refer to “1.17 Memory Operations” in Instruction Manual (Advanced).

- [CONDITION FILE]: Perform setting condition file operations.
Perform operations such as saving and loading the setting information of this instrument.
- [CONDITION FILE]—[⇒ USB MEMORY]: Switch to the menu for performing measurement condition file operations for a USB memory device.
 - Setting procedure
<List operations (immediate execution)>
- [CONDITION FILE]—[⇒ INT MEMORY]: Switch to the menu for performing measurement condition file operations for internal memory.

- Setting procedure
 - <List operations (immediate execution)>

■ [CONDITION FILE]—[SAVE]: Save the measurement conditions.

This saves a measurement condition file to the internal memory or a USB memory device.

- Setting procedure
 - <Execution operations (requiring confirmation)>, <Text settings (requiring confirmation)>
- Functions of function keys
 - [SAVE] : Save measurement conditions.

■ [CONDITION FILE]—[LOAD]: Load measurement conditions.

This loads a measurement condition file from the internal memory or a USB memory device.

- Setting procedure
 - <Execution operations (requiring confirmation)>
- Functions of function keys
 - [LOAD] : Load measurement conditions.

■ [CONDITION FILE]—[DELETE]: Delete a measurement condition file.

This deletes a measurement condition file from the internal memory or a USB memory device.

- Setting procedure
 - <Execution operations (requiring confirmation)>
- Functions of function keys
 - [DELETE] : Delete a measurement condition file.

■ [CONDITION FILE]—[RENAME]: Rename a measurement condition file.

This renames a measurement condition file when the target is a USB memory device. It renames a file title when the target is the internal memory.

- Setting procedure
 - <Execution operations (requiring confirmation)>, <Text settings (requiring confirmation)>
- Functions of function keys
 - [RENAME] : Rename a measurement condition file (USB memory device) or title (internal memory).

■ [CONDITION FILE]—[MOVE]: Move a measurement condition file (internal memory).

This move a measurement condition file in the internal memory to another position.

For sequence measurement, the measurement is performed by loading the settings in order from internal memory number 1. Use this function to change the order of measurement conditions for sequence measurement.

- Setting procedure
 - <Execution operations (immediate execution)>
- Functions of function keys
 - [MOVE UP] : The selected measurement condition memory changes positions with the memory above.
 - [MOVE DOWN] : The selected measurement condition memory changes positions with the memory below.
- [CONDITION FILE]—[CREATE NEW FOLDER] : Create a sub-folder (USB memory device).
 - Setting procedure
 - <Execution operations (immediate execution)>, <Text settings (requiring confirmation)>
 - Functions of function keys
 - [CREATE] : Create a new folder.

- [DATA FILE]: Perform data file operations.
This performs operations such as saving and loading the measurement data.

- [DATA FILE]—[⇒ USB MEMORY]: Switch to the menu for performing data file operations for a USB memory device.
 - Setting procedure
 - <List operations (immediate execution)>

- [DATA FILE]—[⇒ INT MEMORY]: Switch to the menu for performing data file operations for internal memory.
 - Setting procedure
 - <List operations (immediate execution)>

- [DATA FILE]—[SAVE]: Save data.
- [DATA FILE]—[SAVE]—[MEAS TRACE]: Save measurement data.
This saves measurement data to the internal memory or a USB memory device.
 - Setting procedure
 - <Execution operations (requiring confirmation)>, <Text settings (requiring confirmation)>
 - Functions of function keys
 - [SAVE] : Save measurement data.

- [DATA FILE]—[SAVE]—[REF TRACE]: Save reference data.

This saves reference data to the internal memory or a USB memory device.

- Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>, <Text settings (requiring confirmation)>, <Execution operations (requiring confirmation)>

- Functions of function keys

- [SAVE] : Save reference data.
- [EDIT] : Set the reference data number with the numerical input palette.
- [MODIFY] : Modify the reference data number with the knob or cursor keys.

- [DATA FILE]—[LOAD]: Load data.

- [DATA FILE]—[LOAD]—[MEAS TRACE]: Load to measurement data.

This loads measurement data from the internal memory or a USB memory device.

- Setting procedure

<Execution operations (requiring confirmation)>

- Functions of function keys

- [LOAD] : Load measurement data.

- [DATA FILE]—[LOAD]—[REF TRACE]: Load to reference data.

This loads reference data from the internal memory or a USB memory device.

- Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>, <Execution operations (requiring confirmation)>

- Functions of function keys

- [LOAD] : Load reference data.
- [EDIT] : Set the reference data number with the numerical input palette.
- [MODIFY] : Modify the reference data number with the knob or cursor keys.

- [DATA FILE]—[LOAD]—[EQU CORR MEM] : Load to equalizing data.

- [DATA FILE]—[LOAD]—[OPEN CORR MEM] : Load to open correction data.

- [DATA FILE]—[LOAD]—[SHORT CORR MEM] : Load to short correction data.

- [DATA FILE]—[LOAD]—[LOAD CORR MEM] : Load to load correction data.

- [DATA FILE]—[LOAD]—[OPEN_PEXT CORR MEM]

: Load to port extended end open correction data.

- [DATA FILE]—[LOAD]—[SHORT_PEXT CORR MEM]:

: Load to port extended end short correction data.

- [DATA FILE]—[LOAD]—[LOAD_PEXT CORR MEM]:

: Load to port extended end load correction data.

This loads each correction data from the internal memory or a USB memory device. The [EQU CORR MEM] load operation can be performed when the measurement mode is G-PH, and the load operations for other correction data can be performed when the measurement

mode is IMPD-EXT, IMPD-3T, and IMPD-2T.

- Setting procedure
 - <Execution operations (requiring confirmation)>
- Functions of function keys
 - [LOAD] : Load each correction data.

The load destination correction data numbers (1 to 32) displayed on the left side of the function keys are the numbers set in the following.

- [Calibration]—[EQUALIZING] ; Equalizing data
- [Calibration]—[OPEN CORR] ; Open correction data
- [Calibration]—[SHORT CORR] ; Short correction data
- [Calibration]—[LOAD CORR] ; Load correction data
- [Calibration]—[PORT EXT]—[OPEN_PEXT CORR]
 - ; Port extended end open correction data
- [Calibration]—[PORT EXT]—[SHORT_PEXT CORR]:
 - ; Port extended end short correction data
- [Calibration]—[PORT EXT]—[LOAD_PEXT CORR]:
 - ; Port extended end load correction data

The load destination numbers can be modified in the above [Calibration] menu.

■ [DATA FILE]—[DELETE]: Delete a data file.

This deletes a data file from the internal memory or a USB memory device.

- Setting procedure
 - <Execution operations (requiring confirmation)>
- Functions of function keys
 - [DELETE] : Delete a data file.

■ [DATA FILE]—[RENAME]: Rename a data file.

This renames a data file when the target is a USB memory device. It renames a file title when the target is the internal memory.

- Setting procedure
 - <Execution operations (requiring confirmation)>, <Text settings (requiring confirmation)>
- Functions of function keys
 - [RENAME] : Rename a data file (USB memory device) or title (internal memory).

■ [DATA FILE]—[CREATE NEW FOLDER]: Create a sub-folder (USB memory device).

- Setting procedure
 - <Execution operations (immediate settings)>, <Text settings (requiring confirmation)>
- Functions of function keys
 - [CREATE] : Create a new folder.

■ [EJECT]: Eject the USB memory device.

This performs the unmount process to enable the USB memory device to be removed safely.

○ Setting procedure

<Execution operations (immediate execution)>

○ Functions of function keys

- [EJECT] : Unmount the USB memory device.

When you tap the [EJECT] function key, a process end message will appear. When the message appears, remove the USB memory device.

A USB memory device left inserted after performing the eject process cannot be accessed. If removed from the USB port and then reinserted, it will be recognized again and become able to be accessed.

■ [SCRN COPY FILE NUMBER] : Set the screen copy file numbering.

This sets the initial value of the serial numbers of the screen copy files (.bmp files) saved to a USB memory device. The number is incremented by one each time a screen copy file is saved to the USB memory device.

○ Setting procedure

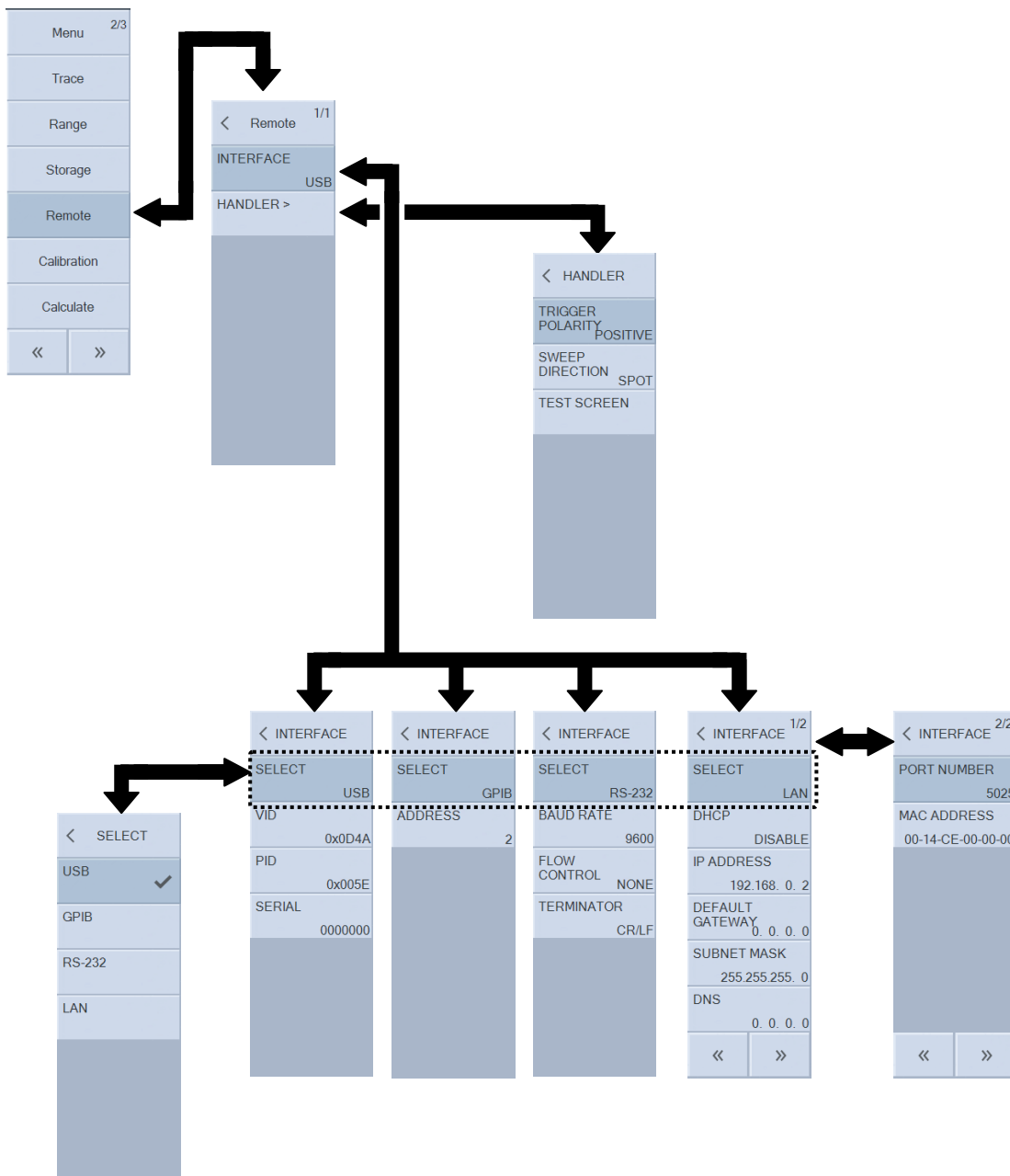
<Numerical settings (requiring confirmation)>, <Numerical settings>

The setting range is 000 to 999 and the setting resolution is 1.

○ Functions of function keys

- [EDIT] : Set the file number with the numerical input palette.
- [MODIFY] : Modify the file number with the knob or cursor keys.

3.5.10 Remote Menu



■ Common settings

○ Functions of function keys

- [INTERFACE APPLY] : Apply the setting changes to the hardware.

Even if the remote relationship setting is changed, it will not take effect in the hardware until the [INTERFACE APPLY] function key is pressed.

■ [SELECT] : Select the remote interface.

This selects the communication interface to use.

○ Setting procedure

<List operations (immediate settings)>

- USB : Use USBTMC for communication.
- GPIB : Use GPIB for communication.
- RS-232 : Use RS-232 for communication.
- LAN : Use Ethernet for communication.

■ [INTERFACE USB]: Display the USB information.

There is no item to set. The vendor ID, product ID, and serial number are displayed.

■ [INTERFACE GPIB]: Set GPIB.

■ [INTERFACE GPIB]–[ADDRESS]: Set the GPIB address.

This sets the address for GPIB.

○ Setting procedure

<Numerical settings (immediate settings)>, <Numerical settings>

The setting range is 0 to 30 and the setting resolution is 1.

○ Functions of function keys

- [EDIT] : Set the address with the numerical input palette.
- [MODIFY] : Modify the address with the knob or cursor keys.

■ [INTERFACE RS-232]: Set RS-232.

■ [INTERFACE RS-232]–[BAUD RATE]: Set the baud rate.

This sets the baud rate for RS-232.

○ Setting procedure

<List operations (immediate settings)>

- 4800 : 4,800 bps
- 9600 : 9,600 bps
- 19200 : 19,200 bps
- 38400 : 38,400 bps
- 57600 : 57,600 bps
- 115200 : 115,200 bps
- 230400 : 230,400 bps

■ [INTERFACE RS-232]–[FLOW CONTROL]: Set flow control.

This sets the flow control for RS-232.

○ Setting procedure

<List operations (immediate settings)>

- NONE : No flow control
- SOFT : Software flow control (Xon, Xoff)
- HARD : Hardware flow control (RTS, CTS)

- [INTERFACE RS-232]–[TERMINATOR]: Set the message terminator.

This sets the terminator character for RS-232.

- Setting procedure

<List operations (immediate settings)>

- CR/LF : CR+LF
- LF : LF

- [INTERFACE LAN]: Set LAN (Ethernet).

- [INTERFACE LAN]–[DHCP]: Select the method to determine the IP address.

This sets the method for determining the Ethernet IP address.

- Setting procedure

<List operations (immediate settings)>

- ENABLE : Enable DHCP.
- DISABLE : Disable DHCP (set the IP address manually).

- Functions of function keys

- [LAN RESET] : Initialize the settings related to the LAN.

- [INTERFACE LAN]–[IP ADDRESS]: Set the IP address.

- [INTERFACE LAN]–[DEFAULT GATEWAY]: Set the default gateway.

- [INTERFACE LAN]–[SUBNET MASK]: Set the subnet mask.

- [INTERFACE LAN]–[DNS]: Set the DNS server.

These settings specify the IP address of this instrument, IP address of the default gateway, IP address of the DNS server, and subnet mask of the LAN.

- Setting procedure

<Numerical settings (immediate settings)>

The setting range for each octet is 0 to 255 and the setting resolution is 1.

- Functions of function keys

- [MODIFY] : Modify the octets with the knob or cursor keys.
- [LAN RESET] : Initialize the settings related to the LAN.

- [INTERFACE LAN]–[PORT NUMBER]: Display the port number.

This is the port number. It cannot be changed.

- [INTERFACE LAN]–[MAC ADDRESS]: Display the MAC address.

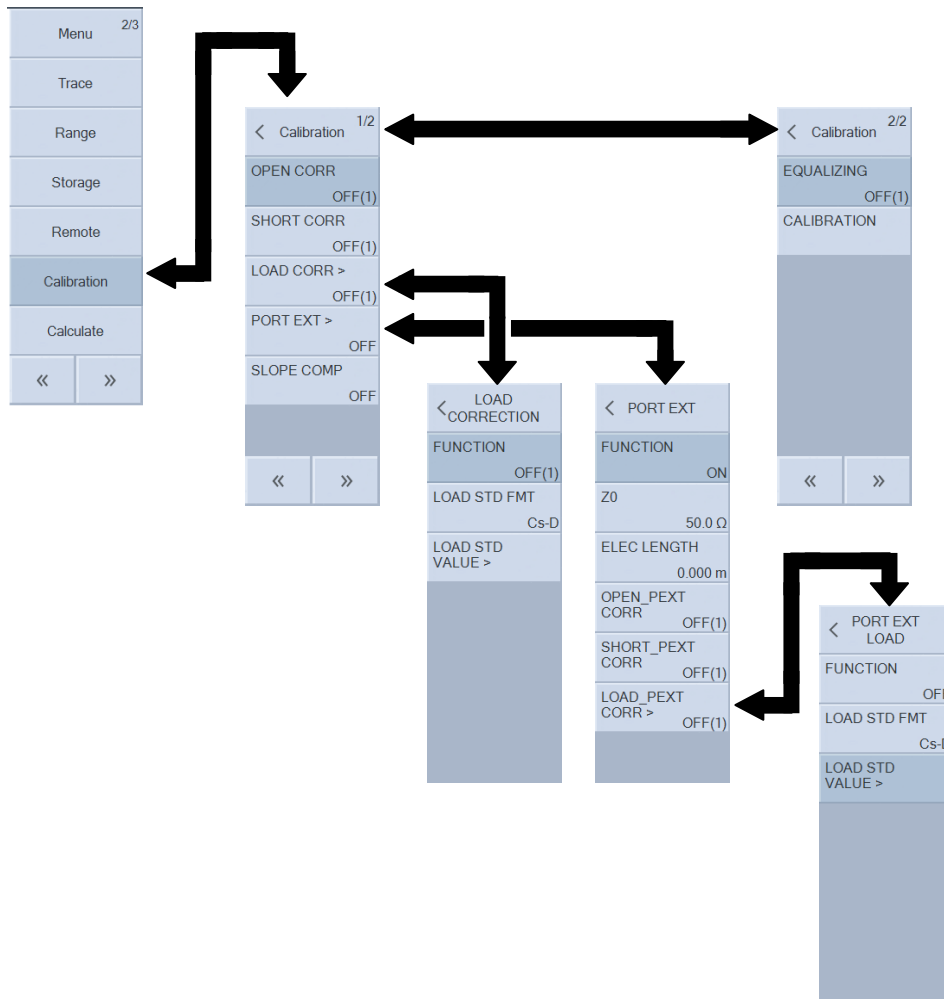
This is the MAC address of the Ethernet connector of this instrument. It cannot be changed.

- [HANDLER]: Set the handler interface.
- [HANDLER]—[TRIGGER POLARITY]: Select the trigger polarity.
Set the trigger polarity (rising or falling).
 - Setting procedure
<List operations (immediate settings)>
 - POSITIVE : Trigger on the rising edge.
 - NEGATIVE : Trigger on the falling edge.

- [HANDLER]—[SWEEP DIRECTION] : Set the direction for a sweep using a handler trigger.
This sets the direction for sweep measurement using a handler trigger.
 - Setting procedure
<List operations (immediate settings)>
 - UP : Start up-sweep measurement with a trigger.
 - DOWN : Start down-sweep measurement with a trigger.
 - SPOT : Start spot measurement with a trigger.

- [HANDLER]—[TEST SCREEN]: Display the handler test screen.
This displays a screen to check the connection state of the handler interface and perform simulation output of comparison results. For the operating procedures, refer to “1.16.3 Handler Interface Test Screen” in Instruction Manual (Advanced).
 - Setting procedure
<Execution operations (immediate execution)>
 - Functions of function keys
 - [TEST] : Display the handler interface test screen.

3.5.11 Calibration Menu



■ [OPEN CORR]: Set open correction.

This sets the open correction function. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable open correction.
- [MEASURE] : Start correction data measurement (when measurement mode is IMPD-3T and IMPD-2T only).
- [COPY TO REF8] : Copy the open correction data to reference data 8 (REF8).
- [EDIT] : Set the open correction data number with the numerical input palette.
- [MODIFY] : Modify the open correction data number with the knob or cursor keys.

The currently set open correction data number is displayed in the menu. When open correction is turned off, the open correction data number indication becomes “OFF”.

For details on open correction, refer to “1.8.3 Open Correction” in Instruction Manual (Advanced).

■ [SHORT CORR]: Set short correction.

This sets the short correction function. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable short correction.
- [MEASURE] : Start correction data measurement (when measurement mode is IMPD-3T and IMPD-2T only).
- [COPY TO REF8] : Copy the short correction data to reference data 8 (REF8).
- [EDIT] : Set the short correction data number with the numerical input palette.
- [MODIFY] : Modify the short correction data number with the knob or cursor keys.

The currently set short correction data number is displayed in the menu. When short correction is turned off, the short correction data number indication becomes “OFF”.

For details on short correction, refer to “1.8.4 Short Correction” in Instruction Manual (Advanced).

■ [LOAD CORR]: Set load correction.

This sets the load correction function. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T.

■ [LOAD CORR]—[FUNCTION]: Set load correction.

Enable or disable the load correction function.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable load correction.
- [MEASURE] : Start correction data measurement (when measurement mode is IMPD-3T and IMPD-2T only).
- [COPY TO REF8] : Copy the load correction data to reference data 8 (REF8).
- [EDIT] : Set the load correction data number with the numerical input palette.
- [MODIFY] : Modify the load correction data number with the knob or cursor keys.

The currently set load correction data number is displayed in the menu. When load correction is turned off, the load correction data number indication becomes “OFF”.

When load correction is enabled, this instrument will operate with open correction and short correction both forcibly enabled internally even if those functions were set to off (disabled).

For details on load correction, refer to “1.8.5 Load Correction” in Instruction Manual (Advanced).

■ [LOAD CORR]–[LOAD STD FMT]: Set the load standard value format.

This specifies the format for when the load standard values are input.

○ Setting procedure

<List operations (immediate settings)>

- Cs-D : Specify with the series capacitance and dissipation factor.
- Cp-D : Specify with the parallel capacitance and dissipation factor.
- Rp-Cp : Specify with the parallel resistance and parallel capacitance.
- Rs-Ls : Specify with the series resistance and series inductance.
- Rs-X : Specify with the resistance (series resistance) and reactance.
- Z-θ : Specify with the impedance and phase.

For details on load correction, refer to “1.8.5 Load Correction” in Instruction Manual (Advanced).

■ [LOAD CORR]–[LOAD STD VALUE]: Set the load standard values.

This sets the load standard values.

When the menu is tapped, the [[LOAD STANDARD VALUE]] dialog box appears.

Set the frequency and load standard values. Up to 30 sets of load standard values (30 frequencies) can be set.

■ [LOAD CORR]–[LOAD STD VALUE]–[[LOAD STANDARD VALUE]]

: Specify the load standard values.

Set the frequency and load standard values. Up to 30 sets of load standard values (30 frequencies) can be set.

When the parameter is selected and the knob is turned clockwise, the setting item changes in the order of No. 1 Frequency → No. 1 Standard Value (Y1) → No. 1 Standard Value (Y2) → No. 2 Frequency → No. 2 Standard Value (Y1) → No. 2 Standard Value (Y2) → ...

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [DELETE LINE] : Delete the line.
- [SORT] : Sort the displayed information in frequency ascending order.
- [EDIT] : Set the load standard values with the numerical input palette.
- [MODIFY] : Modify the load standard values with the knob or cursor keys.

The setting range is 10 μHz to 36 MHz and the setting resolution is 10 μHz for the frequency.

The setting range is –1.0 T to +1.0 T and the setting resolution is 6 digits or 1 a (10^{-18}), whichever is larger, for the load standard values.

■ [PORT EXT]: Set port extension correction.

This sets the port extension correction function. It can be set when the measurement mode is IMPD–EXT, IMPD–3T and IMPD–2T.

For details on port extension, refer to “1.8.6 Port Extension” in Instruction Manual (Advanced).

■ [PORT EXT]–[FUNCTION]: Set the port extension correction function to ON or OFF.

- Setting procedure
 - <List operations (immediate settings)>
- Functions of function keys
 - [OFF] : Disable the port extension correction function.
 - [ON] : Enable the port extension correction function.

■ [PORT EXT]–[Z0]: Set characteristic impedance.

This sets the characteristic impedance of the line for the port extension correction function.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [50Ω] : Set characteristic impedance to 50 Ω.
 - [75Ω] : Set characteristic impedance to 75 Ω.
 - [EDIT] : Set the characteristic impedance value (unit: Ω) with the numerical input palette.
 - [MODIFY] : Modify the characteristic impedance value (unit: Ω) with the knob or cursor keys.

The setting range is 1.00 to 999 Ω and the setting resolution is 3 digits.

■ [PORT EXT]–[ELEC LENGTH]: Set the electrical length.

This sets the electrical length of the line for port extension correction. This is not the physical length. The electrical length is a value that takes into account the velocity factor.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the electrical length (unit: m) with the numerical input palette.
 - [MODIFY] : Modify the electrical length (unit: m) with the knob or cursor keys.

The setting range is 0.000 to 999.999 m and the setting resolution is 0.001 m (1 mm).

■ [PORT EXT]–[OPEN_PEXT CORR]: Set open correction at port extension tip.

This sets the open correction function at port extension tip. It can be set when the measurement mode is IMPD–EXT, IMPD–3T and IMPD–2T.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable the open correction at port extension tip.
- [MEASURE] : Start correction data measurement (when measurement mode is IMPD–3T and IMPD–2T only).
- [COPY TO REF8] : Copy the open correction data at port extension tip to reference data 8 (REF8).
- [EDIT] : Set the open correction data number at port extension tip with the numerical input palette.
- [MODIFY] : Modify the open correction data number at port extension tip with the knob or cursor keys.

The currently set open correction data number at port extension tip is displayed in the menu. When this function is turned off, the open correction data number at port extension tip indication becomes “OFF”.

■ [PORT EXT]–[SHORT_PEXT CORR]: Set short correction at port extension tip.

This sets the short correction function at port extension tip. It can be set when the measurement mode is IMPD–EXT, IMPD–3T and IMPD–2T.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable the short correction at port extension tip.
- [MEASURE] : Start correction data measurement (when measurement mode is IMPD–3T and IMPD–2T only).
- [COPY TO REF8] : Copy the short correction data at port extension tip to reference data 8 (REF8).
- [EDIT] : Set the short correction data number at port extension tip with the numerical input palette.
- [MODIFY] : Modify the short correction data number at port extension tip with the knob or cursor keys.

The currently set short correction data number at port extension tip is displayed in the menu. When this function is turned off, the short correction data number at port extension tip indication becomes “OFF”.

■ [PORT EXT]–[LOAD_PEXT CORR] : Set load correction at port extension tip.

This sets the load correction function at port extension tip. It can be set when the measurement mode is IMPD–EXT, IMPD–3T and IMPD–2T.

■ [PORT EXT]—[LOAD_PEXT CORR]—[FUNCTION]

: Enable or disable load correction function at port extension tip.

Enable or disable the load correction function at port extension tip.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable load correction at port extension tip.
- [MEASURE] : Start correction data measurement (when measurement mode is IMPD-3T and IMPD-2T only).
- [COPY TO REF8] : Copy the load correction data at port extension tip to reference data 8 (REF8).
- [EDIT] : Set the load correction data number at port extension tip with the numerical input palette.
- [MODIFY] : Modify the load correction data number at port extension tip with the knob or cursor keys.

The currently set load correction data number at port extension tip is displayed in the menu. When load correction at port extension tip is turned off, the data number indication becomes “OFF”.

When load correction at port extension tip is enabled, this instrument will operate with open correction and short correction at port extension tip both forcibly enabled internally even if those functions were set to off (disabled).

■ [PORT EXT]—[LOAD_PEXT CORR]—[LOAD STD FMT]

: Set the load standard value format at port extension tip.

This specifies the format for when the load standard values at port extension tip are input.

○ Setting procedure

<List operations (immediate settings)>

- Cs-D : Specify with the series capacitance and dissipation factor.
- Cp-D : Specify with the parallel capacitance and dissipation factor.
- Rp-Cp : Specify with the parallel resistance and parallel capacitance.
- Rs-Ls : Specify with the series resistance and series inductance.
- Rs-X : Specify with the resistance (series resistance) and reactance.
- Z-θ : Specify with the impedance and phase.

■ [PORT EXT]—[LOAD_PEXT CORR]—[LOAD STD VALUE]:

: Set the load standard values at port extension tip.

This sets the load standard values at port extension tip.

When the menu is tapped, the [[PORT EXTENSION LOAD STANDARD VALUE]] dialog box appears. Set the frequency and load standard values at port extension tip. Up to 30 sets of load standard values (30 frequencies) at port extension tip can be set.

■ [PORT EXT]—[LOAD_PEXT CORR]—[LOAD STD VALUE]

—[[PORT EXTENSION LOAD STANDARD VALUE]]: Set the load standard values at port extension tip.

Set the frequency and load standard values at port extension tip. Up to 30 sets of load standard values (30 frequencies) can be set.

When the parameter is selected and the knob is turned clockwise, the setting item changes in the order of No. 1 Frequency → No. 1 Standard Value (Y1) → No. 1 Standard Value (Y2) → No. 2 Frequency → No. 2 Standard Value (Y1) → No. 2 Standard Value (Y2) → ...

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [DELETE LINE] : Delete the line.
- [SORT] : Sort the displayed information in frequency ascending order.
- [EDIT] : Set the load standard values with the numerical input palette.
- [MODIFY] : Modify the load standard values with the knob or cursor keys.

The setting range is 10 μ Hz to 36 MHz and the setting resolution is 10 μ Hz for the frequency. The setting range is -1.0 T to $+1.0$ T and the setting resolution is 6 digits or 1 a (10^{-18}), whichever is larger, for the port extended end load standard values.

■ [SLOPE COMP]: Set the slope compensation function.

This function is used when performing such as electrochemical impedance measurement. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T. Usually, this function should be turned off when using this instrument. For details, refer to “1.8.7 Slope Compensation Function” in Instruction Manual (Advanced).

○ Setting procedure

<List operations (immediate settings)>

- OFF : Turn the slope compensation function off.
- ON : Turn the slope compensation function on.

■ [EQUALIZING] : Set equalizing.

This sets the equalizing function to ON or OFF. It can be set when the measurement mode is G-PH.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [ON/OFF] : Enable or disable the equalizing function.
- [COPY TO REF8] : Copy the equalizing data to reference data 8 (REF8).
- [EDIT] : Set the equalizing data number with the numerical input palette.
- [MODIFY] : Modify the equalizing data number with the knob or cursor keys.

The currently set equalizing data number is displayed in the menu. When the equalizing function is turned off, the equalizing data number indication becomes “OFF”.

For details on equalizing, refer to “1.8.8 Equalizing” in Instruction Manual (Advanced).

■ [CALIBRATION]: Execute self-calibration.

This executes self-calibration. It can be set when the measurement mode is IMPD-EXT and G-PH.

○ Setting procedure

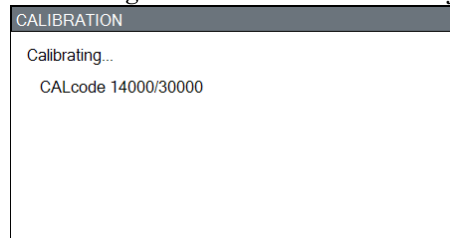
<Execution operations (requiring confirmation)>

○ Functions of function keys

- [EXEC] : Start self-calibration.

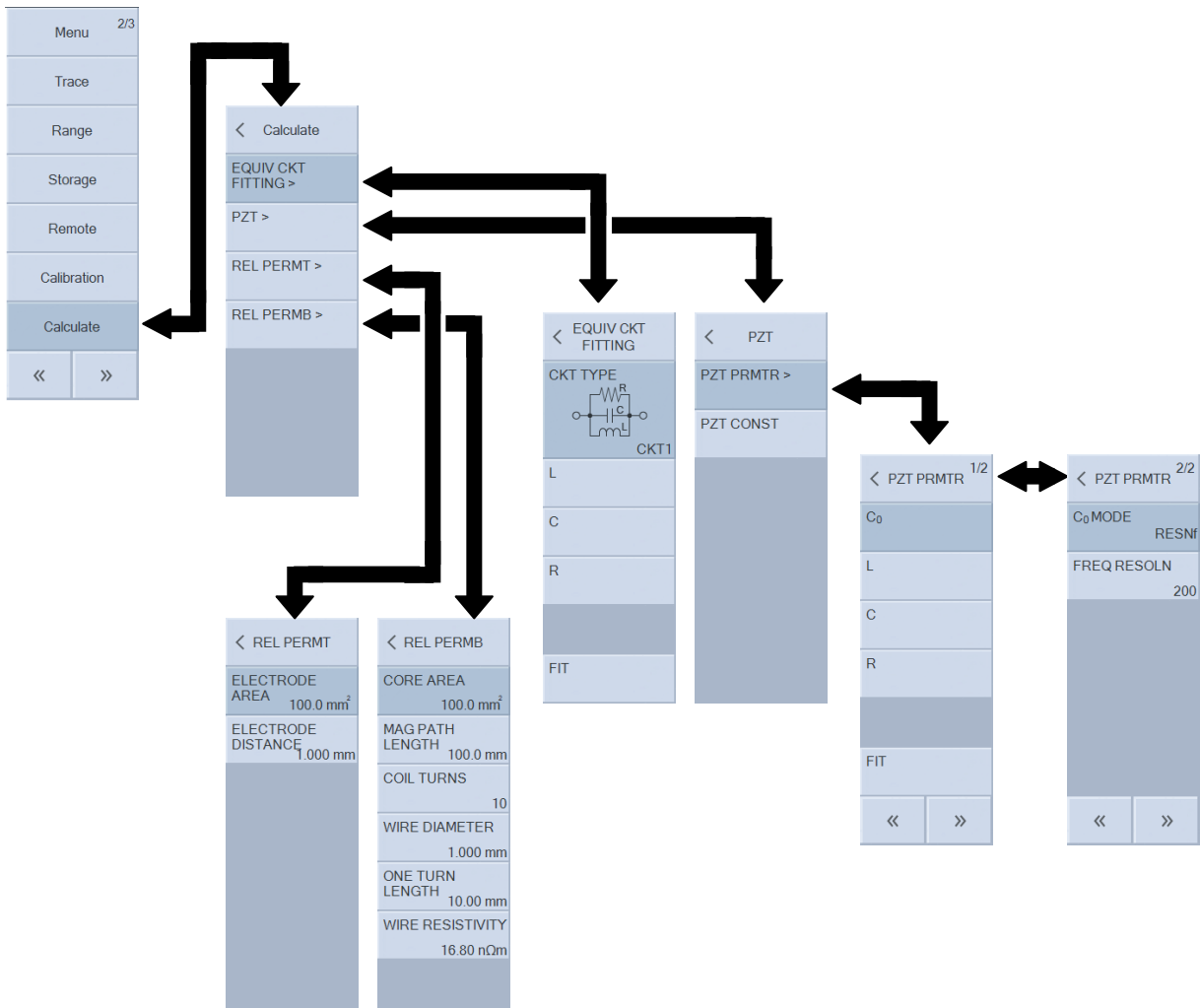
When self-calibration is started, the cable connection confirmation dialog box appears.

Confirm the cable connection and then tap the [OK] button in the confirmation dialog box to start self-calibration. The following dialog box is displayed to indicate the progress during self-calibration. This dialog box closes automatically once the process completes normally.



For details on self-calibration, refer to “1.8.1 Self-Calibration” in Instruction Manual (Advanced).

3.5.12 Calculate Menu



■ [EQUIV CKT FITTING]: Estimate the equivalent circuit.

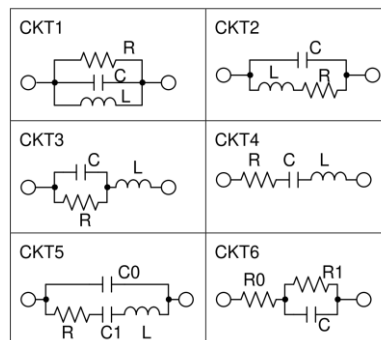
This can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T. For details on equivalent circuit estimation, refer to “1.11 Equivalent Circuit Estimation” in Instruction Manual (Advanced).

■ [EQUIV CKT FITTING]–[CKT TYPE]: Select the equivalent circuit.

○ Setting procedure

<List operations (immediate settings)>

- CKT1 : Select the equivalent circuit 1.
- CKT2 : Select the equivalent circuit 2.
- CKT3 : Select the equivalent circuit 3.
- CKT4 : Select the equivalent circuit 4.
- CKT5 : Select the equivalent circuit 5.
- CKT6 : Select the equivalent circuit 6.



- [EQUIV CKT FITTING] – [(PRMTR1)]: Select element value 1
- [EQUIV CKT FITTING] – [(PRMTR2)]: Select element value 2
- [EQUIV CKT FITTING] – [(PRMTR3)]: Select element value 3
- [EQUIV CKT FITTING] – [(PRMTR4)]: Select element value 4
 - Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
 - Functions of function keys
 - [EDIT] : Set the constant value with the numerical input palette.
 - [MODIFY] : Modify the constant value with the knob or cursor keys.

The L, C, and R based on the currently set equivalent circuit type and the parameter values are displayed in the menu. When the equivalent circuit type is 1 to 4 or 6, [(PRMTR4)] is blank.

The following table shows the correspondence between the equivalent circuit type and the PRMTR 1 to 4 and unit.

Equivalent circuit type	PRMTR1	PRMTR2	PRMTR3	PRMTR4
CKT1 to CKT4	L [H]	C [F]	R [Ω]	–
CKT5	C0 [F]	L [H]	C1 [F]	R [Ω]
CKT6	R0 [Ω]	C [F]	R1 [Ω]	–

- [EQUIV CKT FITTING] – [FIT]: Execute equivalent circuit estimation and save the results.
 - Setting procedure
 - <Text settings (requiring confirmation)>, <Numerical settings>, <Execution operations (immediate execution)>
 - Functions of function keys
 - [FIT] : Execute equivalent circuit estimation.
 - [SAVE] : Save the estimation results to a USB memory device.

For details on file format, refer to “2.4 Equivalent Circuit File Format” in Instruction Manual (Advanced).

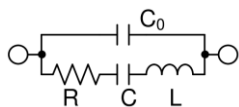
- [PZT]: Calculate the piezoelectric constants.

This extracts the characteristic frequency from frequency - impedance characteristic of the DUT (piezoelectric ceramics) and then calculates the piezoelectric constants, etc. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T.

For details, refer to “1.12 Calculating Piezoelectric Constant” in Instruction Manual (Advanced).

- [PZT] – [PZT PRMTR]: Estimate the piezoelectric equivalent circuit.

Estimate the equivalent circuit of the DUT (piezoelectric ceramics) from the frequency sweep results.



- [PZT] – [PZT PRMTR] – [C0]: Set the piezoelectric equivalent circuit element (C0).
- [PZT] – [PZT PRMTR] – [L]: Set the piezoelectric equivalent circuit element (L).

- [PZT]—[PZT PRMTR]—[C]: Set the piezoelectric equivalent circuit element (C).
- [PZT]—[PZT PRMTR]—[R]: Set the piezoelectric equivalent circuit element (R).
Set these when changing the equivalent circuit element manually.
 - Setting procedure
<Numerical settings (requiring confirmation)>, <Numerical settings>
 - Functions of function keys
 - [EDIT] : Set the equivalent circuit elements with the numerical input palette.
 - [MODIFY] : Modify the equivalent circuit elements with the knob or cursor keys.
- [PZT]—[PZT PRMTR]—[FIT]: Execute piezoelectric equivalent circuit estimation.
 - Setting procedure
< Numerical settings (requiring confirmation) >, < Numerical settings >, < Execution operations (immediate execution) >
 - Functions of function keys
 - [FIT NORMAL] : Execute equivalent circuit estimation using the normal fitting algorithm.
 - [FIT FINE] : Execute equivalent circuit estimation using the fine fitting algorithm.
 - [RESN FREQ DISP] : Display the characteristic frequency.

[FIT NORMAL] has an inferior fit accuracy but is capable of a fit with a certain degree of accuracy for measurement results with a lot of noise and distortion. Conversely, [FIT FINE] is capable of a high-accuracy fit depending on the data, but a fit may not be possible and the results may vary when the data is not ideal such as when there is a lot of noise. Select the most appropriate fit algorithm depending on the condition of the measurement data.

- [PZT]—[PZT PRMTR]—[C₀ MODE]
: Select the C₀ estimation method with the piezoelectric equivalent circuit.

This selects the method (algorithm) to calculate the C₀ of the piezoelectric equivalent circuit.

- Setting procedure
<List operations (immediate settings)>
 - RESNf : Estimate the C₀ from the resonant frequency.
 - fmax : Estimate the C₀ from the susceptance when the maximum frequency.
 - Gmax : Estimate the C₀ from the maximum conductance.
 - Bavg : Estimate the C₀ from the susceptance average.

For ideal measurement data, the result will be the same no matter which method you select. However, the results obtained by the above four algorithms will differ for actual measurement data containing noise, measurement errors, and other problems. Select the C_0 estimation mode in reference to the equivalent circuit fit results. Usually, "RESNf" should be used.

■ [PZT]—[PZT PRMTR]—[FREQ RESOLN]

: Set frequency resolution for impedance characteristic simulation.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [SWEEP SETTING] : It will set the same value as the sweep resolution setting value.
- [EDIT] : Set the frequency resolution with the numerical input palette.
- [MODIFY] : Modify the frequency resolution with the knob or cursor keys.

The impedance characteristic is calculated from the equivalent circuit estimation results and then displayed in a graph. The impedance characteristic is calculated with a number of frequency points of the value set here + 1 in the frequency resolution of this time and then displayed on the graph.

■ [PZT]—[PZT CONST]: Calculate the piezoelectric constants.

■ [PZT]—[PZT CONST]—[[PZT CONSTANT]]

: Display the piezoelectric constant calculation dialog box.

This displays a dialog box to enter information such as the DUT piezoelectric ceramic shape and vibration mode to calculate various piezoelectric constants.

■ [REL PERMT]: Set parameters for relative permittivity measurement.

This sets the shape information of the DUT for displaying the relative permittivity of the DUT. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T. When relative permittivity related (ϵ_s , ϵ_s' , ϵ_s'' , or D_e) measurement is selected in [Graph]—[DISPLAY MODE Y] or [Measure]—[PRMTRn], the relative permittivity will be calculated using the parameters that you set here.

■ [REL PERMT]—[ELECTRODE AREA]: Set the electrode surface area.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [EDIT] : Set the electrode surface area (unit: mm²) with the numerical input palette.
- [MODIFY] : Modify the electrode surface area (unit: mm²) with the knob or cursor keys.

■ [REL PERMT]—[ELECTRODE DISTANCE] : Set the distance between electrodes.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

- Functions of function keys
 - [EDIT] : Set the distance between electrodes (unit: mm) with the numerical input palette.
 - [MODIFY] : Modify the distance between electrodes (unit: mm) with the knob or cursor keys.

■ [REL PERMB]: Set parameters for relative permeability measurement.

This sets the shape information of the DUT for displaying the relative permeability of the DUT. It can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T. When relative permeability related (μ_s , μ_s' , μ_s'' , or D_{μ}) measurement is selected in [Graph]-[DISPLAY MODE Y] or [Measure]-[PRMTRn], the relative permeability will be calculated using the parameters that you set here.

■ [REL PERMB]-[CORE AREA]: Set the core cross-sectional area.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the core cross-sectional area (unit: mm²) with the numerical input palette.
 - [MODIFY] : Modify the core cross-sectional area (unit: mm²) with the knob or cursor keys.

■ [REL PERMB]-[MAG PATH LENGTH]: Set the magnetic path length.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the magnetic path length (unit: mm) with the numerical input palette.
 - [MODIFY] : Modify the magnetic path length (unit: mm) with the knob or cursor keys.

■ [REL PERMB]-[COIL TURNS]: Set the number of coil turns.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the number of coil turns with the numerical input palette.
 - [MODIFY] : Modify the number of coil turns with the knob or cursor keys.

■ [REL PERMB]-[WIRE DIAMETER]: Set the winding wire diameter.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the coil winding wire diameter (unit: mm) with the numerical input

palette.

- [MODIFY] : Modify the coil winding wire diameter (unit: mm) with the knob or cursor keys.

■ [REL PERMB]—[ONE TURN LENGTH]: Set the length of one turn of the coil.

○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [EDIT] : Set the length (unit: mm) of one turn of the coil with the numerical input palette.
- [MODIFY] : Modify the length (unit: mm) of one turn of the coil with the knob or cursor keys.

■ [REL PERMB]—[WIRE RESISTIVITY] : Set the winding wire resistivity.

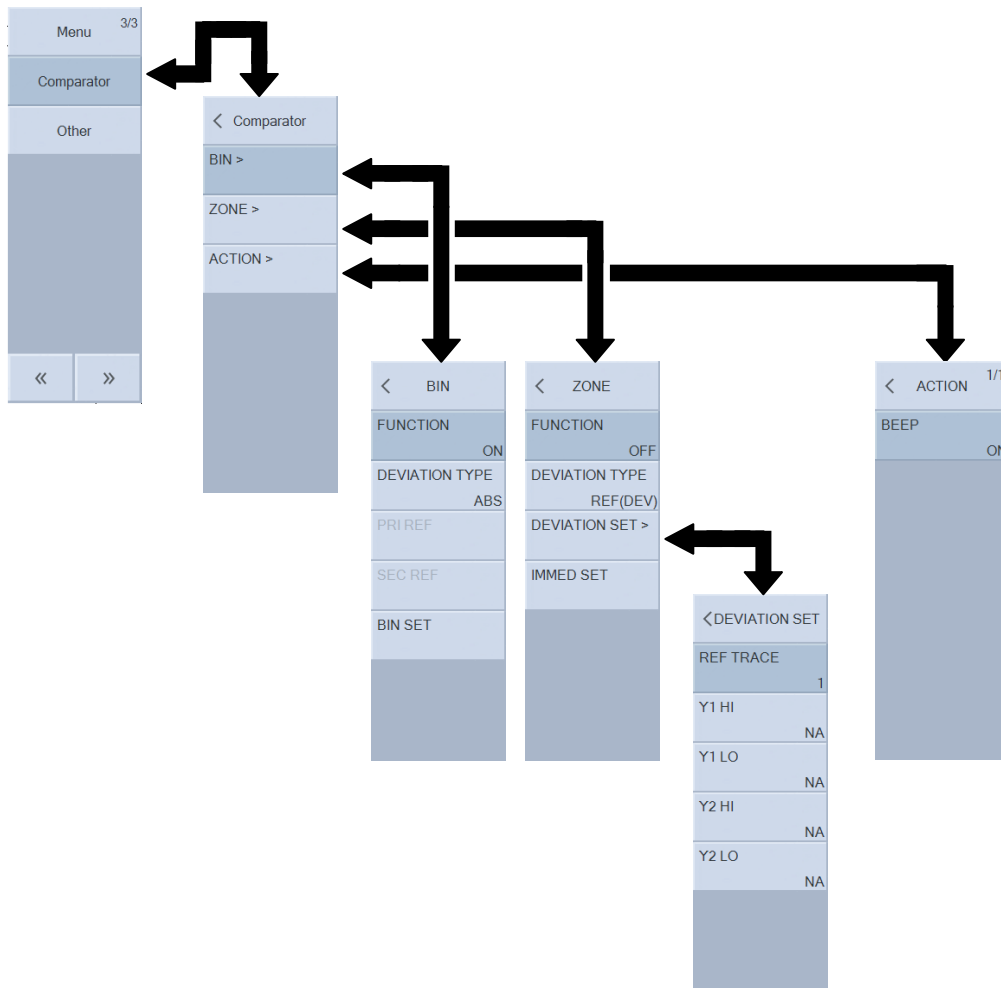
○ Setting procedure

<Numerical settings (requiring confirmation)>, <Numerical settings>

○ Functions of function keys

- [Ag 1.59×10^{-8}] : Set the winding wire resistivity to the resistivity of silver ($1.59 \times 10^{-8} \Omega\text{m}$).
- [Cu 1.68×10^{-8}] : Set the winding wire resistivity to the resistivity of copper ($1.68 \times 10^{-8} \Omega\text{m}$).
- [Al 2.82×10^{-8}] : Set the winding wire resistivity to the resistivity of aluminum ($2.82 \times 10^{-8} \Omega\text{m}$).
- [EDIT] : Set the resistivity (unit: Ωm) with the numerical input palette.
- [MODIFY] : Modify the resistivity (unit: Ωm) with the knob or cursor keys.

3.5.13 Comparator Menu



This can be set when the measurement mode is IMPD-EXT, IMPD-3T and IMPD-2T. Refer to “1.15 Comparator” in Instruction Manual (Advanced) for details on the comparator and refer to “1.16 Handler Interface” in Instruction Manual (Advanced) for details on the handler interface.

- [BIN]: Set BIN sorting / LIMIT comparison.
This sets the BIN sorting or LIMIT comparison performed in spot measurement.
- [BIN]–[FUNCTION]: Set the sorting function to ON or OFF.
 - Setting procedure
<List operations (immediate settings)>
 - OFF : Disable BIN sorting / LIMIT comparison.
 - ON : Enable BIN sorting / LIMIT comparison.
- [BIN]–[DEVIATION TYPE]: Set the deviation mode.
 - Setting procedure
<List operations (immediate settings)>
 - ABS : Compare using upper and lower limit values.

- DEV : Compare using upper and lower limit values in respect to the reference values.
 - DEV% : Compare using upper and lower limit values (%) in respect to the reference values.
- [BIN]—[PRI REF]: Set the primary parameter reference value.
 - [BIN]—[SEC REF]: Set the secondary parameter reference value.
 - Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
 - Functions of function keys
 - [EDIT] : Set the reference values with the numerical input palette.
 - [MODIFY] : Modify the reference values with the knob or cursor keys.
 - [BIN]—[BIN SET]: Set the upper and lower limit values.

This displays a dialog box to set the upper and lower limit values for sorting.
 - [ZONE]: Set zone comparison.

This sets the zone comparison performed in sweep measurement.
 - [ZONE]—[FUNCTION]: Set the comparison function to ON or OFF.
 - Setting procedure
 - <List operations (immediate settings)>
 - OFF : Disable zone comparison.
 - ON : Enable zone comparison.
 - [ZONE]—[DEVIATION TYPE] : Set the deviation mode.
 - Setting procedure
 - <List operations (immediate settings)>
 - IMMED : Directly specify the comparison range.
 - REF(DEV%): Compare using upper and lower limit deviation values (%) in respect to the reference values (REF1 to REF8).
 - REF(DEV) : Compare using upper and lower deviation limit values in respect to the reference data (REF1 to REF8).
 - [ZONE]—[DEVIATION SET]: Set the reference and deviation.
 - [ZONE]—[DEVIATION SET]—[REF TRACE]: Set the reference data trace.
 - Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
 - Functions of function keys
 - [EDIT] : Set the reference data trace number with the numerical input palette.
 - [MODIFY] : Modify the reference data trace number with the knob or cursor keys.

This specifies the data trace number (1 to 8) to be the reference. The numbers correspond to REF1 to REF8.

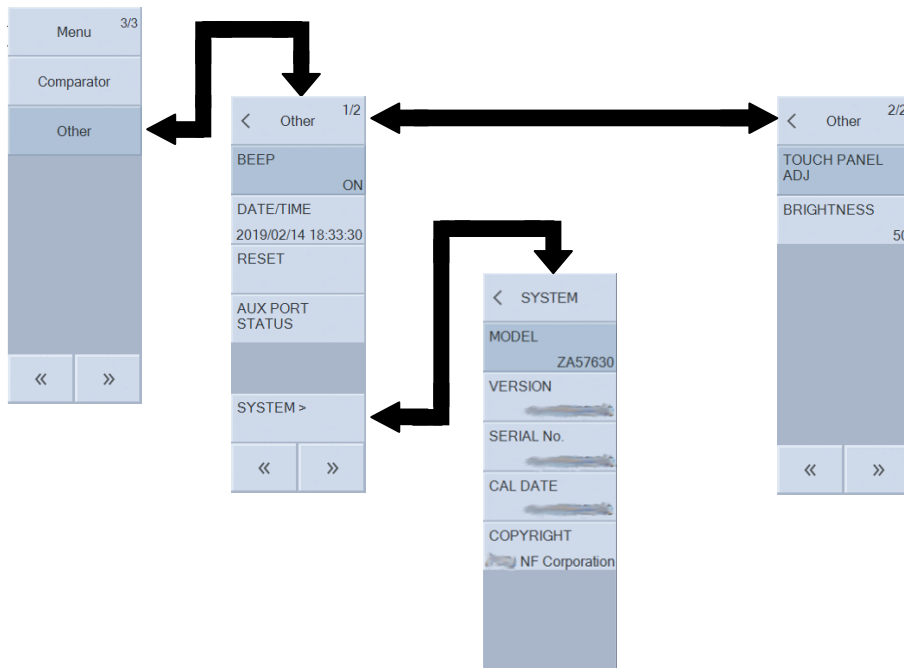
- [ZONE]—[DEVIATION SET]—[Y1 HI]: Set the Y1 upper limit.
- [ZONE]—[DEVIATION SET]—[Y1 LO]: Set the Y1 lower limit.
- [ZONE]—[DEVIATION SET]—[Y2 HI]: Set the Y2 upper limit.
- [ZONE]—[DEVIATION SET]—[Y2 LO]: Set the Y2 lower limit.
 - Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
 - Functions of function keys
 - [NA] : Set as not applicable for comparison.
 - [EDIT] : Set the comparison values with the numerical input palette.
 - [MODIFY] : Modify the comparison values with the knob or cursor keys.
- [ZONE]—[IMMED SET]: Set the upper and lower limit values.

This displays a dialog box to set the upper and lower limit values for comparison.

- [ACTION]: Set the action for when comparison ends.
- [ACTION]—[BEEP]: Set the beep.
 - Setting procedure
 - <List operations (immediate settings)>
 - OFF : Do not generate a beep.
 - ON : Generate a beep depending on whether or not a pass or fail.

Even if [ACTION]—[BEEP] is set to ON, a beep will not be generated if [Other]—[BEEP] is set to OFF.

3.5.14 Other Menu



■ [BEEP]: Turn the beep on/off.

This sets the beep (internal buzzer) to ON or OFF.

○ Setting procedure

<List operations (immediate settings)>

- ON : Enable the beep.
- OFF : Disable the beep.

■ [DATE/TIME]: Set the date and time.

This sets the internal calendar and clock.

○ Setting procedure

<Numerical settings (requiring confirmation)>

○ Functions of function keys

- [MODIFY] : Modify the date and time with the knob or cursor keys.

The date is displayed in the yyyy/mm/dd format, and time in the hh:mm:ss format. The time is in the 24-hour format.

The setting range is 1970 to 2099 for year, 01 to 12 for month, 01 to 31 for day, 00 to 23 for hour, 00 to 59 for minute, and 00 to 59 for second, and the setting resolution is 1 for all of them.

■ [RESET]: Reset the settings.

This resets the settings of this instrument.

○ Setting procedure

<Execution operations (requiring confirmation)>

○ Functions of function keys

- [RESET] : Execute a reset.

A confirmation message appears. Tapping the [OK] button resets the settings.

For details on the settings that are reset, refer to “3.6 Initial Settings”.

■ [AUX PORT STATUS]: Display the AUX connector status.

- Setting procedure
 - <Execution operations (immediate execution)>
- Functions of function keys
 - [STATUS] : Display the AUX connector status.

■ [SYSTEM]: Display this instrument information.

This displays the model name and other information of this instrument in a menu. The information is display only. It cannot be changed. The following information is displayed.

- MODEL : ZA57630
- VERSION : Firmware version
- SERIAL No. : Serial number
- CAL DATE : Date instrument was last calibrated
- COPYRIGHT : Copyright information
- Functions of function keys
 - [FIRMWARE UPDATE] : Update the firmware.
 - [TIME ZONE] : Set the time zone.
 - [LOG OUTPUT] : Save the log file to a USB memory device.
 - [INITIALIZE] : Restore this instrument to the factory default settings.

For details on the factory default state, refer to “3.6 Initial Settings”.

■ [TOUCH PANEL ADJ]: Adjust the touch panel position.

This performs position adjustment of the LCD touch panel of this instrument.

- Setting procedure
 - <Execution operations (requiring confirmation)>
- Functions of function keys
 - [EXEC] : Start touch panel position adjustment.

Tapping the function key displays a confirmation message. Tapping the [OK] button displays the touch panel position adjustment screen and starts adjustment.

For details on touch panel adjustment, refer to “1.20.3 Adjusting Touch Panel” in Instruction Manual (Advanced).

■ [BRIGHTNESS]: Adjust the LCD brightness.

This adjusts the brightness of the LCD backlight of this instrument.

- Setting procedure
 - <Numerical settings (requiring confirmation)>, <Numerical settings>
- Functions of function keys
 - [EDIT] : Set the brightness with the numerical input palette.
 - [MODIFY] : Modify the brightness with the knob or cursor keys.

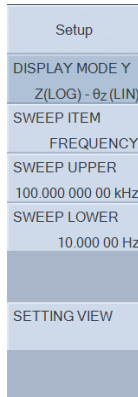
3.5 Setting Screen Reference

The setting range is 0 % to 100 % and the setting resolution is 1 %. The higher the value, the higher the brightness. Even if this is set to 0, the screen will not completely turn off.

3.5.15 Setup Menu

This menu is displayed by pressing the **[SETUP]** key on the front panel or tapping the **[SETUP]** button on the screen.

This shortcut menu allows you to easily set the items for which settings are frequently changed on this instrument.



- **[DISPLAY MODE Y]**: Set the Y-axis formats.

This sets the format (type) of the Y1-axis and Y2-axis of graphs. The setting is the same as “■ DISPLAY MODE Y” in “3.5.5 Graph Menu”.

- **[SWEEP ITEM]**: Set the sweep parameter.

This selects the parameter to sweep. The parameter set here becomes the X-axis of the graph. The setting is the same as “■ SWEEP ITEM” in “3.5.4 Sweep Menu”.

- **[SWEEP UPPER]**: Set the sweep upper limit.

The setting is the same as **[SWEEP UPPER]** in “3.5.4 Sweep Menu”.

- **[SWEEP LOWER]**: Set the sweep lower limit.

The setting is the same as **[SWEEP LOWER]** in “3.5.4 Sweep Menu”.

- **[SETTING VIEW]**: Display a list of the major current settings of this instrument.

- Setting procedure

<Execution operations (immediate execution)>

[Trace] – **[CONDITION VIEW]** displays a list of the settings used when the data trace indicated by the active marker was measured, whereas **[SETTING VIEW]** displays a list of the current measurement conditions of this instrument. Please be careful because they may both differ.

3.6 Initial Settings

The settings of this instrument will be the initial settings in the following cases.

- At the time of shipment from the factory
All the settings are the initial settings. The values in the setting memory are all the same as the initial values.
- When the reset command is executed and when the measurement mode is changed
Everything except the setting memory, measurement data, and interface settings is initialized.
Panel Operation: [Other]–[RESET]
Remote control command: *RST command
- If there is an error with the resume memory where the last settings are stored when the power is turned on

For details on which settings will be reset to the initial settings, refer to “Table 3-4 Initial Settings”. Whether each parameter is a resume target, measurement data save target, and sequence target are also displayed. The “Y” and “N” in the table below have the following meaning.

Y: Setting is initialized

N: Setting is not initialized

Table 3-4 Initial Settings (1/12)

Setting item	Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Mode >						
(MODE)	IMPD-EXT IMPD-3T IMPD-2T G-PH	IMPD-EXT	N	Y	N	N
< OSC >						
FREQUENCY	10 μ to 36 MHz	1 kHz	Y	Y	Y	Y
AMPLITUDE UNIT	V A	V	Y	Y	Y	N
AMPLITUDE	0 to 999 GVrms	1 Vrms	Y	Y	Y	Y
AMPLITUDE LIMIT	1 aVrms to 999 GVrms	3 Vrms	Y	Y	N	Y
ALC	ON OFF	OFF	Y	Y	N	Y
TOLELANCE	1 to 100 %	10 %	Y	Y	N	Y
RETRY TIMES	1 to 100	10	Y	Y	N	Y
CORR FACTOR	1 to 100 %	100 %	Y	Y	N	Y
DC BIAS						
DC BIAS	-999 GV to +999 GV	0 V	Y	Y	Y	Y
HV BIAS	OFF ON	OFF	Y	Y	Y	N
OUTPUT CONN	FRONT REAR	FRONT	Y	Y	N	N
POWER AMP GAIN	-1.00E-12 to +1.00E+12	+1.00E+00	Y	Y	N	Y

Table 3-4 Initial Settings (2/12)

Setting item	Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence	
<OSC> (Continued)							
AUX PORT SET	0 to 15	0	Y	Y	N	Y	
ON/OFF SYNC	ASYNC SYNC(AC+DC) SYNC(AC)	ASYNC	Y	Y	N	Y	
ON/OFF MODE	QUICK SLOW 0° SYNC	QUICK	Y	Y	N	Y	
FREQ CHNG MODE	ASYNC 0° SYNC	ASYNC	Y	Y	N	Y	
10MHz REF IN	DISABLE ENABLE	DISABLE	Y	Y	N	N	
10MHz REF OUT	DISABLE ENABLE	DISABLE	Y	Y	N	N	
<Measure>							
PRMTR1 : PRMTR6	IMPD-EXT IMPD-3T IMPD-2T G-PH	Z θ_Z Y θ_Y R X G B C _S C _P D Q _C L _S L _P Q _L R _S R _P ϵ_S ϵ_S' ϵ_S'' D _{ϵ} μ_S μ_S' μ_S'' D _{μ} V1*1 V2*1 V*2 I*2 FREQUENCY STATUS NA dBR R a b θ GD FREQUENCY V1 V2 STATUS NA	Z θ_Z NA NA NA NA NA	Y	Y	N	N
MEASURE TIME	0 to 9990 sec	0 sec	Y	Y	Y	Y	
START DELAY	0 to 9990 sec	0 sec	Y	Y	Y	Y	
MEASURE DELAY	0 to 9990 sec	0 sec	Y	Y	Y	Y	
TRIG SOURCE	PANEL REMOTE HANDLER	PANEL	Y	Y	N	N	
REPEAT	OFF ON	OFF	Y	Y	N	N	

*1: When the measurement mode is IMPD-EXT

*2: When the measurement mode is IMPD-3T and IMPD-2T

Table 3-4 Initial Settings (3/12)

Setting item		Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Sweep >							
SEQ SWEEP		OFF 1 to 32	OFF	Y	Y	Y	N
SEQ TRIGGER		AUTO STEP	AUTO	Y	Y	N	N
SWEEP ITEM		FREQUENCY AMPLITUDE DC BIAS TIME	FREQUENCY	Y	Y	Y	N
SWEEP UPPER	FREQUENCY	10 μ to 36 MHz	100 kHz	Y	Y	Y	Y
	AMPLITUDE	0 to 999 GVrms	1 Vrms				
	DC BIAS	-999 G to +999 GV	1 V				
	TIME	X	X				
However, > SWEEP LOWER							
SWEEP LOWER	FREQUENCY	10 μ to 36 MHz	10 Hz	Y	Y	Y	Y
	AMPLITUDE	0 to 999 GVrms	1 mVrms				
	DC BIAS	-999 G to +999 GV	0 V				
	TIME	X	X				
However, < SWEEP UPPER							
SWEEP RESOLN		LIN LOG 3 to 2000	LOG 100	Y Y	Y Y	Y Y	Y Y
SLOW SWEEP		ON OFF	OFF	Y	Y	N	N
TYPE	IMPD-EXT	Z Y θ	θ	Y	Y	N	N
	IMPD-3T						
	IMPD-2T						
	G-PH	dBR R θ	θ				
VARIATION	Z	1 a to 999 G Ω	1 k Ω	Y	Y	N	N
	Y	1 a to 999 GS	1 mS				
	θ	0.001 to 179.999 $^\circ$	10 $^\circ$				
	dBR	0.001 to 999.999 dB	10 dB				
	R	1 a to 999 G	1 k				
RESONANT TRACK		ON OFF	OFF	Y	Y	N	N
UPPER FREQUENCY		10 μ to 36 MHz However, > LOWER FREQUENCY	90 kHz	Y	Y	N	N
LOWER FREQUENCY		10 μ to 36 MHz However, < UPPER FREQUENCY	110 kHz	Y	Y	N	N
TARGET PHASE		-179.999 to +180.000 $^\circ$	0 $^\circ$	Y	Y	N	N
TOLERANCE		0.001 to 179.999 $^\circ$	10 $^\circ$	Y	Y	N	N
POLARITY		POSITIVE NEGATIVE	POSITIVE	Y	Y	N	N
CORR FACTOR		1 to 100 %	100 %	Y	Y	N	N

Table 3-4 Initial Settings (4/12)

Setting item	Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Graph >						
TITLE SET	Max. 63 characters	(Blank)	Y	Y	Y	N
DISPLAY MODE X	LOG LIN	LOG	Y	Y	N	N
IMPD-EXT	SWEEP R G	SWEEP	Y	Y	Y	N
IMPD-3T	SWEEP R G	SWEEP				
IMPD-2T	SWEEP R G	SWEEP				
G-PH	SWEEP θ a	SWEEP				
DISPLAY MODE Y	Y1 LOG Y LIN Y2 LOG Y2 LIN	Y1 LIN Y2 LIN	Y	Y	N	N
IMPD-EXT	Z- θ_z Y- θ_y R-X G-B	Z- θ_z	Y	Y	Y	N
IMPD-3T	C _S -R _S C _S -D C _S -Q _C	Z- θ_z				
IMPD-2T	C _P -R _P C _P -D C _S -Q _C					
	L _S -R _S L _S -Q _L L _P -R _P L _P -Q _L ϵ_s -D ϵ_s' - ϵ_s'' μ_s -D μ_s' - μ_s'' V1-V2*1 V-I*2 FREQUENCY- θ_z X -X B					
G-PH	dBR- θ R- θ a-b dBR-GD R-GD V1-V2 FREQUENCY- θ R dBR b		dBR- θ			
DISPLAY TRACE	MEAS	ON OFF	Y	Y	N	N
	REF1	ON OFF	Y	Y	N	N
	REF2	ON OFF	Y	Y	N	N
	REF3	ON OFF	Y	Y	N	N
	REF4	ON OFF	Y	Y	N	N
	REF5	ON OFF	Y	Y	N	N
	REF6	ON OFF	Y	Y	N	N
	REF7	ON OFF	Y	Y	N	N
	REF8	ON OFF	Y	Y	N	N

*1: When the measurement mode is IMPD-EXT

*2: When the measurement mode is IMPD-3T and IMPD-2T

Table 3-4 Initial Settings (5/12)

Setting item		Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
<Graph> (Continued)							
SCALE		AUTO AUTO-R FIX	AUTO	Y	Y	N	N
SCALE RANGE	X MAX	-1.0 T to +1.0 T	100.0 k	Y	Y	N	N
	X MIN	-1.0 T to +1.0 T	10.0	Y	Y	N	N
	Y1 MAX	-1.0 T to +1.0 T	100.0 k	Y	Y	N	N
	Y1 MIN	-1.0 T to +1.0 T	1.0	Y	Y	N	N
	Y2 MAX	-1.0 T to +1.0 T	+180.0	Y	Y	N	N
	Y2 MIN	-1.0 T to +1.0 T	-180.0	Y	Y	N	N
STYLE		SINGLE SPLIT	SINGLE	Y	Y	N	N
GRID		OFF X X-Y1 X-Y2 X-Y1-Y2	X-Y1-Y2	Y	Y	N	N
GRID LINE STYLE		SOLID LINE BROKEN LINE	BROKEN LINE	Y	Y	N	N
PHASE RANGE		±180° 0 to 360° -360 to 0° UNWRAP	± 180°	Y	Y	N	N
APERTURE		2 to 200	10	Y	Y	N	N
PLOT COLOR	MEAS Y1	0x000000 to 0xFFFFFFFF	0xA2142F	Y	Y	N	N
	MEAS Y2	0x000000 to 0xFFFFFFFF	0x0072BD	Y	Y	N	N
	REF1 Y1	0x000000 to 0xFFFFFFFF	0xD95319	Y	Y	N	N
	REF1 Y2	0x000000 to 0xFFFFFFFF	0x4DBEE E	Y	Y	N	N
	REF2 Y1	0x000000 to 0xFFFFFFFF	0xEE631E	Y	Y	N	N
	REF2 Y2	0x000000 to 0xFFFFFFFF	0x54E4FF	Y	Y	N	N
	REF3 Y1	0x000000 to 0xFFFFFFFF	0xFF7724	Y	Y	N	N
	REF3 Y2	0x000000 to 0xFFFFFFFF	0x5DFFF F	Y	Y	N	N
	REF4 Y1	0x000000 to 0xFFFFFFFF	0xFF8F2B	Y	Y	N	N
	REF4 Y2	0x000000 to 0xFFFFFFFF	0x66FFFF	Y	Y	N	N
	REF5 Y1	0x000000 to 0xFFFFFFFF	0xFFAC34	Y	Y	N	N
	REF5 Y2	0x000000 to 0xFFFFFFFF	0x70FFFF	Y	Y	N	N
	REF6 Y1	0x000000 to 0xFFFFFFFF	0xFFCE3 E	Y	Y	N	N
	REF6 Y2	0x000000 to 0xFFFFFFFF	0x7CFFFF	Y	Y	N	N
	REF7 Y1	0x000000 to 0xFFFFFFFF	0xFFF74B	Y	Y	N	N
	REF7 Y2	0x000000 to 0xFFFFFFFF	0x88FFFF	Y	Y	N	N
	REF8 Y1	0x000000 to 0xFFFFFFFF	0xFFFF5A	Y	Y	N	N
	REF8 Y2	0x000000 to 0xFFFFFFFF	0x96FFFF	Y	Y	N	N

Table 3-4 Initial Settings (6/12)

Setting item		Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Marker >							
ACTIVE		1 to 8	1	Y	Y	N	N
AUTO SEARCH		OFF X MAX X MIN X PEAK X BOTTOM Y1 MAX Y1 MIN Y1 PEAK Y1 BOTTOM Y2 MAX Y2 MIN Y2 PEAK Y2 BOTTOM X Y1 Y2 Δ X Δ Y1 Δ Y2 BW1 BW2 BW3	OFF	Y	Y	N	N
SEARCH VALUE	X	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
	Y1	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
	Y2	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
	Δ X	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
	Δ Y1	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
	Δ Y2	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
MARKER1	MODE	OFF NORMAL	OFF	Y	Y	N	N
	TRACE	MEAS REF1 to REF8	MEAS	Y	Y	N	N
	SEQ	0 to 32	0	Y	Y	N	N
	POSITION	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
MARKER2 : MARKER8	MODE	OFF NORMAL Δ Δ TRKG	OFF	Y	Y	N	N
	TRACE	MEAS REF1 to REF8	MEAS	Y	Y	N	N
	SEQ	0 to 32	0	Y	Y	N	N
	POSITION	-1.0 T to +1.0 T	+1.0	Y	Y	N	N
< Trace >							
MEAS COPY							
REF TRACE		1 to 8	1	Y	Y	N	N
AUTO STORE		OFF 1 to 8	OFF	Y	Y	N	N
DELETE REF		1 to 8	1	N	N	N	N

Table 3-4 Initial Settings (7/12)

Setting item		Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Range >							
RANGE			AUTO	Y	Y	Y	Y
IMPD-EXT G-PH	PORT1	AUTO 7 Vrms 5 Vrms 2 Vrms 1 Vrms 500 mVrms 200 mVrms 100 mVrms 50 mVrms 20 mVrms 10 mVrms	AUTO	Y	Y	N	Y
	PORT2	AUTO 7 Vrms 5 Vrms 2 Vrms 1 Vrms 500 mVrms 200 mVrms 100 mVrms 50 mVrms 20 mVrms 10 mVrms	AUTO	Y	Y	N	Y
IMPD-3T		AUTO 1 M Ω 100 k Ω 10 k Ω 1 k Ω 100 Ω 10 Ω	AUTO	Y	Y	N	Y
IMPD-2T		AUTO 1 k Ω 100 Ω 10 Ω 1 Ω					
OVER LEVEL PORT1		0 to 7 Vrms	7 Vrms	Y	Y	N	Y
OVER LEVEL PORT1		0 to 7 Vrms	7 Vrms	Y	Y	N	Y
OVER ACT BEEP		ON OFF	ON	Y	Y	N	N
OVER ACT MEAS		CONT STOP	CONT	Y	Y	N	N
WTG FACTOR	PORT1	-999.999E+09 to +999.999E+09	1.0	Y	Y	N	Y
	PORT2	-999.999E+09 to +999.999E+09	1.0	Y	Y	N	Y
< Storage >							
SCRN COPY FILE NUMBER		000 to 999	000	N	Y	N	N

Table 3-4 Initial Settings (8/12)

Setting item		Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Remote >							
SELECT		USB GPIB RS-232 LAN	USB	N	Y	N	N
GPIB ADDRESS		0 to 30	2	N	Y	N	N
RS-232	BAUD RATE	4800 9600 19200 38400 57600 115200 230400	9600	N	Y	N	N
	FLOW CONTROL	NONE SOFT HARD	NONE	N	Y	N	N
	TERMINATOR	CR+LF LF	CR+LF	N	Y	N	N
LAN	DHCP	ENABLE DISABLE	ENABLE	N ^{*1}	Y	N	N
	IP ADDRESS	0.0.0.0 to 255.255.255.255	192.16.0.2	N ^{*1}	Y	N	N
	GATEWAY	0.0.0.0 to 255.255.255.255	0.0.0.0	N ^{*1}	Y	N	N
	SUBNET MASK	0.0.0.0 to 255.255.255.255	255.255.255.0	N ^{*1}	Y	N	N
	DNS	0.0.0.0 to 255.255.255.255	0.0.0.0	N ^{*1}	Y	N	N
	PORT NUMBER		5025	/	/	/	/
	MAC ADDRESS		00-14-CE-XX-XX-XX	-	-	-	-
HANDLER							
TRIG POLARITY		POSITIVE NEGATIVE	POSITIVE	N	Y	N	N
SWEEP DIR		UP DOWN SPOT	SPOT	Y	Y	N	N

*1: Initialized by LAN RESET

3.6 Initial Settings

Table 3-4 Initial Settings (9/12)

Setting item	Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Calibration >						
OPEN CORR	OFF 1 to 32	OFF	Y	Y	N	Y
SHORT CORR	OFF 1 to 32	OFF	Y	Y	N	Y
LOAD CORR	OFF 1 to 32	OFF	Y	Y	N	Y
LOAD STD FMT	C _S -D C _P -D R _P -C _P R _S -L _S R _S -X Z-θ	C _S -D	Y	Y	N	Y
LOAD STD VALUE	-1.0 T to +1.0 T	1.0	Y	Y	N	Y
PORT EXTENSION	ON OFF	OFF	Y	Y	N	Y
Z0	1.00 to 999 Ω	50.0 Ω	Y	Y	N	Y
ELEC LENGTH	0.000 to 999.999 m	0.000 m	Y	Y	N	Y
OPEN_PEXT CORR	OFF 1 to 32	OFF	Y	Y	N	Y
SHORT_PEXT CORR	OFF 1 to 32	OFF	Y	Y	N	Y
LOAD_PEXT CORR	OFF 1 to 32	OFF	Y	Y	N	Y
LOAD STD FMT	C _S -D C _P -D R _P -C _P R _S -L _S R _S -X Z-θ	C _S -D	Y	Y	N	Y
LOAD STD VALUE	-1.0 T to +1.0 T	1.0	Y	Y	N	Y
SLOPE COMP	ON OFF	OFF	Y	Y	N	Y
EQUALIZING	OFF 1 to 32	OFF	Y	Y	N	Y

Table 3-4 Initial Settings (10/12)

Setting item	Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence
< Calculate >						
EQUIV CKT FITTING						
CKT TYPE	CKT1 to CKT6	CKT1	Y	N	N	N
(PRMTR1)	0 to 999.999 G	1.0	Y	N	N	N
(PRMTR2)	0 to 999.999 G	1.0	Y	N	N	N
(PRMTR3)	0 to 999.999 G	1.0	Y	N	N	N
(PRMTR4)	0 to 999.999 G	1.0	Y	N	N	N
PZT PARAMETER						
C ₀	0 to 999.999 GF	1.0	Y	N	N	N
L	0 to 999.999 GH	1.0	Y	N	N	N
C	0 to 999.999 GF	1.0	Y	N	N	N
R	0 to 999.999 GΩ	1.0	Y	N	N	N
C0 MODE	RESNf fmax Gmax Bavg	RESNf	Y	Y	N	N
FREQ RESOLN	3 to 2000	100	Y	Y	N	N
PZT CONSTANT						
PZT CONSTANT	Disk-Radial Disk-Thickness extensional Rod-Axial Plate-Length extensional Plate-Thickness shear	Disk -Radial	Y	Y	N	N
l	0 to 999.999 mm	10.0 mm	Y	Y	N	N
a	0 to 999.999 mm	10.0 mm	Y	Y	N	N
t	0 to 999.999 mm	10.0 mm	Y	Y	N	N
d	0 to 999.999 mm	10.0 mm	Y	Y	N	N
RELATIVE PERMITTIVITY	0 to 10000	1000	Y	Y	N	N
POISSON'S RATIO	0.2 to 0.5	0.3	Y	Y	N	N
DENSITY	0 to 100 kg/m ³	8.0 kg/m ³	Y	Y	N	N
REL PERMT						
ELECTRODE AREA	0 to 1.0E+06 mm ²	100 mm ²	Y	Y	N	N
ELECTRODE DISTANCE	0 to 1000 mm	1.0 mm	Y	Y	N	N
REL PERMB						
CORE AREA	0 to 1.0E+06 mm ²	100 mm ²	Y	Y	N	N
MAG PATH LENGTH	0 to 1000 mm	100.0 mm	Y	Y	N	N
COIL TURNS	1 to 10000	100	Y	Y	N	N
WIRE DIAMETER	0 to 100 mm	0.2 mm	Y	Y	N	N
ONE TURN LENGTH	0 to 1000 mm	100 mm	Y	Y	N	N
WIRE RESISTIVITY	0 to 1.00 Ωm	16.80 nΩ m	Y	Y	N	N

3.6 Initial Settings

Table 3-4 Initial Settings (11/12)

Setting item	Parameter range	Initial value	Reset	Resume	Save as measurement data	Sequence	
< Comparator >							
BIN	ON OFF	OFF	Y	Y	N	N	
DEVIATION TYPE	ABS DEV DEV%	ABS	Y	Y	N	N	
PRI REF	-999.999 G to +999.999 G	1.0	Y	Y	N	N	
SEC REF	-999.999 G to +999.999 G	1.0	Y	Y	N	N	
BIN SET	-999.999 G to +999.999 G	0.0	Y	Y	N	N	
ZONE	ON OFF	OFF	Y	Y	N	N	
DEVIATION TYPE	IMMED REF(DEV) REF(DEV%)	REF(DEV)	Y	Y	N	N	
DEVIATION SET							
REF TRACE	1 to 8	1	Y	Y	N	N	
Y1 HI	NA -999.999 G to +999.999 G	NA	Y	Y	N	N	
Y1 LO	NA -999.999 G to +999.999 G	NA	Y	Y	N	N	
Y2 HI	NA -999.999 G to +999.999 G	NA	Y	Y	N	N	
Y2 LO	NA -999.999 G to +999.999 G	NA	Y	Y	N	N	
IMMED SET							
SWEEP	-999.999 G to +999.999 G	1.0	Y	Y	N	N	
Y1 HI LO, Y2 HI LO	NA -999.999 G to +999.999 G	NA	Y	Y	N	N	
ACTION BEEP	ON OFF	ON	Y	Y	N	N	
< Other >							
BEEP	ON OFF	ON	Y	Y	N	N	
DATE/TIME	YEAR	1998 to 2099	(At time of shipment)	N	Y	Y	N
	MONTH	1 to 12	(At time of shipment)	N	Y	Y	N
	DATE	1 to 31	(At time of shipment)	N	Y	Y	N
	TIME	0 to 23	(At time of shipment)	N	Y	Y	N
	MINUTE	0 to 59	(At time of shipment)	N	Y	Y	N
	SEC	0 to 59	(At time of shipment)	N	Y	Y	N
BRIGHTNESS	0 to 100	50	N	Y	N	N	
TIME ZONE	-	(At time of shipment)	N	Y	N	N	

4. Basic Operations

4.1	Display and Operation when Power Is Turned On	4-2
4.1.1	Check before Turning On the Power	4-2
4.1.2	Turning the Power On and Off	4-2
4.1.3	Restoration of Settings at Power On	4-3
4.1.4	Startup Screen and Operation on Startup	4-4
4.2	Simple Operation for First Time Use	4-5
4.2.1	Common Operations	4-5
4.2.2	Measuring Impedance (Measurement Mode: IMPD-EXT).....	4-6
4.2.3	Measuring Impedance (Measurement Mode: IMPD-3T)	4-9
4.2.4	Measuring Impedance (Measurement Mode: IMPD-2T)	4-11
4.2.5	Measuring Gain and Phase (Measurement Mode: G-PH).....	4-12
4.3	Setting Measurement Signals	4-13
4.4	Measurement Controls.....	4-18
4.5	Setting Sweep Measurement.....	4-19
4.6	Setting Spot Measurement.....	4-25

4.1 Display and Operation when Power Is Turned On

4.1.1 Check before Turning On the Power

Before turning the power switch on, read “2.3 Grounding and Power Supply Connection” and check this instrument grounding and power supply voltage.

4.1.2 Turning the Power On and Off

This instrument has the three operation states listed below. The operation state is switched by using the power switch (rear panel) and the standby switch (front panel). The operation state is indicated by the lighting state of the standby switch.

Power-on state	This instrument is operating and the settings can be configured and measurement can be performed. Standby switch: Lit in green
Power-off state	This instrument is disconnected from the power supply (not operating). Standby switch: Not lit
Standby state	Power is supplied to this instrument, but this instrument is not operating. Standby switch: Lit in orange

The general procedures for turning the power on and off are described below.

■ Switching to the power-on state

Check that an appropriate power supply is being supplied to the power cord connected to the power inlet and that the power switch is set to the “I” position.

Press the standby switch. The standby switch lights in green, this instrument switches to the power-on state, all of the LED lamps on the front panel light for 2 to 3 seconds, the startup screen is displayed on the LCD, and then this instrument becomes operable.

■ Switching to the standby state

Press the standby switch while this instrument is operating (power-on state). A shutdown confirmation message appears on the LCD. Tap [OK] to start the shutdown process (stop process). All of the LED lamps on the front panel light and then this instrument switches to the standby state and operation stops within 10 or more seconds. When this instrument switches to the standby state, the standby switch lights in orange.

■ Switching to the power-off state

Perform one or both of the following operations while this instrument is in the standby state.

Set the power switch to the “o” position.

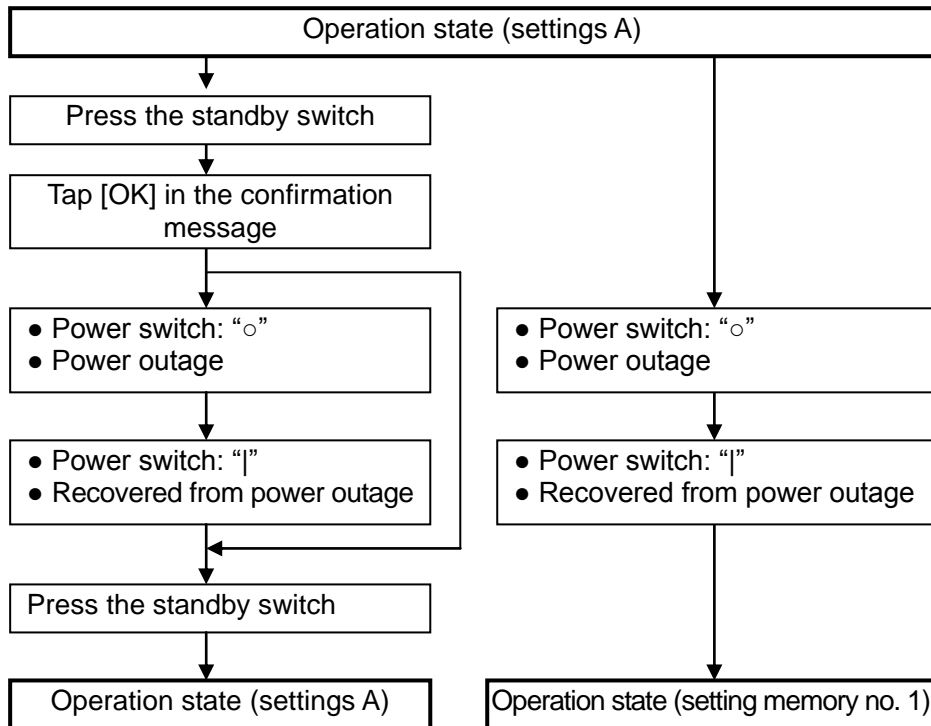
Disconnect the power cord from the power inlet (or disconnect the power plug from the power outlet).

The standby switch will not be lit in the power-off state.

In normal use, there is no need to switch to the power-off state.

4.1.3 Restoration of Settings at Power On

The setting state when this instrument starts differs depending on how the power last turned off. In any case, however, the measurement signal is always off after startup.

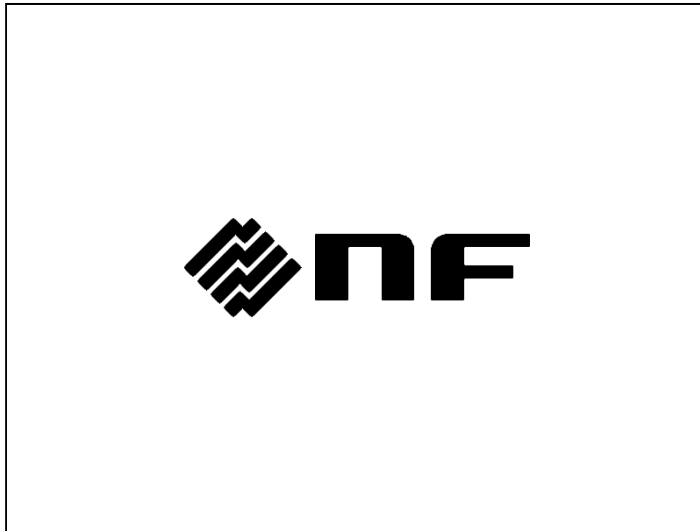


If this instrument has stopped operating because of a power outage or the power switch being set to the “o” position, the power will be turned on automatically by the process for recovery from a power outage or by setting the power switch to the “I” position (standby switch operation is not necessary). However, the settings when the power is restored will not be in the state immediately before the power interruption but will instead become the settings in setting memory no. 1. For details on setting memory, refer to “1.17 Memory Operations” in Instruction Manual (Advanced).

4.1.4 Startup Screen and Operation on Startup

When the power switch is turned on, the startup screen appears. Furthermore, all lamps are lit for the first several seconds while an operation check is performed.

During this period, the internal initial settings are configured and self-diagnosis is performed. If an error is detected, an error message is displayed. If that happens, turn off the power switch on the rear panel, wait at least five seconds, and then turn the power switch back on. If the error occurs again, this instrument may be malfunctioning, so please contact NF Corporation or its authorized agent.



When this instrument starts up normally, the initial screen appears.

2019/02/15 09:40:25	IMPD-EXT IDLE	FREQUENCY [Hz]	AC [Vrms]	DC [V]	SETUP	MENU
		0.000 00	0.00	0.00		

Initial Screen

From this point, operations such as setting and measurement are possible.

4.2 Simple Operation for First Time Use

This section describes setting procedures for basic measurements.

4.2.1 Common Operations

■ Reset settings.

Reset the settings of this instrument as follows.

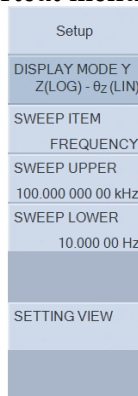
Select [Other]—[RESET] and then tap the [RESET] function key. A confirmation message appears on the LCD. Tap the [OK] button to reset the settings.

For details on the settings that are reset, refer to “3.6 Initial Settings”.

■ SETUP Key

Press the **SETUP** key on the front panel or tap the [SETUP] button to display the Setup menu.

This shortcut menu allows you to easily set the items for which settings are frequently changed.



[DISPLAY MODE Y] : Set the graph Y-axis (measurement item).

[SWEEP ITEM] : Set the sweep item.

[SWEEP UPPER] : Set the sweep upper limit.

[SWEEP LOWER] : Set the sweep lower limit.

[SETTING VIEW] : Display the major settings.

For details on changing the settings and other procedures, refer to “3.3.1 Menu Operating Procedures”.

4.2.2 Measuring Impedance (Measurement Mode: IMPD-EXT)

The IMPD-EXT measurement mode requires current-voltage conversion (current detection resistor / shunt resistor, current probe, etc.) to be performed for measurement but the impedance characteristics of a DUT can be measured using a high voltage or high current, which is not possible with general impedance analyzers. This is achieved by amplifying the measurement signal of this instrument using a DUT drive amplifier. Furthermore, since a measurement connection appropriate for the DUT is possible, impedance characteristic of a DUT with grounding can also be measured.

■ Example impedance measurement connection of DUT using large voltage

Connect the voltage of the DUT to PORT1 and connect the voltage resulting from converting the current flowing to the DUT to PORT2.

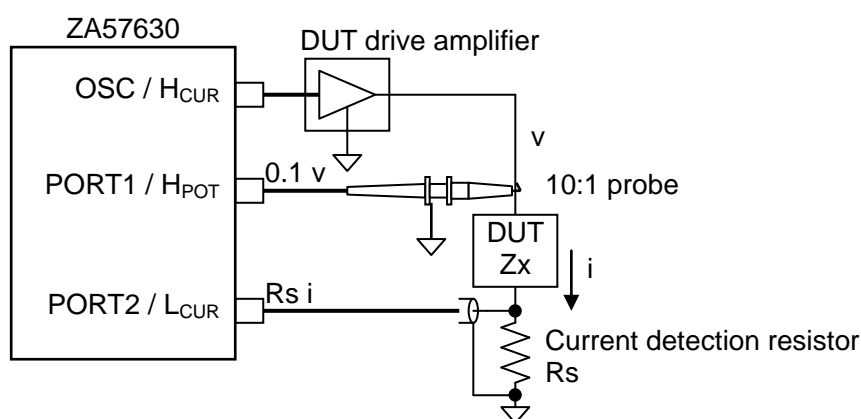


Figure 4-1 Impedance Measurement Connection Example 1 (IMPD-EXT, Measurement of High Voltage)

The above connection allows you to obtain the value of impedance + current detection resistance of the DUT as the measurement result. The influence of the probe and current detection resistor can be removed by short correction and load correction. For details on short correction and load correction, refer to “1.8 Error Correction” in Instruction Manual (Advanced). When the measurement signal output is amplified by a DUT drive amplifier (power amplifier), the impedance characteristics of a DUT can be measured using a high voltage that exceeds the signal amplitude of this instrument (maximum 3 Vrms). When taking the measurement, use, for example, a probe for an oscilloscope or a differential probe so that the signal amplitude input to PORT1 will be no higher than 10 Vrms. Use a current detection resistor, CT, current probe, etc. to convert the current flowing to the DUT to a voltage and then measure the voltage at PORT2.

Setting the gain of the DUT drive amplifier in [OSC]—[POWER AMP GAIN] enables the signal amplitude to apply to the DUT to be directly set on this instrument. For details, refer to “4.3 Setting Measurement Signals”.

If the reciprocals of the conversion ratio for conversion using a probe or current detection resistor are set in [Range]—[WTG FAC PORT1] and [WTG FAC PORT2] respectively, the value equivalent to a DUT voltage/current will be converted and then displayed on this instrument. For details, refer to “1.8.2 Weighting Factor” in Instruction Manual (Advanced).

- Example of measurement connection of DUT with one line grounded

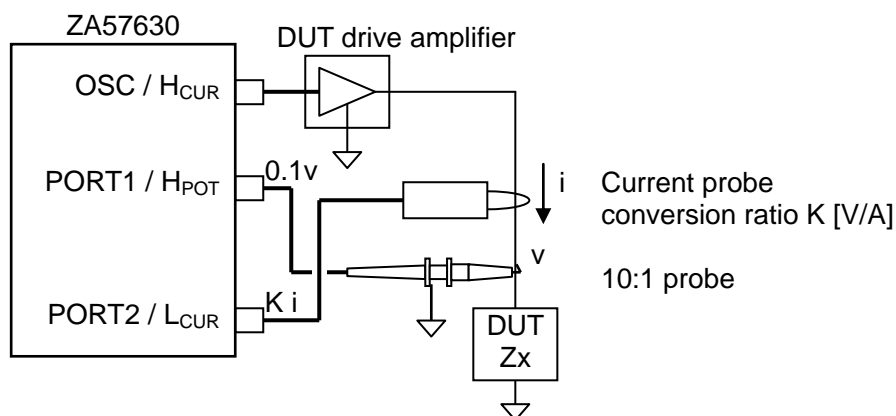


Figure 4-2 Impedance Measurement Connection Example 2 (IMPD-EXT, Measurement of DUT with Grounding)

If a current probe or CT is used for current detection, the impedance of a DUT with grounding can also be measured.

- Example of measurement connection of high-impedance DUT (micro current)

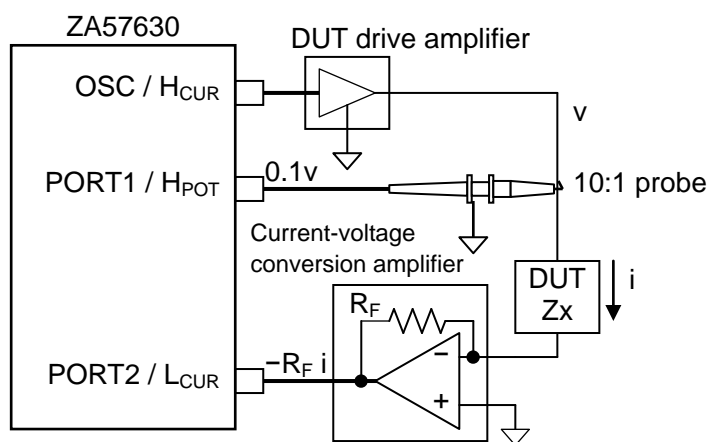
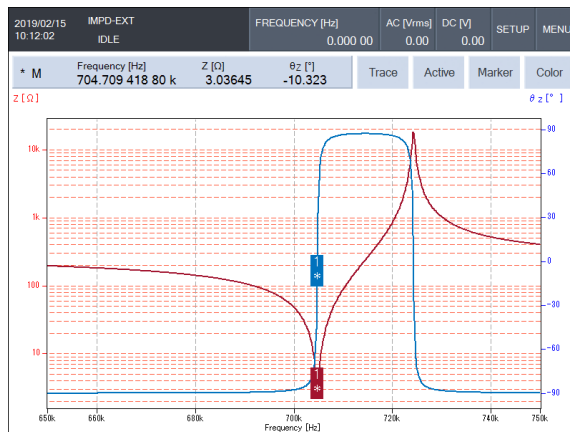


Figure 4-3 Impedance Measurement Connection Example 3 (IMPD-EXT, Measurement of High-Impedance DUT)

Using a current-voltage conversion amplifier for current detection enables the detection of a micro current of nA order or pA order in magnitude, which is difficult to measure with a shunt resistor or current probe, so a high-impedance DUT can be measured with high sensitivity. Amplifiers such as the CA5350 Programmable Current Amplifier and SA-600 Series Wideband Current Amplifier can be used as the current-voltage conversion amplifier. For details on these current-voltage conversion amplifiers, contact NF Corporation or its authorized agent.

Set up this instrument and perform measurement in the following order.

- 1) Set the measurement mode to IMPD-EXT in the [Mode] menu.
- 2) Reset the settings and then connect equipment and DUT.
- 3) Tap [SETUP] or press the **SETUP** key and then change each setting item as necessary.
 - [DISPLAY MODE Y] : Set the graph Y-axis item.
 - [SWEEP ITEM] : Set the sweep item.
 - [SWEEP UPPER] : Set the sweep upper limit.
 - [SWEEP LOWER] : Set the sweep lower limit.
- 4) The initial settings are 1 Vrms for the measurement signal amplitude, 0 V for the DC bias, and 1.0 for the DUT drive amplifier gain. If you wish to measure with a different signal amplitude or use a DUT drive amplifier, tap the [OSC] menu and change the settings.
 - [AMPLITUDE] : Set the measurement signal amplitude.
 - [DC BIAS] : Set the DC bias.
 - [POWER AMP GAIN] : Set the DUT drive amplifier gain.
- 5) Set the conversion coefficient of the voltage probe, current detection resistor, current probe, etc. Set the following items in the [Range] menu.
 - [WTG FAC PORT1] : Set the reciprocal of the conversion ratio of the voltage probe.
 - [WTG FAC PORT2] : Set the reciprocal of the current-voltage conversion ratio.
- 6) Press the **AC/DC ON** key to turn measurement signal output on.
- 7) Press the **MEASURE DOWN** key to perform down-sweep measurement and then wait for the sweep to end. The following shows an example of when a frequency sweep was performed.



- 8) Operating the knob moves a marker on the measurement data. This allows you to read the measurement value at any frequency. You can also perform operations such as detecting the maximum value, searching, and finding the location of an arbitrary gain value. For more details on the operations, refer to “1.7 Marker Operations” in Instruction Manual (Advanced).

Performing open correction, short correction, and load correction enables measurement for which the errors of the measurement system are corrected. For details on these correction procedures, refer to “1.8 Error Correction” in Instruction Manual (Advanced).

4.2.3 Measuring Impedance (Measurement Mode: IMPD-3T)

The IMPD-3T measurement mode is a mode to attach a commercially available test fixture used for an LCR meter or impedance analyzer to this instrument and then measure the impedance characteristics of components.

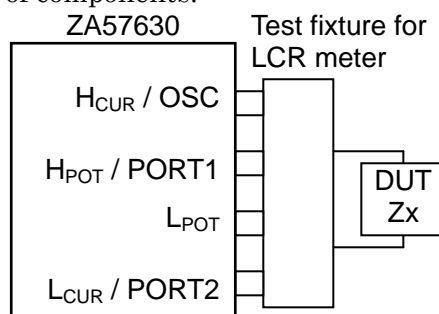


Figure 4-4 Impedance Measurement Connection Example 4 (IMPD-3T)

You can use a test fixture with an internal connection that is 4-terminal, 4-terminal-pair, or 2-terminal. For example, there are the ZM2363 TEST FIXTURE (for lead components) and ZM2394H CHIP TEST FIXTURE (for SMD). Other test fixtures are also available depending on the purpose. For details, contact NF Corporation or its authorized agent.

Measurement in the IMPD-3T mode will be with a 3-terminal connection to the DUT even when using a test fixture that is a 4-terminal or 4-terminal-pair. Therefore, measurements will be affected by contact resistance and its variations. For low impedance measurements of approximately 10 Ω or less, we recommend evaluating the measurement value variations due to contact resistance using an actual DUT before use.

Set up this instrument and perform measurement in the following order.

- 1) Set the measurement mode to IMPD-3T in the [Mode] menu.
- 2) Reset the settings and then connect the test fixture and DUT.
- 3) Tap [SETUP] or press the **SETUP** key and then change each setting item as necessary.
 - [DISPLAY MODE Y] : Set the graph Y-axis item.
 - [SWEEP ITEM] : Set the sweep item.
 - [SWEEP UPPER] : Set the sweep upper limit.
 - [SWEEP LOWER] : Set the sweep lower limit.
- 4) Press the **AC/DC ON** key to turn measurement signal output on.
- 5) Press the MEASURE **DOWN** key to perform down-sweep measurement and then wait for the sweep to end.
- 6) Operating the knob moves a marker on the measurement data. This allows you to read the measurement value at any frequency. You can also perform operations such as detecting the maximum value, searching, and finding the location of an arbitrary gain value. For more details on the operations, refer to "1.7 Marker Operations" in Instruction Manual (Advanced).

Performing open correction, short correction, and load correction enables measurement for which the errors of the measurement system are corrected. For details on these correction

procedures, refer to “1.8 Error Correction” in Instruction Manual (Advanced).

The included 100 Ω RESISTOR can be used for checking the operation in the IMPD-3T measurement mode.

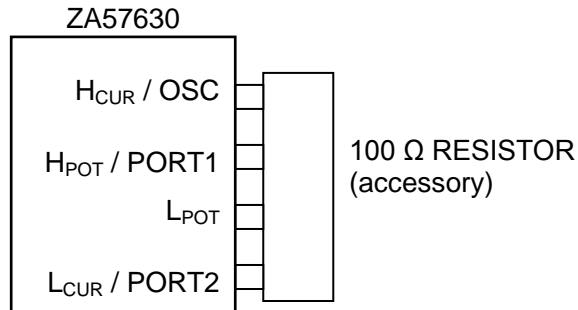


Figure 4-5 How to Check Operation Using 100 Ω RESISTOR (IMPD-3T)

The measurement result of impedance Z and phase θ_z are normal if they are roughly in the following ranges.

- 1 MHz or less Z : 100 $\Omega \pm 2.0 \Omega$, θ_z : $0^\circ \pm 2^\circ$
- 10 MHz or less Z : 100 $\Omega \pm 4.0 \Omega$, θ_z : $0^\circ \pm 10^\circ$
- 36 MHz or less Z : 100 $\Omega \pm 25.0 \Omega$, θ_z : $0^\circ \pm 20^\circ$

Measurements at frequencies above 10 MHz are for supplemental value.

4.2.4 Measuring Impedance (Measurement Mode: IMPD-2T)

The IMPD-2T measurement mode is a mode to measure the impedance of a DUT connected to PORT3 (N connector). The shielded side of the PORT3 connector is connected to the enclosure. Therefore, a DUT with grounding can be measured. Furthermore, this instrument includes a function to correct the phase shift due to the measurement cable (port extension function), so there is no limitation to the length of the measurement cable.

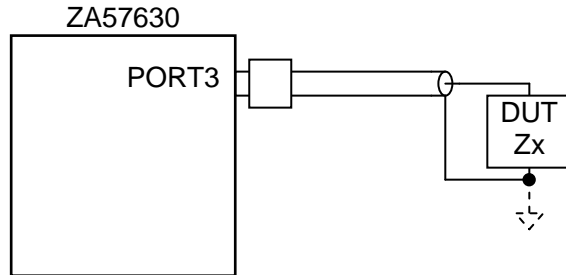


Figure 4-6 Impedance Measurement Connection Example 5 (IMPD-2T)

Measurement in the IMPD-2T mode is 2-terminal measurement using an N connector, so stable measurement even at high frequency is possible. However, measurements will be affected by connector contact resistance and coaxial cable wire resistance and their variations. For low impedance measurements of approximately $10\ \Omega$ or less, we recommend evaluating the measurement value variations due to contact resistance using an actual DUT before use.

Set up this instrument and perform measurement in the following order.

- 1) Set the measurement mode to IMPD-2T in the [Mode] menu.
- 2) Reset the settings and then connect the DUT.
- 3) Tap [SETUP] or press the **SETUP** key and then change each setting item as necessary.
 - [DISPLAY MODE Y] : Set the graph Y-axis item.
 - [SWEEP ITEM] : Set the sweep item.
 - [SWEEP UPPER] : Set the sweep upper limit.
 - [SWEEP LOWER] : Set the sweep lower limit.
- 4) Press the **AC/DC ON** key to turn measurement signal output on.
- 5) Press the MEASURE **DOWN** key to perform down-sweep measurement and then wait for the sweep to end.
- 6) Operating the knob moves a marker on the measurement data. This allows you to read the measurement value at any frequency. You can also perform operations such as detecting the maximum value, searching, and finding the location of an arbitrary gain value. For more details on the operations, refer to “1.7 Marker Operations” in Instruction Manual (Advanced).

Performing open correction, short correction, and load correction enables measurement for which the errors of the measurement system are corrected. Furthermore, the influence of the phase shift due to the measurement cable can be corrected by the port extension function. For details on these correction procedures, refer to “1.8 Error Correction” in Instruction Manual (Advanced).

4.2.5 Measuring Gain and Phase (Measurement Mode: G-PH)

The G-PH measurement mode is a mode to measure the transmission characteristics of an amplifier, filter, etc.

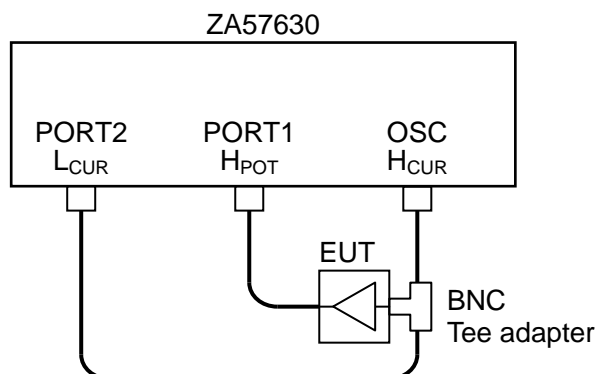


Figure 4-7 Gain and Phase Measurement Connection Example

Measure and display the gain and phase of the PORT1 signal using the PORT2 signal as the reference. The gain-phase characteristics of the EUT (equipment under test) can be obtained by measuring with the input signal of the EUT connected to PORT2 and the output signal connected to PORT1 as shown in the figure above.

Set up this instrument and perform measurement in the following order.

- 1) Set the measurement mode to G-PH in the [Mode] menu.
- 2) Reset the settings and then connect the EUT.
- 3) Tap [SETUP] or press the **SETUP** key and then change each setting item as necessary.
 - [DISPLAY MODE Y] : Set the graph Y-axis item.
 - [SWEEP ITEM] : Set the sweep item.
 - [SWEEP UPPER] : Set the sweep upper limit.
 - [SWEEP LOWER] : Set the sweep lower limit.
- 4) Press the **AC/DC ON** key to turn measurement signal output on.
- 5) Press the **MEASURE DOWN** key to perform down-sweep measurement and then wait for the sweep to end.
- 6) Operating the knob moves a marker on the measurement data. This allows you to read the measurement value at any frequency. You can also perform operations such as detecting the maximum value, searching, and finding the location of an arbitrary gain value. For more details on the operations, refer to "1.7 Marker Operations" in Instruction Manual (Advanced).

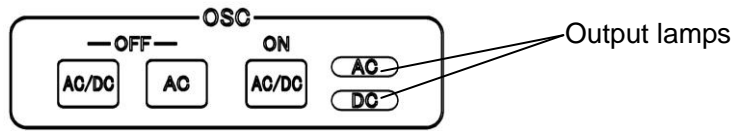
Performing equalizing enables measurement for which the errors of the measurement system are corrected. For details on equalizing, refer to "1.8.8 Equalizing" in Instruction Manual (Advanced).

4.3 Setting Measurement Signals

This section describes the basic settings and operations for measurement signals.

■ Turning output on/off

Operate the OSC keys on the front panel.



Press the **AC/DC ON** key to turn both AC output and DC output on.

Press the **AC/DC OFF** key to turn both AC output and DC output off.

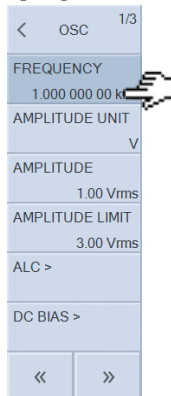
Press the **AC OFF** key to turn only AC output off. DC output remains on.

Output can also be turned on when measurement starts and turned off automatically when measurement ends. Use this when you wish the application of a signal to the DUT to be kept to the minimum. For details, refer to “1.4.1 Measurement Synchronous Driving” in Instruction Manual (Advanced).

■ Setting the frequency

The following describes how to set the measurement signal frequency. The frequency can be set in the range of 10 μ Hz to 36 MHz with a 10 μ Hz resolution. This frequency setting is for measurement (spot measurement) performed at a fixed frequency.

Tap [OSC] – [FREQUENCY].



Tap a function key at the bottom of the LCD to set the frequency setting.

[SWEEP MIN -> FREQ]* : Set the frequency to the sweep lower frequency limit.

[SWEEP MAX -> FREQ]* : Set the frequency to the sweep upper frequency limit.

[MKR -> FREQ]* : Set the frequency to the frequency of the active marker.

[CURR -> FREQ] : Set the frequency to the current measurement signal frequency.

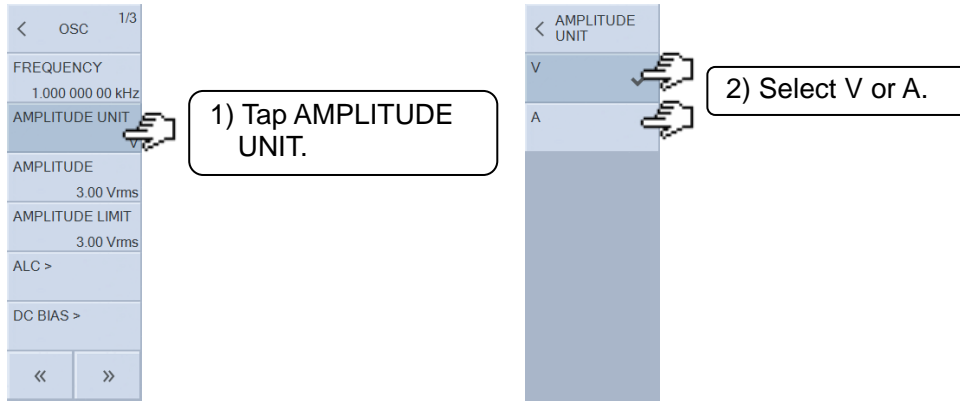
[EDIT] : Set the frequency with the numerical input palette.

[MODIFY] : Modify the frequency setting with the knob or cursor keys.

*: Displayed when frequency sweep.

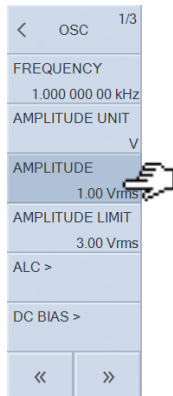
■ Setting the amplitude and DC bias unit

Select whether to set the signal amplitude (measurement signal amplitude or DC bias) as a voltage or a current. Tap [OSC] - [AMPLITUDE UNIT] and select whether voltage (V) or current (A). When the measurement mode is IMPD-3T and IMPD-2T, voltage or current can be selected. When the measurement mode is IMPD-EXT and G-PH, this is limited to voltage (setting as a current is not possible).



■ Setting the measurement signal amplitude

Set the measurement signal amplitude for measurement. This amplitude setting is for measurement (spot measurement) performed at a fixed amplitude. Tap [OSC] - [AMPLITUDE].



Tap a function key at the bottom of the LCD to set the amplitude setting.

- [SWEEP MIN -> AMPTD]* : Set the amplitude to the sweep lower amplitude limit.
- [SWEEP MAX -> AMPTD]* : Set the amplitude to the sweep upper amplitude limit.
- [MKR -> AMPTD]* : Set the amplitude to the amplitude of the active marker.
- [CURR -> AMPTD] : Set the amplitude to the current output amplitude.
- [EDIT] : Set the amplitude with the numerical input palette.
- [MODIFY] : Modify the amplitude setting with the knob or cursor keys.

*: Displayed when measurement signal amplitude sweep.

○ Limits on the measurement signal amplitude setting range and DC bias setting range

When normal DC bias is used, the settings for the measurement signal amplitude (converted to the peak value) and DC bias are limited to a total of ± 5 Vpk. Please note that when the DC bias is set to +4.5 V (or -4.5 V), the measurement signal amplitude setting range is limited to a

maximum of 0.352 Vrms (= (5-4.5) ÷ 1.42 (≈ √2)).

When HV bias is used, the settings for the measurement signal amplitude (converted to the peak value) and DC bias are limited to a total of ±42 Vpk. Please note that when the DC bias is set to +40 V (or -40 V), the measurement signal amplitude setting range is limited to a maximum of 1.40 Vrms (= (42-40) ÷ 1.42 (≈ √2)).

○ Setting the amplitude limit

You can set the maximum value for the measurement signal amplitude that can be output in [OSC] - [AMPLITUDE LIMIT]. In addition to preventing damage to the DUT caused by setting an incorrect amplitude, this will ensure that an amplitude exceeding the amplitude limit set here will also not be output during automatic level control (ALC) operation.

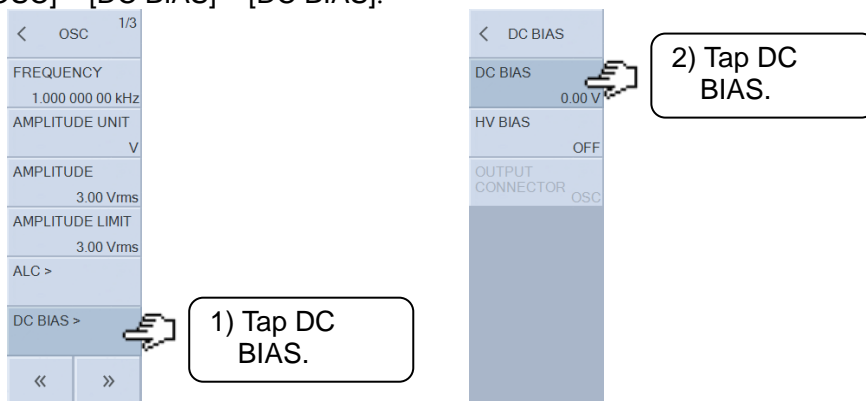
○ Setting the DUT drive amplifier gain

When the measurement mode is IMPD-EXT or G-PH, setting the DUT drive amplifier gain ([OSC] - [POWER AMP GAIN]) enables directly setting it as the signal amplitude to apply to the DUT. If the DUT drive amplifier gain is set to K, 0 to 3 × K Vrms will become the setting range. The amplitude limit setting range and mutual setting restriction range of DC bias and AC amplitude will also increase by K times (in the case of |K| < 1, the range is reduced from 3 Vrms). If a DUT drive amplifier will not be used, set to the initial value of 1.0.

■ Setting the DC bias

This is the setting of the DC bias applied to the device/equipment under test. It can be set in the range of -5 to +5 V.

Select [OSC] - [DC BIAS] - [DC BIAS].



Tap a function key at the bottom of the LCD to set the amplitude setting.

- [SWEEP MIN -> DC BIAS]* : Set the DC bias to the sweep lower DC bias limit.
- [SWEEP MAX -> DC BIAS]* : Set the DC bias to the sweep upper DC bias limit.
- [MKR -> DC BIAS]* : Set the DC bias to the DC bias of the active marker.
- [CURR -> DC BIAS] : Set the DC bias to the current output DC bias.
- [EDIT] : Set the DC bias with the numerical input palette.
- [MODIFY] : Modify the DC bias setting with the knob or cursor keys.

*: Displayed when DC bias sweep.

○ Normal DC bias and HV DC bias

HV DC bias can be used when the measurement mode is IMPD-3T and IMPD-2T. When [OSC] - [DC BIAS] - [HV BIAS] is set to ON, HV bias is enabled. When it is set to OFF, normal DC bias is enabled.

The setting range of normal DC bias is a maximum of ± 5 V, but a maximum of ± 40 V can be set for HV DC bias. A large DC bias can be applied to the DUT for measurement, but HV DC bias has the following limitations.

- The output impedance of the measurement signal connector (H_{CUR}) is approximately $1\text{ k}\Omega$ for DC and $50\ \Omega$ for AC. Consequently, the bias voltage actually applied to the DUT is significantly attenuated in the case of a DUT in which DC current flows (resistor, inductor, etc.). In the case of normal DC bias, the output impedance is approximately $50\ \Omega$ regardless of the frequency range.
- The lower frequency limit for which measurement is possible is 1 kHz. In the case of normal DC bias, the lower measurement frequency limit is $10\ \mu\text{Hz}$.

○ Limits on the measurement signal amplitude setting range and DC bias setting range

When normal DC bias is used, the settings for the measurement signal amplitude (converted to the peak value) and DC bias are limited to a total of ± 5 Vpk. Please note that when the measurement signal amplitude is set to 3 Vrms, the DC bias setting range is limited to a maximum of $\pm 0.74\text{ V} (= (5 - 3 \times 1.42) (\approx \sqrt{2}))$.

When HV bias is used, the settings for the measurement signal amplitude (converted to the peak value) and DC bias are limited to a total of ± 42 Vpk. Please note that when the measurement signal amplitude is set to 3 Vrms, the DC bias setting range is limited to a maximum of $\pm 37.74\text{ V} (= (42 - 3 \times 1.42) (\approx \sqrt{2}))$.

○ Selecting the DC bias output connector

Normally, the DC bias is added to the measurement signal output and then output from the OSC connector on the front panel.

When the measurement mode is IMPD-EXT and G-PH, the DC bias will be output from the DC BIAS OUT connector on the rear panel if [OSC] - [DC BIAS] - [OUTPUT CONNECTOR] is set to [REAR]. Please note that the DC bias will not be output from the OSC connector on the front panel at that time. Use this setting when you wish to supply the DC bias applied to the device/equipment under test via a different path than the signal for measurement.

○ Setting the DUT drive amplifier gain

When the measurement mode is IMPD-EXT and G-PH, setting the DUT drive amplifier gain ([OSC] - [POWER AMP GAIN]) enables directly setting it as the DC bias to apply to the DUT. If the DUT drive amplifier gain is set to K, $(-5 \text{ to } +5) \times K\text{ V}$ will become the setting range. The amplitude limit setting range and mutual setting restriction range of DC bias and measurement signal amplitude will also increase by K times (in the case of $|K| < 1$, the range is reduced from ± 5 V). If a DUT drive amplifier will not be used, set to the initial value of 1.0.

4.3 Setting Measurement Signals

For details on advanced measurement signal settings other than the above, refer to “1.4 Measurement Signal Control” in Instruction Manual (Advanced).

4.4 Measurement Controls

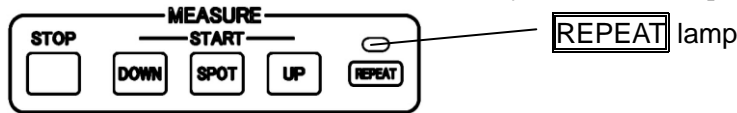
This section describes how to start and stop measurement with this instrument.

This instrument can perform sweep measurement and spot measurement.

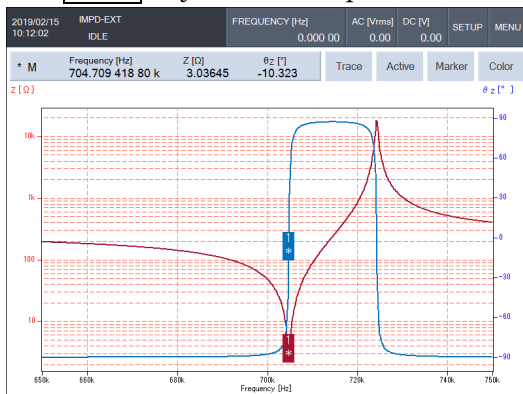
Sweep measurement: This measures the impedance characteristics by sweeping any of frequency, measurement signal amplitude, DC bias, and time. The measurement results are displayed in a graph. There is up-sweeping to measure the sweep item in ascending order and down-sweeping to measure the sweep item in descending order (time sweeping is only in ascending order).

Spot measurement: This measures at a fixed frequency, measurement signal amplitude, or DC bias. The measurement results are displayed as numerical values on the LCD.

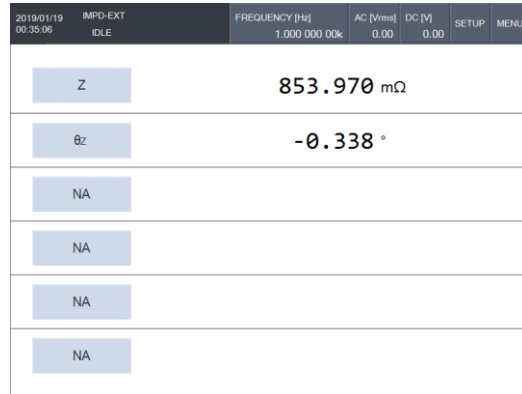
Measurement is controlled with the MEASURE keys on the front panel.



- DOWN** key : Start down-sweep measurement.
- SPOT** key : Start spot measurement.
- UP** key : Start up-sweep measurement.
- STOP** key : Stop measurement.



Example of screen after sweep measurement



Example of screen after spot measurement

Most operations, including saving and restoring settings or data and initialization, cannot be performed during measurement. To perform such operations, stop the measurement.

■ Trigger source

If [Measure] - [TRIGGER SOURCE] is set to other than PANEL, measurement cannot be controlled with the MEASURE keys on the front panel (key operation is ignored).

■ Measurement repeat control

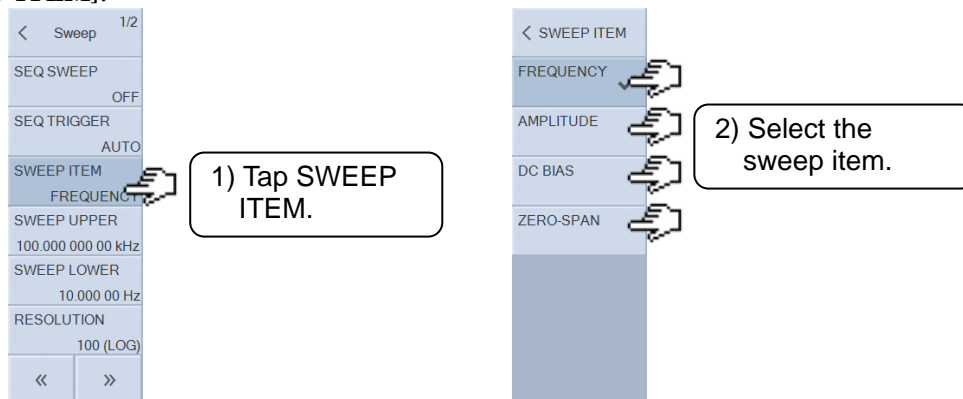
The **REPEAT** key sets the automatic repeating of measurement. When the **REPEAT** lamp is lit, both sweep and spot measurement will repeat. When the **REPEAT** lamp is not lit, this instrument enters the wait state when measurement finishes. Pressing the **REPEAT** key toggles the **REPEAT** lamp above the key on and off.

4.5 Setting Sweep Measurement

This section describes the basic settings for sweep measurement. The measurement results are displayed in a graph. For more details on the functions, refer to “1.6 Graph Operations” in Instruction Manual (Advanced).

■ Setting the sweep item

This instrument can measure by sweeping any of frequency, measurement signal amplitude (voltage or current), DC bias, and time (zero-span sweep). Set the sweep item in [Sweep] - [SWEEP ITEM].



[FREQUENCY] : Sweep the frequency.

[AMPLITUDE] : Sweep the measurement signal amplitude (voltage or current).

[DC BIAS] : Sweep the DC bias.

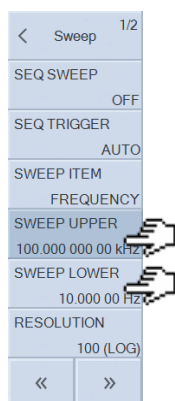
[ZERO-SPAN] : Zero-span sweep

In the case of the measurement signal amplitude sweep, whether voltage amplitude or current amplitude sweeping is performed is determined by whether the setting unit of the measurement signal is voltage or current. Refer to “■ Setting the amplitude and DC bias unit” in “4.3 Setting Measurement Signals”.

For the zero-span sweep, measurement is performed using the same conditions without changing the frequency, measurement signal amplitude, and DC bias.

■ Setting the sweep range

Set the range (upper limit and lower limit) for sweep measurement. Set the sweep upper limit in [Sweep] - [SWEEP UPPER] and the sweep lower limit in [Sweep] - [SWEEP LOWER].



The unit for the upper and lower limits differs depending on the sweep item ([Sweep] – [SWEEP ITEM]) setting.

● Sweep range when zero-span sweep

The sweep range cannot be set for a zero-span sweep. The sweep lower limit is fixed to 0 s. The sweep time is (the time required to perform one measurement (measurement time setting)) × (the sweep density setting ([Sweep] – [SWEEP RESOLUTION])). When a zero-span sweep is performed, the sweep upper time limit (sweep end time) may become even longer if auto range, automatic high density sweep, or ALC is set.

■ Setting the display mode

Select the items to display on the X-axis, Y1-axis, and Y2-axis of the graph in [Graph] – [DISPLAY MODE X] / [DISPLAY MODE Y]. The items that can be selected differ depending on the measurement mode. If a setting other than one in this table is set, nothing will be displayed in the graph. LIN indicates the linear axis, and LOG the logarithmic axis. Furthermore, “√” and “×” indicate whether or not the linear axis or logarithmic axis can be set.

Table 4-1 Display Modes (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T)

X-axis	LIN	LOG	Y1-axis	LIN	LOG	Y2-axis	LIN	LOG	Remarks
SWEEP	√	√*1	Z	√	√	θ_z	√	×	
SWEEP	√	√*1	Y	√	√	θ_y	√	×	
SWEEP	√	√*1	R	√	×	X	√	×	
SWEEP	√	√*1	G	√	×	B	√	×	
SWEEP	√	√*1	C _P	√	×	R _P	√	×	
SWEEP	√	√*1	C _P	√	×	D	√	×	
SWEEP	√	√*1	C _P	√	×	Q _C	√	×	
SWEEP	√	√*1	C _S	√	×	R _S	√	×	
SWEEP	√	√*1	C _S	√	×	D	√	×	
SWEEP	√	√*1	C _S	√	×	Q _C	√	×	
SWEEP	√	√*1	L _P	√	×	R _P	√	×	
SWEEP	√	√*1	L _P	√	×	Q _L	√	×	
SWEEP	√	√*1	L _S	√	×	R _S	√	×	
SWEEP	√	√*1	L _S	√	×	Q _L	√	×	
SWEEP	√	√*1	ϵ_s	√	×	D _{ϵ}	√	×	Relative permittivity
SWEEP	√	√*1	ϵ_s'	√	×	ϵ_s''	√	×	Relative permittivity
SWEEP	√	√*1	μ_s	√	×	D _{μ}	√	×	Relative permeability
SWEEP	√	√*1	μ_s'	√	×	μ_s''	√	×	Relative permeability
SWEEP	√	√*1	V1	√	√	V2	√	√	Voltage monitoring*2
SWEEP	√	√*1	V	√	√	I	√	√	Voltage/current monitoring*3
SWEEP*4	√	×	FREQ	√	×	θ_z	√	×	Resonant frequency tracking measurement
R	√	×	X	√	×	—	—	—	Complex impedance plane
R	√	×	-X	√	×	—	—	—	Cole-cole plot
G	√	×	B	√	×	—	—	—	Complex admittance plane

*1: LOG can be set only when SWEEP ITEM is FREQUENCY or AMPLITUDE.

*2: When the measurement mode is IMPD-EXT

*3: When the measurement mode is IMPD-3T and IMPD-2T

*4: When SWEEP ITEM is ZER-SPAN

Table 4-2 Display Modes (Measurement Mode: G-PH)

X-axis	LIN	LOG	Y1-axis	LIN	LOG	Y2-axis	LIN	LOG	Remarks
SWEEP	✓	✓*1	dBR	✓	×	θ	✓	×	Bode plot
SWEEP	✓	✓*1	R	✓	✓	θ	✓	×	
SWEEP	✓	✓*1	a	✓	×	b	✓	×	
SWEEP	✓	✓*1	dBR	✓	×	GD*3	✓	✓	
SWEEP	✓	✓*1	R	✓	✓	GD*3	✓	✓	
SWEEP	✓	✓*1	V1	✓	✓	V2	✓	✓	
SWEEP*2	✓	×	FREQ	✓	×	θ	✓	×	(Resonant frequency tracking measurement)
θ	✓	×	dBR	✓	×	—	—	—	Nichols plot
θ	✓	×	R	×	✓	—	—	—	
a	✓	×	b	✓	×	—	—	—	Nyquist plot

*1: LOG can be set only when SWEEP ITEM is FREQUENCY or AMPLITUDE.

*2: When SWEEP ITEM is ZER-SPAN

*3: Can be set only when SWEEP ITEM is FREQUENCY.

The axis setting parameters are described and their units are given in the following table.

Table 4-3 Graph Axis Parameters (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T)

Axis setting	Description	Unit
SWEEP	This is the sweep item. Select one of the following. Frequency measurement signal amplitude DC bias ZERO-SPAN	Hz Vrms / Arms V / A s
Z	Impedance	Ω
Y	Admittance	S
θ_Z	Phase (impedance)	°
θ_Y	Phase (admittance)	°
R	Resistance	Ω
X	Reactance	Ω
G	Conductance	S
B	Susceptance	S
L _P	Parallel inductance	H
L _S	Series inductance	H

Table 4-3 Graph Axis Parameters (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T) (Continued)

Axis setting	Description	Unit
C _P	Parallel capacitance	F
C _S	Series capacitance	F
R _P	Parallel resistance	Ω
R _S	Series resistance	Ω
Q _C	Quality coefficient (capacitance)	None
Q _L	Quality coefficient (inductance)	None
D	Dissipation factor (capacitance)	None
D _ε	Dissipation factor (relative permittivity)	None
D _μ	Dissipation factor (relative permeability)	None
V1, V2, V ^{*1}	Voltage amplitude	Vrms
I ^{*1}	Current amplitude	Arms
FREQ	Frequency	Hz
ε _S	Relative permittivity	None
ε _S '	Complex relative permittivity (real part)	None
ε _S ''	Complex relative permittivity (imaginary part)	None
μ _S	Relative permeability	None
μ _S '	Complex relative permeability (real part)	None
μ _S ''	Complex relative permeability (imaginary part)	None

*1: V1, V2, V, and I are the voltage and current values measured by this instrument. Whereas, impedance Z and other parameters are the results after various internal corrections have been made, so (Z=V/I) does not necessary hold true.

Table 4-4 Graph Axis Parameters (Measurement Mode: G-PH)

Axis setting	Description	Unit
SWEEP	This is the sweep item. Select one of the following. Frequency measurement signal amplitude DC bias ZERO-SPAN	Hz Vrms / Arms V / A s
R	Gain	None (ratio)
dBR	Gain	dB
θ	Phase	°
a	Gain (real part)	None (ratio)
b	Gain (imaginary part)	None (ratio)
GD	Group delay	s
V1,V2 ^{*1}	Voltage amplitude	Vrms
FREQ	Frequency	Hz

*1: V1 and V2 are the voltage values measured by this instrument. Whereas, gain R and other parameters are the results after various internal corrections have been made, so (R=V1 / V2) does not necessary hold true.

■ Formulas for converting measurement data to display parameters

This section describes the formulas for converting the various parameter formats that are used for measurement and display.

The magnitude of impedance and the phase obtained through measurement at frequency f [Hz] are Z [Ω] and θ [$^\circ$], respectively. Furthermore, each parameter is defined as follows.

$$p = \theta\pi / 180 \text{ [rad]}, \text{ angular frequency } \omega = 2 \pi f \text{ [rad/s]}$$

Table 4-5 Display Parameter Conversion Formulas (Measurement Mode: IMPD-EXT / IMPD-3T / IMPD-2T)

Display parameter	Units	Formula	Remarks
Z	Ω	Z	Magnitude of impedance
θ_z	$^\circ$	θ	Phase of impedance
Y	S	1/Z	Magnitude of admittance
θ_y	$^\circ$	$-\theta$	Phase of admittance
R	Ω	$Z \cos(p)$	Resistance
X	Ω	$Z \sin(p)$	Reactance
G	S	$\cos(p) / Z$	Conductance
B	S	$-\sin(p) / Z$	Susceptance
L_s	H	$Z \sin(p) / \omega$	Series inductance
L_p	H	$Z / (\omega \sin(p))$	Parallel inductance
C_s	F	$-1 / (Z \omega \sin(p))$	Series capacitance
C_p	F	$-\sin(p) / (Z \omega)$	Parallel capacitance
R_s	Ω	$Z \cos(p)$	Series resistance
R_p	Ω	$Z / \cos(p)$	Parallel resistance
Q_L	None	$\tan(p)$	Quality coefficient (inductor)
Q_C	None	$-\tan(p)$	Quality coefficient (capacitor)
D	None	$-1 / \tan(p)$	Dissipation factor (capacitor)
D_ϵ	None	$\epsilon_s'' / \epsilon_s'$	Dissipation factor (relative permittivity)
D_μ	None	μ_s'' / μ_s'	Dissipation factor (relative permeability)
ϵ_s	None	$\sqrt{\epsilon_s'^2 + \epsilon_s''^2}$	Relative permittivity*1
ϵ_s'	None	C_p / C_0	Complex relative permittivity (real part)*1
ϵ_s''	None	$1 / (\omega C_0 R_p)$	Complex relative permittivity (imaginary part)*1
μ_s	None	$\sqrt{\mu_s'^2 + \mu_s''^2}$	Relative permeability*2
μ_s'	None	L_s / L_0	Complex relative permeability (real part)*2
μ_s''	None	$(R_s - R_w) / (\omega L_0)$	Complex relative permeability (imaginary part)*2

*1: C_0 is the virtual capacitance when the DUT is a dielectric substance in a vacuum. For details on relative permittivity measurement, refer to "1.13 Relative Permittivity Measurement" in Instruction Manual (Advanced).

*2: L_0 is the virtual inductance when the DUT is a magnetic substance in a vacuum. R_w is the amount equivalent to the winding resistance of the DUT (coil). For details on relative permeability measurement, refer to "1.14 Relative Permeability Measurement" in Instruction Manual (Advanced).

When the measurement mode is G-PH, the ratio of V1 and V2 and the phase obtained through measurement at frequency f [Hz] are R [unitless] and θ [°], respectively. Furthermore, each parameter is defined as follows.

$$p = \theta / 180 \text{ [rad]}, \text{ angular frequency } \omega = 2\pi f \text{ [rad/s]}$$

Table 4-6 Display Parameter Conversion Formulas (Measurement Mode: G-PH)

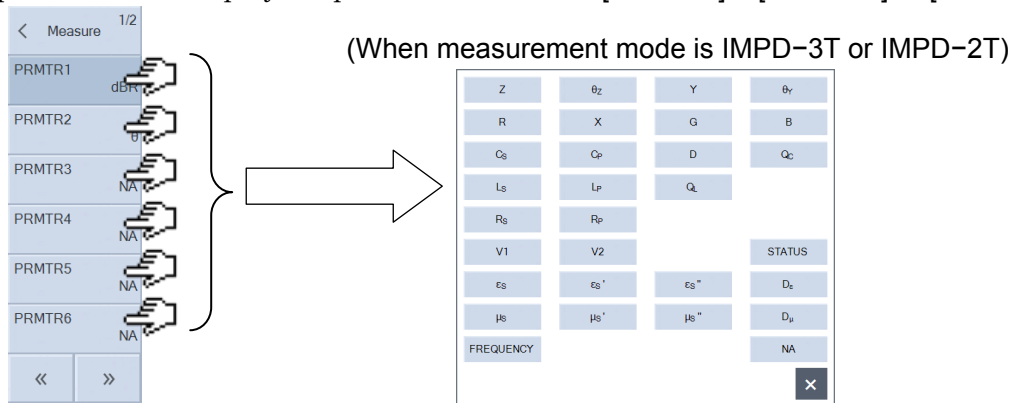
Display parameter	Units	Formula	Remarks
R	None	R	Gain
dBR	dB	$20 \times \log_{10}(R)$	Gain
θ	°	θ	Phase
a	None	$R \cos(p)$	Gain (real part)
b	None	$R \sin(p)$	Gain (imaginary part)
GD	s	$-\partial p / \partial \omega$	Group delay

4.6 Setting Spot Measurement

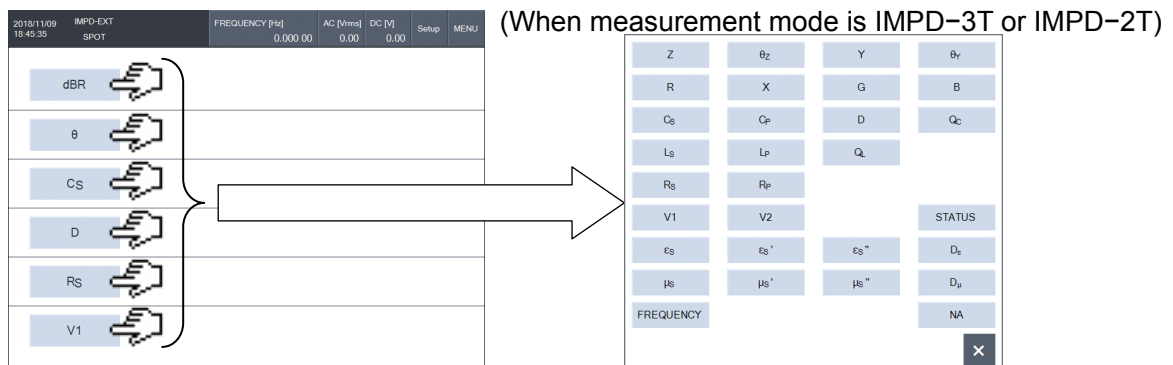
This section describes the basic settings for spot measurement.

Up to six parameters can be simultaneously measured and displayed in spot measurement. In addition, unlike sweep measurement, there are no limitations on the parameters that can be displayed simultaneously.

Set the parameters to display in spot measurement in [Measure] – [PRMTR1] to [PRMTR6].



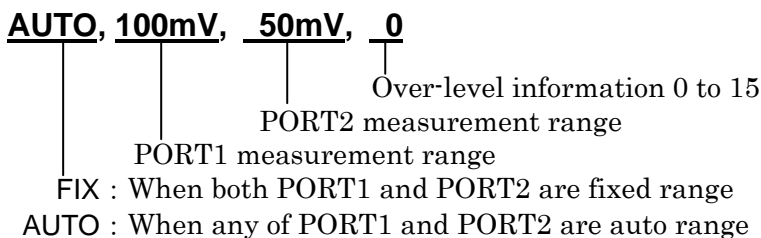
Tap the menu to display a palette listing the parameters that can be measured. Tap to select the parameters to measure and display in the palette. The measurement and display items can also be changed by tapping the parameter buttons in the spot measurement result screen.



If you select [NA], that parameter will be hidden (only PRMTR3 to 6). The types and formulas of parameters other than [STATUS] are the same as for sweep measurement. Refer to Table 4-3 and Table 4-6.

[STATUS] displays information such as the range and over-level information for measurement.

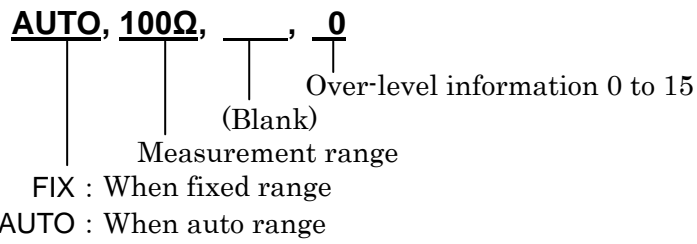
(Measurement Mode: IMPD-EXT and G-PH)



The over-level information is a decimal number from 0 to 13 with the following value added.

- When PORT1 over +8
- When PORT2 over +4
- When ALC error +1

(Measurement Mode 2: IMPD-3T and IMPD-2T)



The over-level information is a decimal number from 0 to 15 with the following value added.

When voltage detection section over	+8
When current detection section over	+4
When range over	+2
When ALC error	+1

5. Specifications

5.1 Measurement Modes	5-2
5.2 Measurement Value Display Ranges	5-3
5.3 Measurement Connectors (Measurement Mode IMPD-EXT).....	5-5
5.4 Measurement Connectors (Measurement Mode IMPD-3T)	5-8
5.5 Measurement Connectors (Measurement Mode IMPD-2T)	5-11
5.6 Measurement Connectors (Measurement Mode G-PH).....	5-14
5.7 Measured Signal Control Section	5-18
5.8 Measurement Accuracy	5-20
5.9 Measurement Processing Section	5-31
5.10 Display Section	5-35
5.11 Memory	5-36
5.12 External Memory	5-36
5.13 External Input/Output Function	5-37
5.14 Miscellaneous Specifications	5-39

Nominal, Typical, Supplemental, and Approximate values

These values are supplemental data do not represent a guarantee of the performance of this product.

Unless otherwise specified, the conditions are that $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, warming up for at least 30 minutes.

5.1 Measurement Modes

Four measurement modes are available depending on the measurement purpose.

- Measurement mode IMPD-EXT
 - Impedance measurement mode
 - Conversion between current to voltage needs to be performed externally.
 - DUT drive amplifier, probe, etc. can be used.
- Measurement mode IMPD-3T
 - Impedance measurement mode
 - Test fixture and test leads for LCR meters can be used.
- Measurement mode IMPD-2T
 - Impedance measurement mode
 - Stable measurement at high frequency is possible using an N connector.
- Measurement mode G-PH
 - Gain-phase measurement mode
 - For measuring transfer characteristics of filters and amplifiers

The connector to use for measurement differs depending on the measurement mode setting.

- IMPD-EXT, IMPD-3T, G-PH : H_{CUR}/OSC, H_{POT}/PORT1, L_{CUR}/PORT2
- IMPD-2T : PORT3

5.2 Measurement Value Display Ranges

The actual measurement and display ranges for each parameter are limited by the measurement range and frequency. The SI prefixes added before units represent a(10^{-18}), f(10^{-15}), p(10^{-12}), n(10^{-9}), μ (10^{-6}), m(10^{-3}), k(10^3), M(10^6), and G(10^9), respectively. The s and p suffixes of L, C, and R represent the series components and parallel components, respectively.

5.2.1 Measurement Mode IMPD-EXT

- Z (magnitude of impedance) 0 Ω to 999.999 G Ω , resolution 6 digits or 1 a Ω
- R, X (resistance, reactance) $\pm(1$ a to 999.999 G) Ω and 0 Ω , resolution 6 digits or 1 a Ω
- Y (Magnitude of admittance) 0 S to 999.999 GS, resolution 6 digits or 1 aS
- G, B (conductance, susceptance) $\pm(1$ a to 999.999 G) S and 0 S, resolution 6 digits or 1 aS
- L_S, L_P (inductance) $\pm(1$ a to 999.999 G) H and 0 H, resolution 6 digits or 1 aH
- C_S, C_P (capacitance) $\pm(1$ a to 999.999 G) F and 0 F, resolution 6 digits or 1 aF
- R_S, R_P (resistance) $\pm(1$ a to 999.999 G) Ω and 0 Ω , resolution 6 digits or 1 a Ω
- θ_Z , θ_Y (phase of impedance, phase of admittance)
 - $\pm 180^\circ$ -180.000° to 179.999° , resolution 0.001°
 - 0 to 360° 0.000° to 359.999° , resolution 0.001°
 - -360 to 0° -360.000° to -0.001° , resolution 0.001°
 - UNWRAP -9999.999° to $+9999.999^\circ$, resolution 0.001°
- D, D _{ϵ} , D _{μ} (dissipation factor) $\pm(0.00001$ to 99999.9) and 0 (unitless number)
resolution 6 digits or 0.00001
- Q_C, Q_L (quality coefficient) $\pm(0.00001$ to 99999.9) and 0 (unitless number)
resolution 6 digits or 0.00001
- V1, V2
Remark V1 and V2 are the voltages resulting from the PORT1 measurement voltage and PORT2 measurement voltage being corrected (multiplied) by the respective input weighting factor setting values.
- ϵ_S , ϵ_S' , ϵ_S'' , μ_S , μ_S' , μ_S'' (relative permittivity, relative permeability)
 $\pm(1$ a to 999.999 G) and 0 (unitless number), resolution 6 digits or 1 a
- FREQUENCY 10 μ Hz to 36.000 000 000 00 MHz, resolution 10 μ Hz
This item is selectable when resonant frequency tracking measurement.

5.2.2 Measurement Mode IMPD-3T and IMPD-2T

- Z (common to " • Z" in "5.2.1 Measurement Mode IMPD-EXT")
- R, X (common to " • R, X" in "5.2.1 Measurement Mode IMPD-EXT")
- Y (common to " • Y" in "5.2.1 Measurement Mode IMPD-EXT")
- G, B (common to " • G, B" in "5.2.1 Measurement Mode IMPD-EXT")
- L_S, L_P (common to " • L_S, L_P " in "5.2.1 Measurement Mode IMPD-EXT")
- C_S, C_P (common to " • C_S, C_P " in "5.2.1 Measurement Mode IMPD-EXT")
- R_S, R_P (common to " • R_S, R_P " in "5.2.1 Measurement Mode IMPD-EXT")
- θ_Z, θ_Y (common to " • θ_Z, θ_Y " in "5.2.1 Measurement Mode IMPD-EXT")
- D, D_ε, D_μ (common to " • D, D_ε, D_μ " in "5.2.1 Measurement Mode IMPD-EXT")
- Q_C, Q_L (common to " • Q_C, Q_L " in "5.2.1 Measurement Mode IMPD-EXT")
- V (voltage) 0 to 9.99999 Vrms, resolution 6 digits or 1 aVrms
- I (current) 0 to 99.9999 mA rms, resolution 6 digits or 1 aArms
- $\varepsilon_S, \varepsilon_S', \varepsilon_S'', \mu_S, \mu_S', \mu_S''$
(common to " • $\varepsilon_S, \varepsilon_S', \varepsilon_S'', \mu_S, \mu_S', \mu_S''$ " in "5.2.1 Measurement Mode IMPD-EXT")
- FREQUENCY (common to " • FREQUENCY" in "5.2.1 Measurement Mode IMPD-EXT")

5.2.3 Measurement Mode G-PH

- Gain
 - dBR (gain dB) -999.999 dB to +999.999 dB, resolution 0.001 dB
 - R (absolute gain) 0 to 999.999 G (unitless number), resolution 6 digits or 1 a
 - a (real part of gain) $\pm(1 \text{ a to } 999.999 \text{ G})$ or 0 (unitless number), resolution 6 digits or 1 a
 - b (imaginary part of gain) $\pm(1 \text{ a to } 999.999 \text{ G})$ or 0 (unitless number), resolution 6 digits or 1 a
- θ (phase)
 - $\pm 180^\circ$ -180.000° to $+179.999^\circ$, resolution 0.001°
 - 0 to 360° 0.000° to $+359.999^\circ$, resolution 0.001°
 - -360 to 0° -360.000° to -0.001° , resolution 0.001°
 - UNWRAP -9999.999° to $+9999.999^\circ$, resolution 0.001°
- GD (group delay) $\pm(1 \text{ a to } 999.999 \text{ G})\text{s}$ and 0 s, resolution 6 digits or 1 as
- V1, V2 0 to 999.999 GVrms, resolution 6 digits or 1 aVrms
- Remark V1 and V2 are the voltages resulting from the PORT1 measurement voltage and PORT2 measurement voltage being corrected (multiplied) by the respective input weighting factor setting values.

5.3 Measurement Connectors (Measurement Mode IMPD-EXT)

5.3.1 Front Panel H_{CUR}/OSC

An AC signal for measurement and a normal DC bias can be output as signals for measurement.

The AC signal for measurement is output from the front panel H_{CUR}/OSC connector.

The normal DC bias is output from either the front panel H_{CUR}/OSC connector or rear panel DC BIAS OUT connector selected as the output destination.

HV DC bias cannot be used in measurement mode IMPD-EXT.

When the normal DC bias output destination is set to the front panel H_{CUR}/OSC connector, a signal with the AC signal for measurement and normal DC bias composite is output from the front panel H_{CUR}/OSC connector.

Unless otherwise specified, DUT drive amplifier gain setting $K = +1.0$ and ALC is OFF

- Connector BNC connector (front panel H_{CUR}/OSC)
- Frequency
 - Setting range 10 μ Hz to 36 MHz
 - Setting resolution 10 μ Hz
 - Accuracy ± 10 ppm (when using internal reference clock)
- Measurement signal amplitude
 - Setting range 0 to 999 GVrms
 However, the setting range is limited to $(0 \text{ to } 3.0) \times |K|$ Vrms by DUT drive amplifier gain setting K.
 There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.
 $(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{Normal DC bias setting [V]}| \leq 5.0 \times |K|$
 - Setting resolution 3 digits or M_{AC} Vrms, whichever is the largest
 $M_{AC} = 10^{K'}$. Here, K' indicates the maximum integer that does not exceed $\log_{10}(|K| \times 10^{-5})$.
 Example) When $K = 9.8$, $K' = -5$, and $M_{AC} = 10 \mu$ Vrms.
 - Accuracy ± 0.3 dB or less
 Conditions: 1 kHz, 70 mVrms to 3.0 Vrms, no load
 - Frequency characteristics ± 0.3 dB or less (100 kHz or less)
 ± 0.5 dB or less (1 MHz or less)
 ± 1.0 dB or less (15 MHz or less)
 ± 3.0 dB or less (30 MHz or less)
 ± 4.0 dB or less (36 MHz or less)
 Conditions: 1 kHz reference, 70 mVrms to 3 Vrms, use normal DC

	bias, DC bias setting 0 V, 50 Ω load
Distortion	0.2% or less (no load when 100 kHz or less, BW500 kHz, and 3 Vrms output)
ALC	PORT1 / PORT2 / OFF The range that can be controlled constantly will be narrower than the setting range of the measurement signal amplitude depending on product variations or DUT impedance.
Output limit	
Setting range	1 aVrms to 999 GVrms
Setting resolution	3 digits or 1 aVrms, whichever is the largest
Remark	This function prevents an excessive signal level being output due to an incorrect setting. A measurement signal amplitude exceeding the output limit setting cannot be output.
• Normal DC bias	
Setting range	–999 GV to +999 GV However, the setting range is limited to $-5.00 \times K \text{ V}$ to $+5.00 \times K \text{ V}$ by DUT drive amplifier gain setting K. There is a following restriction between the measurement signal amplitude setting and normal DC bias setting. (Measurement signal amplitude setting [Vrms] \times 1.42) + Normal DC bias setting [V] \leq 5.0 \times K
Setting resolution	3 digits or $M_{DC} \text{ V}$, whichever is the largest $M_{DC} = 10^{K''}$. Here, K'' indicates the maximum integer that does not exceed $\log_{10}(K \times 10^{-2})$. Example: When $K = 82$, $K'' = -1$ and $M_{DC} = 100 \text{ mV}$.
Accuracy	
	$\pm(1\%$ of normal DC bias setting [V] + 3% of measurement signal amplitude setting [Vrms] + 30 mV) When no load
Remark	Either the front panel H _{CUR} /OSC or rear panel DC BIAS OUT is selected for the output connector of the normal DC bias.
• Output impedance	50 Ω (nominal value)
• DUT drive amplifier gain setting K	
	Set the gain of the amplifier or attenuator that supplies the measurement signal to the DUT. The measurement signal amplitude and normal DC bias applied to the DUT can be set directly.
Setting range	$\pm(1\text{E}-12 \text{ to } 1\text{E}+12)$
Setting resolution	3 digits or 1E–12, whichever is the largest

5.4 Measurement Connectors (Measurement Mode IMPD-3T)

5.4.1 Front Panel H_{CUR}/OSC

An AC signal for measurement and a DC bias can be output as signals for measurement.

The AC signal for measurement is output from the front panel H_{CUR}/OSC connector.

There are the two types of DC bias, the normal DC bias and HV DC bias, and the selected type can be used.

The normal DC bias and HV DC bias are output from the front panel H_{CUR}/OSC connector. (The normal DC bias and HV DC bias cannot be output from the rear panel DC BIAS OUT connector.)

A signal with the AC signal for measurement and DC bias composited is output from the front panel H_{CUR}/OSC connector.

Unless otherwise specified, the measurement signal amplitude is set as a voltage and ALC is OFF.

- Connector BNC connector (front panel H_{CUR}/OSC)
- Frequency
 - Setting range 10 μ Hz to 36 MHz (when HV DC bias is off)
 - 1 kHz to 36 MHz (when HV DC bias is on)
 - Setting resolution 10 μ Hz
 - Accuracy (Common to "• Frequency" in "5.3.1 Front Panel H_{CUR}/OSC")
- Measurement signal amplitude
 - Setting range
 - Voltage 0 to 3.00 Vrms
 - There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.
 - $(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{Normal DC bias setting [V]}| \leq 5.0$
 - There is a following restriction between the measurement signal amplitude setting and HV DC bias setting.
 - $(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{HV DC bias setting [V]}| \leq 42.0$
 - Current 0 to 60 mArms
 - The setting range is limited because it is dependent on the measurement range, etc.
 - There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.
 - $(\text{Measurement signal amplitude setting [Arms]} \times 71) + |\text{Normal DC bias setting [A]} \times 50| \leq 5.0$

Setting resolution	
Voltage	3 digits or 10 μ Vrms, whichever is the largest
Current	3 digits or 100 nArms, whichever is the largest
Accuracy	
When voltage setting	(Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H _{CUR} /OSC")
When current setting	(nominal value)
Frequency characteristics	(Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H _{CUR} /OSC")
Distortion	(Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H _{CUR} /OSC")
ALC	{CV (constant voltage) or CC (constant current)} / OFF Operation is with a CV when the measurement signal amplitude is set as a voltage and with a CC when it is set as a current. The range that can be controlled constantly will be narrower than the setting range of the measurement signal amplitude depending on product variations or DUT impedance.
Output limit	
Setting range	
Voltage	10 μ Vrms to 3.00 Vrms
Current	100 nArms to 60 mArms
Setting resolution	
Voltage	3 digits or 10 μ Vrms, whichever is the largest
Current	3 digits or 100 nArms, whichever is the largest
Remark	This function prevents an excessive signal level being output due to an incorrect setting. A measurement signal amplitude exceeding the output limit setting cannot be output.
Remark	The setting unit (voltage or current) is common for the measurement signal amplitude and normal DC bias.
• Normal DC bias	
Setting range	
Voltage	-5.00 V to +5.00 V There is a following restriction between the measurement signal amplitude setting and normal DC bias setting. (Measurement signal amplitude setting [Vrms] \times 1.42) + Normal DC bias setting [V] \leq 5.0
Current	-100 mA to +100 mA There is a following restriction between the measurement signal

amplitude setting and normal DC bias setting.

$$(\text{Measurement signal amplitude setting [Arms]} \times 71) + |\text{Normal DC bias setting [A]} \times 50| \leq 5.0$$

Setting resolution

Voltage 10 mV

Current 100 nA

Accuracy

When voltage setting (Common to " • Normal DC bias" in "5.3.1 Front Panel H_{CUR}/OSC")

When current setting (nominal value)

Remark The setting unit (voltage or current) is common for the measurement signal amplitude and normal DC bias.
The normal DC bias and HV DC bias cannot be used at the same time.

• HV DC bias

Setting range -40.0 V to +40.0 V (when no load)

There is a following restriction between the measurement signal amplitude setting and HV DC bias setting.

$$(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{HV DC bias setting [V]}| \leq 42.0$$

Setting resolution 10 mV

Accuracy $\pm(|1\% \text{ of HV DC bias setting [V]}| + 3\% \text{ of measurement signal amplitude setting [Vrms]} + 30 \text{ mV})$

However, when no load

Output Impedance 1 k Ω (nominal value)

Remark The measurement lower limit frequency is 1 kHz when the HV DC bias is used.

The normal DC bias and HV DC bias cannot be used at the same time.

• Output Impedance 50 Ω (nominal value)

When the HV DC bias is on, approximately 1 k Ω at approximately 100 Hz or less.

5.4.2 Front Panel H_{POT}/PORT1 and L_{CUR}/PORT2

- Input connectors BNC connectors (front panel H_{POT}/PORT1 and L_{CUR}/PORT2)
- Measurement range 10 Ω , 100 Ω , 1 k Ω , 10 k Ω , 100 k Ω , 1 M Ω , AUTO

5.5 Measurement Connectors (Measurement Mode IMPD-2T)

5.5.1 Front Panel PORT3

An AC signal for measurement and a DC bias can be output as signals for measurement.

The AC signal for measurement is output from the front panel PORT3 connector.

There are the two types of DC bias, the normal DC bias and HV DC bias, and the selected type can be used.

The normal DC bias and HV DC bias are output from the front panel PORT3 connector. (The normal DC bias and HV DC bias cannot be output from the rear panel DC BIAS OUT connector.)

A signal with the AC signal and DC bias composited is output from the front panel PORT3 connector.

Unless otherwise specified, the measurement signal amplitude is set as a voltage and ALC is OFF.

- Connector N connector (front panel PORT3)
- Frequency
 - Setting range 10 μ Hz to 36 MHz (when HV DC bias is off)
 - 1 kHz to 36 MHz (when HV DC bias is on)
 - Setting resolution 10 μ Hz
 - Accuracy (Common to " • Frequency" in "5.3.1 Front Panel H_{CUR}/OSC")
- Measurement signal amplitude
 - Setting range
 - Voltage 0 to 3.00 Vrms
 - There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.
 - $(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{Normal DC bias setting [V]}| \leq 5.0$
 - There is a following restriction between the measurement signal amplitude setting and HV DC bias setting.
 - $(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{HV DC bias setting [V]}| \leq 42.0$
 - Current 0 to 60 mArms
 - The setting range is limited because it is dependent on the measurement range, etc.
 - There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.
 - $(\text{Measurement signal amplitude setting [Arms]} \times 71) + |\text{Normal DC bias setting [A]} \times 50| \leq 5.0$

Setting resolution	
Voltage	3 digits or 10 μ Vrms, whichever is the largest
Current	3 digits or 100 nArms, whichever is the largest
Accuracy	
When voltage setting	(Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H _{CUR} /OSC")
When current setting	(nominal value)
Frequency characteristics	(Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H _{CUR} /OSC")
Distortion	(Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H _{CUR} /OSC")
ALC	{CV (constant voltage) or CC (constant current)} / OFF Operation is with a CV when the measurement signal amplitude is set as a voltage and with a CC when it is set as a current. The range that can be controlled constantly will be narrower than the setting range of the measurement signal amplitude depending on product variations or DUT impedance.
Output limit	
Setting range	
Voltage	10 μ Vrms to 3.00 Vrms
Current	100 nArms to 60 mArms
Setting resolution	
Voltage	3 digits or 10 μ Vrms, whichever is the largest
Current	3 digits or 100 nArms, whichever is the largest
Remark	This function prevents an excessive signal level being output due to an incorrect setting. A measurement signal amplitude exceeding the output limit setting cannot be output.
Remarks	The setting unit (voltage or current) is common for the measurement signal amplitude and normal DC bias.
• Normal DC bias	
Setting range	
Voltage	-5.00 V to +5.00 V There is a following restriction between the measurement signal amplitude setting and normal DC bias setting. (Measurement signal amplitude setting [Vrms] \times 1.42) + Normal DC bias setting [V] \leq 5.0
Current	-100 mA to +100 mA

There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.

$$(\text{Measurement signal amplitude setting [Arms]} \times 71) + |\text{Normal DC bias setting [A]} \times 50| \leq 5.0$$

Setting resolution

Voltage 10 mV

Current 100 nA

Accuracy

When voltage setting (Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H_{CUR}/OSC")

When current setting (nominal value)

Remark The setting unit (voltage or current) is common for the measurement signal amplitude and normal DC bias.
The normal DC bias and HV DC bias cannot be used at the same time.

• HV DC bias

Setting range -40.0 V to +40.0 V (when no load)

There is a following restriction between the measurement signal amplitude setting and HV DC bias setting.

$$(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{HV DC bias setting [V]}| \leq 42.0$$

Setting resolution 10 mV

Accuracy (Common to " • HV DC bias" in "5.4.1 Front Panel H_{CUR}/OSC")

Output impedance 1 k Ω (nominal value)

Remark The measurement lower limit frequency is 1 kHz when the HV DC bias is used.

The normal DC bias and HV DC bias cannot be used at the same time.

• Measurement range 1 Ω , 10 Ω , 100 Ω , 1 k Ω , AUTO

5.6 Measurement Connectors (Measurement Mode G-PH)

5.6.1 Front Panel OSC/H_{CUR}

An AC signal for measurement and a normal DC bias can be output as signals for measurement.

The AC signal for measurement is output from the front panel H_{CUR}/OSC connector.

The normal DC bias is output from either the front panel H_{CUR}/OSC connector or rear panel DC BIAS OUT connector selected as the output destination.

HV DC bias cannot be used in measurement mode G-PH.

When the normal DC bias output destination is set to the front panel H_{CUR}/OSC connector, a signal with the AC signal and normal DC bias composited is output from the front panel H_{CUR}/OSC connector.

Unless otherwise specified, DUT drive amplifier gain setting $K = +1.0$ and ALC is OFF

- Connector BNC connector (front panel H_{CUR}/OSC)
- Frequency
 - Setting range 10 μ Hz to 36 MHz
 - Setting resolution 10 μ Hz
 - Accuracy (Common to " • Frequency" in "5.3.1 Front Panel H_{CUR}/OSC")
- Measurement signal amplitude
 - Setting range 0 to 999 GVrms
 However, the setting range is limited to $(0 \text{ to } 3.0) \times |K| \text{ Vrms}$ by DUT drive amplifier gain setting K .
 There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.
 $(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{Normal DC bias setting [V]}| \leq 5.0 \times |K|$
 - Setting resolution 3 digits or $M_{AC} \text{ Vrms}$, whichever is the largest
 $M_{AC} = 10^{K'}$. Here, K' indicates the maximum integer that does not exceed $\log_{10}(|K| \times 10^{-5})$.
 Example: When $K = 9.8$, $K' = -5$, and $M_{AC} = 10 \mu\text{Vrms}$.
 - Accuracy (Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H_{CUR}/OSC")
 - Frequency characteristics (Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H_{CUR}/OSC")
 - Distortion (Common to " • Measurement signal amplitude" in "5.3.1 Front Panel H_{CUR}/OSC")
 - ALC PORT1 / PORT2 / OFF
 The range that can be controlled constantly will be narrower than

the setting range of the measurement signal amplitude depending on variations of the product or load/signal source impedance of the DUT.

Output limit

Setting range 1 aVrms to 999 GVrms

Setting resolution 3 digits or 1 aVrms, whichever is the largest

Remark This function prevents an excessive signal level being output due to an incorrect setting. A measurement signal amplitude exceeding the output limit setting cannot be output.

• Normal DC bias

Setting range -999 GV to +999 GV

However, the setting range is limited to $-5.00 \times K \text{ V}$ to $+5.00 \times K \text{ V}$ by DUT drive amplifier gain setting K.

There is a following restriction between the measurement signal amplitude setting and normal DC bias setting.

$$(\text{Measurement signal amplitude setting [Vrms]} \times 1.42) + |\text{Normal DC bias setting [V]}| \leq 5.0 \times |K|$$

Setting resolution 3 digits or $M_{DC} \text{ V}$, whichever is the largest

$M_{DC} = 10^{K''}$. Here, K'' indicates the maximum integer that does not exceed $\log_{10}(|K| \times 10^{-2})$.

Example: When $K = 82$, $K'' = -1$ and $M_{DC} = 100 \text{ mV}$.

Accuracy (Common to "• Normal DC bias" in "5.3.1 Front Panel H_{CUR}/OSC")

Remark Either the front panel H_{CUR}/OSC or rear panel DC BIAS OUT is selected for the output connector of the normal DC bias.

• Output Impedance 50 Ω (nominal value)

• DUT drive amplifier gain setting K

Set the gain of the amplifier or attenuator that supplies the measurement signal to the DUT.

The measurement signal amplitude and normal DC bias applied to the DUT can be set directly.

Setting range $\pm(1\text{E}-12 \text{ to } 1\text{E}+12)$

Setting resolution 3 digits or $1\text{E}-12$, whichever is the largest

5.6.2 Front Panel PORT1/H_{POT} and PORT2/L_{CUR}

- Input connectors BNC connectors (front panel PORT1/H_{POT} and PORT2/L_{CUR})
- Input Impedance 1 M Ω \pm 2 %, 25 pF \pm 5 pF (PORT1) / 30 pF \pm 5 pF (PORT2) in parallel
- Maximum non-destructive input voltage \pm 20 V
- Measurement range 10 mV_{rms} to 5 V_{rms}(1–2–5 sequence), 7 V_{rms} and AUTO
PORT1 and PORT2 can be set individually.

Measurement range and maximum measurement input voltage

Measurement range [rms]	Maximum measurement input voltage
10 mV	\pm 16 mV
20 mV	\pm 31 mV
50 mV	\pm 78 mV
100 mV	\pm 160 mV
200 mV	\pm 310 mV
500 mV	\pm 780 mV
1 V	\pm 1.6 V
2 V	\pm 3.1 V
5 V	\pm 7.8 V
7 V, AUTO	\pm 11 V

- Input weighting factor PORT1 and PORT2 can be set individually.
Setting range \pm (1.00000E–15 to 999.999E+09)
Setting resolution 6 digits or 1E–15
Remark This function corrects the conversion ratios of the voltage probe, current probe, preamplifier, etc. for measurement.
- Over detection
Setting range
H_{POT}/PORT1 0 to 7 V_{rms}
L_{CUR}/PORT2 0 to 7 V_{rms}
Setting resolution 3 digits or 1 μ V_{rms}, whichever is the largest.
Processing Buzzer alarm sound (can be turned on/off)
Stopping of measurement (can be turned on/off)
- Dynamic range 110 dB typ (10 Hz to 1 MHz)
60 dB typ (1 MHz to 10 MHz)
50 dB typ (10 MHz to 36 MHz)
(However, the largest of the port inputs is 3 V_{rms} and measurement time setting 40 s or more)

5.6.3 Rear Panel Normal DC Bias Output

- Connector BNC connector (rear panel DC BIAS OUT)
- Setting range and setting resolution (Common to " • Normal DC bias" in "5.3.1 Front Panel H_{CUR}/OSC")
- Accuracy (Common to " • Accuracy" in "5.3.3 Rear Panel Normal DC Bias Output")
- Output impedance 600 Ω (nominal value)
- Remark (Normal DC bias setting [V] ÷ K) [V] is output from the DC BIAS OUT connector.

Either the front panel H_{CUR}/OSC or rear panel DC BIAS OUT is selected for the output connector of the normal DC bias.

5.7 Measured Signal Control Section

- Signal output control

Measurement synchronous drive

SYNC(AC+DC) The measurement signal and DC bias are turned on at the start of measurement and turned off at the end of measurement.

SYNC(AC) The measurement signal is turned on at the start of measurement and turned off at the end of measurement. The DC bias does not change.

ASYNCR The measurement signal and DC bias are not changed at the start of measurement and end of measurement.

ON/OFF mode

QUICK The measurement signal amplitude and DC bias changes immediately.

SLOW Output changes gradually over a period of approximately 10 seconds.

0° SYNC This instrument waits until the measurement signal phase becomes 0° and then output turns off

Remark Regardless of the setting, output always turns on at phase 0°.

Frequency change mode

ASYNCR The frequency changes immediately.

0° SYNC The frequency changes when the measurement signal phase becomes 0°.

Remark The phase of the measurement signal is the phase at the signal source inside this instrument. It may differ from the phase of the signal applied to the DUT.

- Sweep

Sweep item One of frequency, measurement signal amplitude, DC bias, and time (zero span)

Sweep type Either linear or log
Log can be set only when the sweep item is frequency or measurement signal amplitude.

Sweep control SWEEP UP: Sweeps in the direction of lower limit → upper limit.

SWEEP DOWN: Sweeps in the direction of upper limit → lower limit.

SPOT: Measures with fixed frequency, measurement signal amplitude, and bias.

REPEAT: Repeats SWEEP or SPOT when turns on.

Sweep density	3 to 2,000 steps/sweep
Sweep time	
Frequency	From 0.5 ms/point 500 ms is added when frequency changes across 1 kHz. (frequency < 1 kHz ↔ frequency ≥ 1 kHz) 5 ms is added when frequency changes across 30 kHz. (frequency < 30 kHz ↔ frequency ≥ 30 kHz)
Signal amplitude	From 2 ms/point
DC bias	From 3 ms/point
Zero span	From 0.5 ms/point

5.8 Measurement Accuracy

5.8.1 Measurement Mode IMPD-EXT and G-PH

The conditions are that ambient temperature of 0 to +40°C, within 12 hours since self-calibration was performed after warming up for at least 30 minutes, and ambient temperature variations are within $\pm 5^\circ\text{C}$ after self-calibration.

DUT drive amplifier gain setting $K = +1.0$ and input weighting factor is 1.0 for both PORT1 and PORT2.

- Measurement accuracy Relative accuracy + Calibration accuracy
- Relative accuracy $\pm(\text{basic accuracy} + \text{dynamic accuracy} + \text{inter-range accuracy})$
- Calibration accuracy Accuracy of external equipment connected to this instrument, such as a shunt resistance, probe, or calibration standard
- Basic accuracy Upper row: Impedance Z (measurement mode IMPD-EXT)
Middle row: Gain (measurement mode G-PH)
Lower row: Phase

Measurement range [rms]	Measurement frequency [Hz]		
	$f \leq 1 \text{ M}$	$1 \text{ M} < f \leq 10 \text{ M}$	$10 \text{ M} < f \leq 36 \text{ M}$
7 V : 100 mV	0.12 % 0.01 dB 0.06°	0.35 % 0.03 dB	1.20 % 0.10 dB
50 mV : 10 mV	0.24 % 0.02 dB 0.12°	0.18°	0.60°

Conditions: Largest or mre of measurement time setting 100 ms and $(10 \div \text{measurement frequency [Hz]})$ s, measurement range of 10 mVrms to 7 Vrms, both ports have the same measurement range. The Z, gain and phase errors when full-scale signal (max. 3 Vrms) input of the measurement range.

- Dynamic accuracy Upper row: Impedance Z (measurement mode IMPD-EXT)
Middle row: Gain (measurement mode G-PH)
Lower row: Phase

Measurement range [rms]	Measurement frequency [Hz]		
	$f \leq 1 \text{ M}$	$1 \text{ M} < f \leq 10 \text{ M}$	$10 \text{ M} < f \leq 36 \text{ M}$
7 V : 100 mV	0.24 % 0.02 dB 0.12°	0.35 % 0.03 dB 0.18°	1.20 % 0.10 dB 0.60°
50 mV : 10 mV	1.20 % 0.10 dB 0.60°		

Conditions: Largest or more of measurement time setting 100 ms and $(10 \div$

measurement frequency [Hz] s, measurement range of 10 mVrms to 7 Vrms, and both ports have the same range. Z, gain and phase variation for when the signal level changes from full-scale (max. 3 Vrms) of measurement range to 3/10. The input signal is 1:1 or 1:0.3 between port.

- Inter-range accuracy Upper row: Impedance Z (measurement mode IMPD-EXT)
 Middle row: Gain (measurement mode G-PH)
 Lower row: Phase

Measurement range [rms]	Measurement frequency [Hz]		
	$f \leq 1 \text{ M}$	$1 \text{ M} < f \leq 10 \text{ M}$	$10 \text{ M} < f \leq 36 \text{ M}$
7 V	0.24 % 0.02 dB 0.12°	0.35 % 0.03 dB 0.18°	1.40 % 0.12 dB 0.72°
5 V	(Same as above)	(Same as above)	(Same as above)
2 V	(Same as above)	(Same as above)	(Same as above)
1 V	(Same as above)	(Same as above)	1.20 % 0.10 dB 0.60°
500 mV	(Same as above)	(Same as above)	(Same as above)
200 mV	(Same as above)	(Same as above)	(Same as above)
100 mV	(Same as above)	(Same as above)	(Same as above)
50 mV	(Same as above)	(Same as above)	(Same as above)
20 mV	(Same as above)	(Same as above)	(Same as above)
10 mV	0.35 % 0.03 dB 0.18°		(Same as above)

Conditions: Largest or more of measurement time setting 100 ms and (10 ÷ measurement frequency [Hz]) s, and measurement range of 10 mVrms to 7 Vrms. Z, gain and phase errors when difference of the measurement ranges of both port is one and the input signal levels are the same for both ports (full scale level of smallest measurement range, max. 3 Vrms).

5.8.2 Measurement Mode IMPD-3T

Unless otherwise specified, the conditions are that 0 to +40 °C, open and short correction was performed after warming up for at least 30 minutes.

- Basic accuracy $\pm 0.08\%$
- Measurement range

Measurement range Z_R	Measurable range	Recommended range
1 M Ω	900 k $\Omega \leq$	1 M Ω to 11 M Ω
100 k Ω	90 k $\Omega \leq$	100 k Ω to 1.1 M Ω
10 k Ω	9 k $\Omega \leq$	10 k Ω to 110 k Ω
1 k Ω	900 $\Omega \leq$	1 k Ω to 11 k Ω
100 Ω	No limitation	9 Ω to 1.1 k Ω
10 Ω	$\leq 10 \Omega$	1 Ω to 10 Ω

Measurable range: Approximate range in which measurement and display are possible (supplementary value)

Recommended range: Operating range in which measurement accuracy is high.

- Impedance measurement accuracy

Accuracy of $|Z|$

$\pm A_Z$ [%]

$$A_Z = \{(A + B \times U + K_Z + K_Y) \times K_V + K_B\} \times K_T$$

Accuracy of phase angle θ of impedance

$\pm P_Z$ [°]

when 10 kHz < f < 30 kHz and measurement range is 1 k Ω

$$P_Z = 0.573 \times \{(1.5 \times A + 1.5 \times B \times U + K_Z + K_Y) \times K_V + K_B\} \times K_T$$

when 10 kHz < f < 30 kHz and measurement range is 100 Ω

$$P_Z = 0.573 \times \{(2 \times A + 2 \times B \times U + K_Z + K_Y) \times K_V + K_B\} \times K_T$$

other than above

$$P_Z = 0.573 \times A_Z$$

Remark

The measurement accuracy when A_Z exceeds 10 % is a supplementary value.

Excluding the highest and lowest measurement ranges that can be used with that frequency, the measurement accuracy for a measured value smaller than half the lower limit of each recommended measurement range or larger than twice the upper limit is a supplementary value.

Each parameter value in the expression of A_Z and P_Z is listed below. The meaning of the symbol used when calculating each parameter is shown below.

Z_r : Measurement range [Ω]

Z_X : Measurement value [Ω] of magnitude of impedance $|Z|$

- U: Ratio coefficient

Z_r	U
$\geq 1 \text{ k}\Omega$	$ Z_X / Z_r - 1 $
$\leq 100 \Omega$	$ Z_r / Z_X - 1 $

- A (upper row): Basic coefficient [%]

B (lower row): Proportional coefficient [%]

Measurement time setting is larger than (200 ms or (20 / measurement frequency[Hz]) s) or more.

Measurement range Z_r	Measurement frequency [Hz]			
	$2 \text{ m} < f \leq 1 \text{ k}$	$1 \text{ k} < f < 30 \text{ k}$	$30 \text{ k} \leq f \leq 50 \text{ k}$	$50 \text{ k} < f \leq 100 \text{ k}$
1 M Ω	1.50 2.00	0.80 0.60	--- ---	--- ---
100 k Ω	0.30 0.20	0.25 0.10	0.70 0.70	0.40 0.40
10 k Ω	0.15 0.03	0.14 0.02	0.15 0.06	0.20 0.03
1 k Ω	0.10 0.01	0.09 0.01	0.09 0.01	0.14 0.02
100 Ω	0.13 0.03	0.06 0.04	0.05 0.05	0.06 0.10
10 Ω	0.30 0.15	0.30 0.20	0.40 0.15	0.40 0.15

Measurement range Z_r	Measurement frequency [Hz]			
	$100 \text{ k} < f \leq 1 \text{ M}$	$1 \text{ M} < f \leq 2 \text{ M}$	$2 \text{ M} < f \leq 5 \text{ M}$	$5 \text{ M} < f \leq 10 \text{ M}$
1 M Ω	--- ---	--- ---	--- ---	--- ---
100 k Ω	--- ---	--- ---	--- ---	--- ---
10 k Ω	0.20 0.03	0.80 0.30	--- ---	--- ---
1 k Ω	0.15 0.01	0.20 0.07	0.35 0.35	--- ---
100 Ω	0.15 0.03	0.15 0.05	0.20 0.20	0.30 0.40
10 Ω	0.40 1.20	0.50 2.00	1.50 5.00	--- ---

The measurement accuracy in the " - - - " column is not guaranteed.

- K_Z : Residual impedance coefficient [%]

Frequency range	K_Z [%]
$f \leq 1$ MHz	$2 / Z_X$ [Ω]
1 MHz $< f \leq 10$ MHz	f [kHz] $\times 2 \times 10^{-3} / Z_X$ [Ω]

- K_Y : Residual admittance coefficient [%]

Frequency range	K_Y [%]
$f < 30$ kHz	Z_X [Ω] / (1×10^8)
30 kHz $\leq f \leq 10$ MHz	f [kHz] $\times Z_X$ [Ω] / (3×10^9)

- K_V : Signal level coefficient

When the measurement signal amplitude setting is less than 100 mVrms, the measurement accuracy is not guaranteed.

When the signal level is set as a current, refer to K_V of the value calculated by measurement signal amplitude setting [Arms] $\times 71$ as the signal level [Vrms].

When the measurement signal amplitude setting is 2.1 mArms, refer to K_V of $2.1 \times 10^{-3} \times 71 = 149$ m[Vrms].

Measurement frequency ≤ 1 kHz

Measurement range Z_r	Signal level [Vrms]					
	100 m \leq V ≤ 300 m	300 m $<$ V ≤ 500 m	500 m $<$ V ≤ 800 m	800 m $<$ V < 1.00	V = 1.00	1.00 $<$ V ≤ 3.00
1 M Ω	5.0	2.5	2.0	1.0	1.0	1.0
100 k Ω	4.0	1.8	2.0	1.0	1.0	2.0
10 k Ω	3.0	1.5	1.5	1.0	1.0	2.5
1 k Ω	2.5	1.2	1.2	1.0	1.0	3.5
100 Ω	1.8	1.1	1.1	1.0	1.0	4.0
10 Ω	1.2	1.1	1.1	1.0	1.0	1.8

1 kHz $<$ Measurement frequency ≤ 30 kHz

Measurement range Z_r	Signal level [Vrms]					
	100 m \leq V ≤ 300 m	300 m $<$ V ≤ 500 m	500 m $<$ V ≤ 800 m	800 m $<$ V < 1.00	V = 1.00	1.00 $<$ V ≤ 3.00
1 M Ω	5.0	1.8	1.5	1.1	1.0	1.2
100 k Ω	3.5	1.5	1.5	1.1	1.0	2.0
10 k Ω	2.5	1.2	1.2	1.1	1.0	3.0
1 k Ω	2.0	1.2	1.1	1.1	1.0	4.5
100 Ω	2.5	1.2	1.5	1.1	1.0	6.5
10 Ω	1.1	1.1	1.1	1.1	1.0	2.0

30 kHz < Measurement frequency ≤ 100 kHz

Measurement range Z_r	Signal level [Vrms]					
	100 m ≤ V ≤ 300 m	300 m < V ≤ 500 m	500 m < V ≤ 800 m	800 m < V < 1.00	V = 1.00	1.00 < V ≤ 3.00
100 kΩ	8.0	2.5	1.8	1.1	1.0	2.0
10 kΩ	8.0	2.5	1.8	1.1	1.0	3.0
1 kΩ	6.5	2.0	1.5	1.1	1.0	5.0
100 Ω	6.0	2.0	2.0	1.1	1.0	7.0
10 Ω	1.2	1.1	1.2	1.1	1.0	1.8

100 kHz < Measurement frequency ≤ 1 MHz

Measurement range Z_r	Signal level [Vrms]					
	100 m ≤ V ≤ 300 m	300 m < V ≤ 500 m	500 m < V ≤ 800 m	800 m < V < 1.00	V = 1.00	1.00 < V ≤ 3.00
10 kΩ	5.0	1.8	1.5	1.0	1.0	3.0
1 kΩ	4.5	1.5	1.5	1.1	1.0	4.0
100 Ω	4.0	1.2	1.5	1.0	1.0	4.0
10 Ω	1.0	1.0	1.0	1.0	1.0	1.8

1 MHz < Measurement frequency ≤ 2 MHz

Measurement range Z_r	Signal level [Vrms]					
	100 m ≤ V ≤ 300 m	300 m < V ≤ 500 m	500 m < V ≤ 800 m	800 m < V < 1.00	V = 1.00	1.00 < V ≤ 3.00
10 kΩ	1.5	1.0	1.0	1.0	1.0	1.2
1 kΩ	1.5	1.0	1.0	1.0	1.0	3.0
100 Ω	2.0	1.0	1.2	1.0	1.0	4.0
10 Ω	1.0	1.0	1.0	1.0	1.0	1.2

2 MHz < Measurement frequency ≤ 10 MHz

Measurement range Z_r	Signal level [Vrms]					
	100 m ≤ V ≤ 300 m	300 m < V ≤ 500 m	500 m < V ≤ 800 m	800 m < V < 1.00	V = 1.00	1.00 < V ≤ 3.00
1 kΩ	1.0	1.0	1.0	1.0	1.0	2.0
100 Ω	1.5	1.0	1.0	1.0	1.0	2.0
10 Ω	1.0	1.0	1.0	1.0	1.0	1.0

- K_B : DC bias coefficient [%]

When the normal DC bias setting is 0.00 V, $K_B = 0\%$.

The K_B [%] when the normal DC bias is output from the front panel H_{CUR}/OSC is as shown in the table below. This is common for the voltage setting and current setting.

Normal DC bias

Measurement range Z_r	Measurement frequency [Hz]		
	$f \leq 1 \text{ k}$	$1 \text{ k} < f \leq 30 \text{ k}$	$30 \text{ k} < f \leq 10 \text{ M}$
1 M Ω	5.0	2.0	---
100 k Ω	1.0	0.2	2.0
10 k Ω	0.2	0.1	0.2
1 k Ω	0.1	0.1	0.1
100 Ω	0.3	0.3	0.3
10 Ω	0.5	0.5	0.5

The K_B [%] when the HV DC bias is enabled is as shown in the table below.

HV DC bias

Measurement range Z_r	Measurement frequency [Hz]	
	$1 \text{ k} \leq f < 30 \text{ k}$	$30 \text{ k} \leq f \leq 10 \text{ M}$
1 M Ω	2.0	---
100 k Ω	0.5	2.0
10 k Ω	0.2	0.2
1 k Ω	0.2	0.2
100 Ω	0.5	0.5
10 Ω	0.5	0.5

- K_T : Temperature-dependent coefficient

Ambient temperature T[°C]	K_T
0 ~ +18	$1 + k \times (18 - T)$
+18 ~ +28	1
+28 ~ +40	$1 + k \times (T - 28)$

- k: Temperature coefficient

Measurement range Z_r	Measurement frequency [Hz]			
	$f < 30 \text{ k}$	$30 \text{ k} \leq f \leq 1 \text{ M}$	$1 \text{ M} < f \leq 5 \text{ M}$	$5 \text{ M} < f \leq 10 \text{ M}$
1 M Ω	0.04	---	---	---
100 k Ω	0.05	0.04	---	---
10 k Ω	0.05	0.04	0.04	---
1 k Ω	0.06	0.04	0.06	---
100 Ω	0.08	0.05	0.04	0.08
10 Ω	0.03	0.02	0.02	---

5.8.3 Measurement Mode IMPD-2T

Unless otherwise specified, the conditions are that 0 to +40 °C, open and short correction was performed after warming up for at least 30 minutes.

- Basic accuracy $\pm 0.32\%$
- Measurement range

Measurement range Z_r	Measurable range	Recommended range
1 k Ω	No limitation	90 Ω to 10 k Ω
100 Ω	$\leq 110 \Omega$	9 Ω to 100 Ω
10 Ω	$\leq 11 \Omega$	0.9 Ω to 10 Ω
1 Ω	$\leq 1.1 \Omega$	0.09 Ω to 1 Ω

Measurable range: Approximate range in which measurement and display are possible (supplementary values).

Recommended range: Operating range in which measurement accuracy is high.

- Impedance measurement accuracy

$$\text{Accuracy of } |Z| \quad \pm A_Z [\%] \quad A_Z = \{(A + B \times U + K_Z + K_Y) \times K_V + K_B\} \times K_T$$

Accuracy of phase angle θ of impedance

$$\pm P_Z [^\circ] \quad P_Z = 0.573 \times A_Z$$

Remark The measurement accuracy when A_Z exceeds 10[%] is a supplementary value.

Each parameter value in the expression of A_Z is listed below. The meaning of the symbol used when calculating each parameter is shown below.

Z_r : Measurement range [Ω]

Z_X : Measurement value [Ω] of magnitude of impedance $|Z|$

- U: Ratio coefficient

Measurement range Z_r	U
1 k Ω	Z_X / Z_r (however, 0.1 when $Z_X / Z_r < 0.1$)
Other than 1 k Ω	Z_r / Z_X (however, 1 when $Z_r / Z_X < 1$)

- A (upper row): Basic coefficient [%]
- B (lower row): Proportional coefficient [%]

Measurement time setting is larger than (200 ms or (20 / measurement frequency[Hz]) s) or more.

Measurement range Z_r	Measurement frequency [Hz]					
	2 m < f ≤ 1 k	1 k < f < 30 k	30 k ≤ f ≤ 100 k	100 k < f ≤ 1 M	1 M < f ≤ 10 M	10 M < f ≤ 36 M
1 kΩ	0.20 0.15	0.30 0.35	0.30 0.15	0.30 0.60	1.00 2.00	--- ---
100 Ω	0.30 0.03	0.30 0.02	0.30 0.02	0.30 0.02	1.00 0.15	3.00 0.30
10 Ω	0.20 0.40	0.20 0.30	0.20 0.20	0.20 0.30	1.50 1.00	--- ---
1 Ω	0.40 3.00	0.20 3.00	0.20 2.00	0.40 2.50	--- ---	--- ---

The measurement accuracy in the "- - -" column is not guaranteed.

- K_Z : Residual impedance coefficient [%]

Frequency range	K_Z [%]
$f \leq 100$ kHz	$0.02 / Z_X [\Omega]$
100 kHz < $f \leq 36$ MHz	f [kHz] $\times 2 \times 10^{-4} / Z_X [\Omega]$

- K_Y : Residual admittance coefficient [%]

Frequency range	K_Y [%]
$f < 30$ kHz	$Z_X / (1 \times 10^6)$
30 kHz $\leq f \leq 1$ MHz	f [kHz] $\times Z_X [\Omega] / (3 \times 10^6)$
1 MHz < $f \leq 36$ MHz	f [kHz] $\times Z_X [\Omega] / (2 \times 10^6)$

- K_V : Signal level coefficient [%]

When the signal level is less than 100 mV, the measurement accuracy is not guaranteed.

When the signal level is set as a current, refer to K_V of the value calculated by measurement signal amplitude setting [Arms] $\times 50$ as the signal level [Vrms].

When the measurement signal amplitude setting is 3.0 mArms, refer to K_V of $3.0 \times 10^{-3} \times 50 = 150$ m[Vrms].

Frequency < 30 kHz

Measurement range Z_r	Signal level [Vrms]		
	100 m ≤ V ≤ 300 m	300 m < V ≤ 1.00	1.00 < V ≤ 3.00
1 kΩ	1.2	1.0	3.0
100 Ω	1.3	1.0	2.2
10 Ω	1.0	1.0	1.5
1 Ω	1.0	1.0	1.2

30 kHz ≤ Frequency ≤ 1 MHz

Measurement range Z_r	Signal level [Vrms]				
	100 m ≤ V ≤ 300 m	300 m < V ≤ 500 m	500 m < V ≤ 800 m	800 m < V ≤ 1.00	1.00 < V ≤ 3.00
1 kΩ	1.5	1.0	1.1	1.0	2.5
100 Ω	1.6	1.0	1.1	1.0	2.2
10 Ω	1.5	1.0	1.0	1.0	2.0
1 Ω	1.2	1.0	1.0	1.0	1.2

1 MHz < Frequency

Measurement range Z_r	Signal level [Vrms]				
	100 m ≤ V ≤ 300 m	300 m < V ≤ 500 m	500 m < V ≤ 800 m	800 m < V ≤ 1.00	1.00 < V ≤ 3.00
1 kΩ	1.5	1.0	1.1	1.0	1.1
100 Ω	1.6	1.0	1.1	1.0	1.2
10 Ω	1.5	1.0	1.0	1.0	1.0

- K_B : DC bias coefficient [%]

When the HV DC bias is enabled, $K_B = 0.1$ %.

The K_B [%] when the normal DC bias is output from the front panel PORT3 is as shown in the table below. This is common for the voltage setting and current setting.

Frequency range	normal DC bias	
	0 V	≠ 0 V
$f \leq 1$ kHz	0.00	1.00
1 kHz < f	0.00	0.05

- K_T : Temperature-dependent coefficient

Ambient temperature T[°C]	K_T	
	$f \leq 10$ MHz	10 MHz < f
0 to +18	$1 + 0.03 \times (18 - T)$	$1 + 0.04 \times (18 - T)$
+18 to +28	1	1
+28 to +40	$1 + 0.03 \times (T - 28)$	$1 + 0.04 \times (T - 28)$

5.8.4 Measurement Accuracy of Measurement Parameters Other Than Z and θ (Measurement Modes IMPD-EXT, IMPD-3T and IMPD-2T)

Calculate the measurement accuracy from the impedance measurement accuracy as follows. Here, Q_x is the measurement value of Q, D_x is the measurement value of D, and θ_x is the measurement value of θ . It is also acceptable to calculate the θ_x used for the accuracy calculation by either $(90^\circ - \tan^{-1} |1/Q_x|)$ or $(90^\circ - \tan^{-1} |D_x|)$.

Parameter	Measurement accuracy (supplementary value)
$ Y , \epsilon_s, \mu_s$	$\pm A_z$ [%]
$L_P, L_S, X, \epsilon_s', \mu_s'$	$\pm A_z$ [%] ($ Q_x \geq 10$), $\pm A_z / \sin \theta_x$ [%] ($ Q_x < 10$)
C_P, C_S, B	$\pm A_z$ [%] ($ D_x \leq 0.1$), $\pm A_z / \sin \theta_x$ [%] ($ D_x > 0.1$)
$R_P, R_S, G, \epsilon_s'', \mu_s''$	$\pm A_z$ [%] ($ Q_x \leq 0.1$), $\pm A_z / \cos \theta_x$ [%] ($ Q_x > 0.1$)
Q	$\pm Q_x^2 \times P_e / (1 - Q_x \times P_e)$ ($ Q_x \geq 10$ or $ Q_x \times P_e \leq 0.1$) Here, phase angle error P_e [rad] = P_z [°] / 57.3. The measurement accuracy of Q is the actual value and not the % value.
D	$\pm (P_z$ [°] / 57.3) ($ D_x \leq 0.1$) The measurement accuracy of D is the actual value and not the % value.

5.8.5 Measurement Accuracy of Measurement Parameters Other Than Gain and θ (Measurement Mode G-PH)

Calculate the measurement accuracy from the phase measurement accuracy as follows. Here, P_G is the measurement accuracy [°] of θ .

Parameter	Measurement accuracy (supplementary value)
GD	$\pm \frac{P_G}{360 \times APT}$ [s] Here, APT is the aperture frequency (Δf [Hz]), and is aperture setting ^{*1} \times sweep measurement frequency interval.

*1: "Aperture setting" is a parameter that is set in this instrument for group delay (GD) measurement.

5.9 Measurement Processing Section

- Measurement time setting

Setting of time required for one measurement (in the case of sweep measurement, the setting of the measurement time of not the entire sweep but of each point). Measurement results are averaged within the range not exceeding the set time and the influence of noise is reduced.

Setting range 0 ms to 9,990 s

Setting resolution 3 digits or 0.1 ms, whichever is the largest

The minimum measurement time is approximately the following time depending on measurement frequency f .

$f < 1.36 \text{ kHz}$: $(1 / f) \text{ s}$

$< 30 \text{ kHz}$: 0.8 ms to 1.5 ms

$\leq 36 \text{ MHz}$: 0.5 ms

Remark A time longer than the minimum measurement time is required for measurement regardless of the setting.

The measurement delay time and measurement start delay time are not included. The time resulting from adding these delay times to the measurement time setting will be the actual measurement time.

The measurement time may become longer than the set time due to auto ranging and other processing.

- Measurement delay function This function delays the start of measurement after the sweep parameters are changed.

Setting range 0 to 9,990 s

Setting resolution 3 digits or 0.1 ms, whichever is the largest

- Measurement start delay function This function delays the start of measurement only when sweeping starts.

Setting range 0 to 9,990 s or MANual

Setting resolution 3 digits or 0.1 ms, whichever is the largest

Remark MANual is a function for sequence measurement. For every sequence, sweep measurement enters the wait state until the UP or DOWN key is pressed.

- Automatic high density sweep (slow sweep)

When there is a sudden change in the measurement data during frequency sweep measurement, this function performs measurement by automatically increasing the frequency sweep density in the regions before and after that point. This function is disabled when the sweep item is set to other than frequency. If the number of measurement frequency points exceeds 20,000 in one sweep, sweep measurement is

stopped.

Variation limit setting

- Measurement modes IMPD-EXT, IMPD-3T and IMPD-2T

Z 1 a to 999 GΩ, setting resolution 3 digits or 1 aΩ, whichever is the largest

Y 1 a to 999 GS, setting resolution 3 digits or 1 aS, whichever is the largest

θ 0.001 to 179.999°, setting resolution 0.001°

- Measurement mode G-PH

Gain

Linear 1 a to 999 G, setting resolution 3 digits or 1 a, whichever is the largest

Log 0.001 to 999.999 dB, setting resolution 0.001 dB

θ 0.001 to 179.999°, setting resolution 0.001°

- Sequence measurement function

This function performs measurements according to the contents of setting memory (condition file).

When up sweeping is performed, the first up sweep is performed over the sweep range set in condition file number 1, the next up sweep is performed over the range set in condition file number 2, and so on continuously up to the upper limit condition file number. For down sweeping, the first down sweep is performed over the range set in the upper limit condition file number, the next down sweep is performed over the range set in the next condition file number down (upper limit condition file number minus 1), and so on continuously down to condition file number 1. With the exception of zero span, sequence measurement is performed with frequency, measurement signal amplitude, and DC bias sweeping. Furthermore, the sweep items in sequence measurement are common.

Upper limit condition file number 1 to 32

Setting resolution 1

- Resonant frequency tracking function

This function automatically keeps the measurement frequency tracked to the resonance frequency of the DUT. The resonant frequency is the frequency at which the measurement phase becomes the target phase.

Target phase -179.999 to +180.000°, setting resolution of 0.001°

Allowable error 0.001 to 179.999°, setting resolution of 0.001°

Frequency correction factor 1 to 100%, setting resolution of 1%

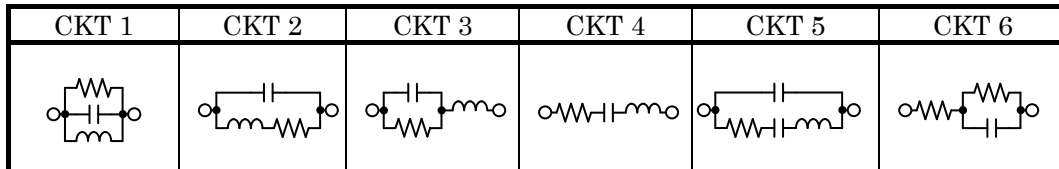
Remark This is the rate for changing the measurement frequency when the resonance frequency of the DUT changed.

Phase polarity POS (positive) or NEG (negative)

Remark Specify the sample characteristics – specifically whether the phase increases (POS) or decreases (NEG) as the frequency increases.

- Equivalent circuit estimation function (Measurement modes IMPD-EXT, IMPD-3T and IMPD-2T)

Estimate each constant of the following equivalent circuits from the frequency sweep measurement results.



- Piezoelectric constant calculation function (Measurement modes IMPD-EXT, IMPD-3T and IMPD-2T)

Calculates the following piezoelectric related constants from the frequency sweep measurement results.

Piezoelectric constant calculation

Calculates the piezoelectric constants, piezoelectric parameters, resonant frequency, etc.

Simulation

Calculates and displays the admittance characteristics from the piezoelectric parameters.

- Comparator

SPOT measurement results Max. 14 bins

SWEEP measurement results

Upper limit and lower limit comparison

Number of comparison settings 1 to 20

- Discharge protection (Measurement mode G-PH) Supplementary value

Protection tolerance 2 J or less (voltage 100 V or less)

Remark For voltage $V[V]$, the energy stored in capacitance $C[F]$ is $0.5 \times C \times V^2 [J]$.

5.9.1 Error Correction Function

(Measurement mode IMPD-EXT)

- Slope compensation This function performs analysis that is unaffected by the DC level for signals that have a composited DC level that varies linearly over time. It is used when measuring the impedance of batteries during charging and discharging.

(Measurement modes IMPD-EXT, IMPD-3T and IMPD-2T)

- Open correction Corrects the stray admittance.
 - Short correction Corrects the residual impedance.
 - Load correction Corrects the voltage-current conversion coefficient of the measurement system.
- Load standard value Standard values can be entered for up to 30 frequency points.
- Port extension Corrects the error due to phase delay in cables for 2-terminal measurements.

Characteristic impedance

Setting range 1.00 to 999 Ω , setting resolution 3 digits

Electrical length

Setting range 0.000 to 999.999 m, setting resolution 0.001 m

Open correction Corrects the stray admittance at the extended port end.

Short correction Corrects the residual impedance at the extended port end.

Load correction Corrects the mismatch, etc. of the characteristic impedance at the extended port.

Load standard value Standard values can be entered for up to 30 frequency points.

(Measurement mode G-PH)

- Equalizing This function acquires the characteristics of only the EUT by measuring the frequency characteristics of the measurement system (sensors, cables, etc.) in advance and then eliminating the error components of the measurement system when actual measurements are taken later.

(Measurement modes IMPD-EXT and G-PH)

- Self-calibration This function measures and corrects the measurement errors that arise within this instrument itself.

5.10 Display Section

- Display unit 8.4-inch color TFT-LCD (SVGA) with touch panel
- Graphs Bode plot, Nyquist plot,
Cole-cole plot (Measurement modes IMPD-EXT, IMPD-3T and
IMPD-2T only)
- Graph display styles
 - SINGLE One graph is displayed on the LCD.
 - SPLIT Two graphs are displayed, one above the other.
- Graph axis setting The X, Y1, and Y2 axes can each be set to Lin/Log individually.
- Graph traces 9 traces of measurement data (MEAS) and reference data (REF 1 to
8)
- Auto scaling On or off

This function automatically optimizes the graph display scale.
- Marker display Markers are displayed on a graph, and the data at a marker
position is displayed as a numerical value.
- Number of markers Max. 8
- Marker search function
 - Search items
 - Max, Min Search for the maximum and minimum values.
 - Peak, Bottom Search for the peak (maximal) and bottom (minimal) values.
 - NextPeak Search for the next peak.
 - NextBottom Search for the next bottom.
 - PrevPeak Search for the previous peak.
 - PrevBottom Search for the previous bottom.
 - Value Search for the marker value.
 - ΔValue Search for the difference between the reference marker and search
marker values.
 - XValue Search for the sweep parameter.
 - BW1 Display the passband gain and cutoff frequency.
 - BW2 Display the center frequency and pass bandwidth.
 - BW3 Display the notch frequency and notch bandwidth.

A search can be performed automatically at the end of sweep measurement.

5.11 Memory

- Measurement conditions 32 sets (per measurement mode)
- Measurement data (MEAS) Data from sweep measurement
 Up to 32 sets of data can be saved to the internal storage of this instrument.
- Reference data (REF) Data (up to 8 sets) that can be displayed on a graph together with measurement data (MEAS)
 This can be measurement data or data copied from a USB memory device. The display can be turned on or off.
- Error correction data Open correction (32 sets), short correction (32 sets), load correction (32 sets), open correction at port extension tip (32 sets), short correction at port extension tip (32 sets), load correction at port extension tip (32 sets), equalizing (32 sets)

Except for data not saved in the internal storage are retained, even if the power is turned off.

5.12 External Memory

- Media USB memory device
 - Connector Front panel, USB-A connector
 - File system FAT
 - Saved items Setting conditions, measurement data (MEAS) and reference data (REF 1 to 8), equivalent circuit estimation results, piezoelectric constant calculation results, and marker information
 - File format CSV format
 - Screen capture function A screen capture of the LCD screen can be saved to a USB memory device.
- | | |
|-------------|---|
| File format | Microsoft Window bitmap file (.BMP) |
| File size | Approx. 1.9 MB |
| File name | ZAnnn.BMP
(nnn: three-digit number, incremented automatically, initial value can be set) |

5.13 External Input/Output Function

- GPIB

Standards conformance	IEEE488.1, IEEE488.2
Connector	Rear panel, GPIB connector
Interface functions	SH1,AH1,T6,L4,SR1,RL1,PP0,DC1,DT0,C0,E1

- USB

Specification	USB 2.0 High Speed
Connector	Rear panel, USB-B connector
Device class	TMC

- LAN

Specification	10/100Base-T
Connector	Rear panel, RJ-45 connector
Protocol	TCP/IP (socket communication)

- RS-232

Connector	Rear panel, RS-232 connector (D-sub 9-pin, male, inch screw thread)
Baud rate	4800 / 9600 / 19200 / 38400 / 57600 / 115200 / 230400 bps At a baud rate that exceeds 19200 bps, the characteristics of the cable and controller may prevent communication.
Flow control	None, software (X-ON/X-OFF), hardware (RTS/CTS)

- External monitor For connecting a projector or external monitor, etc.

Connector	Rear panel, analog VGA connector (mini D-sub 15-pin, female)
Signal	800 × 600 dot (SVGA), analog RGB component video signal

- Reference clock input

Connector	Rear panel, BNC connector
Input impedance	300 Ω (nominal value), AC coupling
Frequency	Within 10 MHz \pm 100 ppm
Input waveform	Sinusoidal or square
Input voltage	0.5 V _{p-p} to 5 V _{p-p}
Maximum non-destructive input voltage	10 V _{p-p}
Signal grounding	Isolated from the enclosure, max. 42 V _{pk} (DC + AC _{pk})

- Reference clock output

Connector	Rear panel, BNC connector
Output impedance	50 Ω (nominal value), AC coupling
Frequency	10 MHz \pm 10 ppm (when using internal reference clock) When this instrument is operating with an external reference clock, the input reference clock frequency is output as is.
Output waveform	1 V _{p-p} / 50 Ω , square waveform

- Handler interface (This can be used in Measurement modes IMPD-EXT, IMPD-3T and IMPD-2T.)
 - Signal isolation All I/O signals are optically isolated (withstand voltage ± 42 V)
 - Input signal Trigger, setting condition file number
 - Output signal Sorting results BIN1 to BIN14
- Expansion connector This connector is for expansion. Do not connect a device other than one specified by NF Corporation.
 - Connector Rear panel, AUX connector

5.14 Miscellaneous Specifications

- Power input

Voltage AC 100 V to 230 V $\pm 10\%$, however 250 V or less

Frequency 50 Hz / 60 Hz ± 2 Hz

Power consumption Max. 100 VA

Overvoltage category II

- Cooling Forced air cooling, rear exhaust

- Installation attitude Horizontal (within $\pm 10^\circ$)

- Environmental conditions

Operation 0 to +40 °C, 5 to 85 %RH

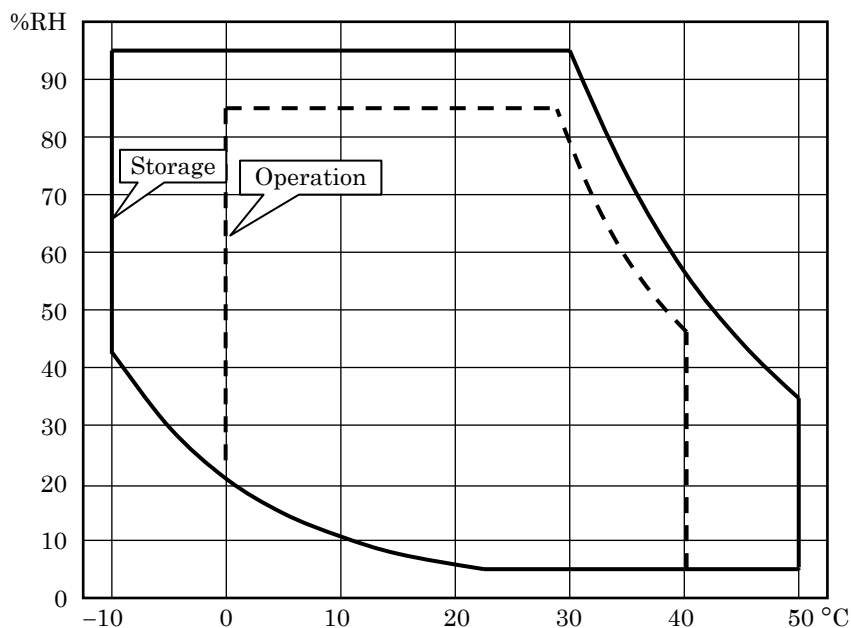
(However, absolute humidity 1 to 25 g/m³, no condensation)

Altitude 2000 m or less

Storage -10 to +50 °C, 5 to 95 %RH

(However, absolute humidity 1 to 29 g/m³, no condensation)

Pollution degree 2 (indoor use)



- External dimensions 430 (W) × 177 (H) × 350 (D) mm (excluding protruding parts)

- Weight Approx. 7.0 kg (excluding accessories)

- Safety standards and EMC EN61010-1, EN61010-2-030

EN61326-1(Group1, ClassA), EN61326-2-1

Remark: Applies to products with CE marking displayed on the rear panel.

- RoHS Directive Directive2011/65/EU

- Warm-up time At least 30 minutes

- Calibration cycle 1 year

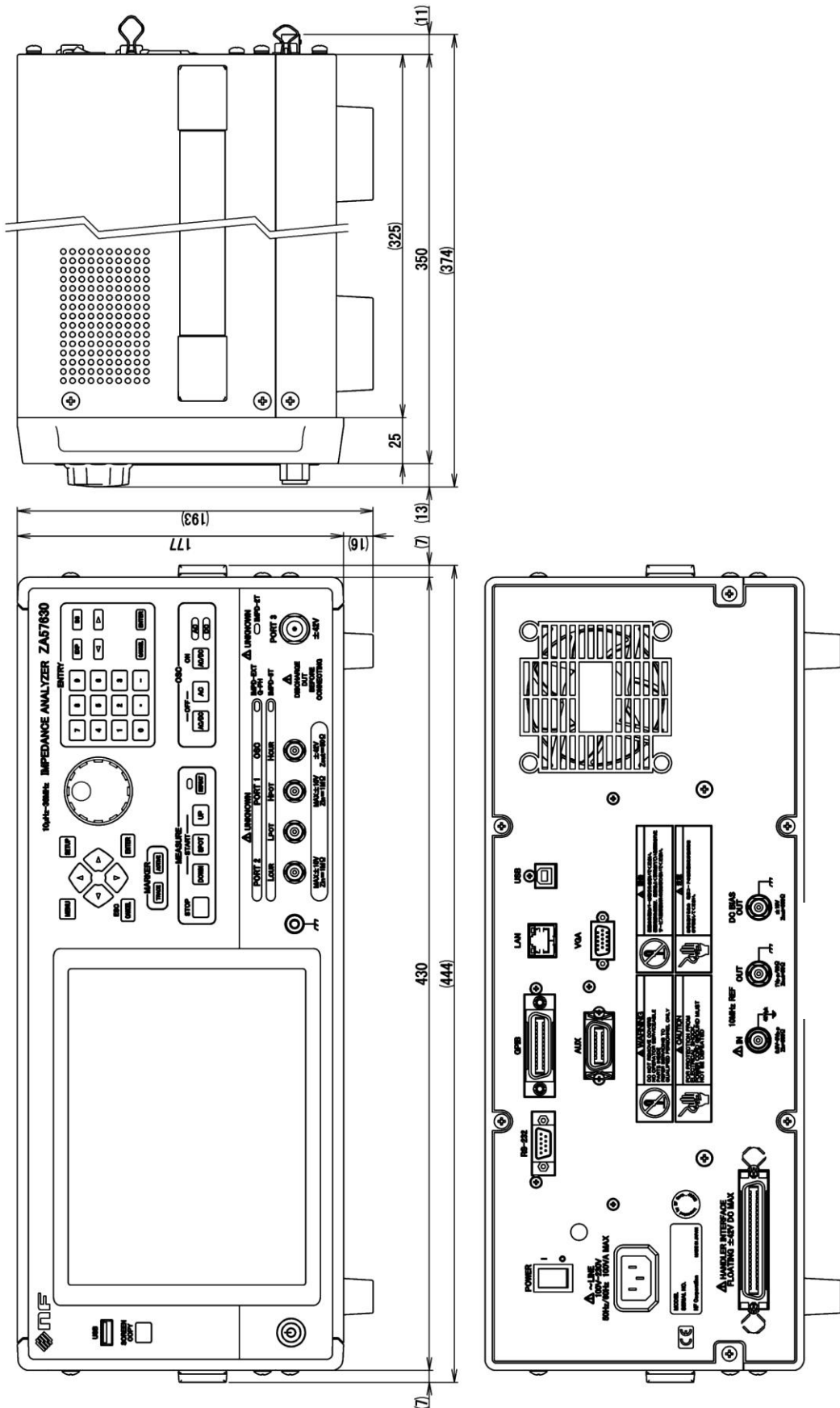


Figure 5-1 External dimensions

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 - record or transmit customer information
 - perform related management functions
 - provide information directly and indirectly to customers about available products and services.

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- are only used to support the industry application, and
- operate only when used with the industry application.

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- directly support the manufacturer's specific use for the device, or

-
- provide system utilities, resource management, or anti-virus or similar protection.
- c. Cloud Applications. If your industry system uses Internet browsing functionality to connect to cloud hosted applications:
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 - any files that result from the use of desktop functions may not be permanently stored on the industry system.
- d. Storage/Network Use. You may also store or install one (1) copy of the software on a storage device, such as network server, used only to install or run the software on your other industry systems over an internal network; however, you must acquire and dedicate an additional license for each separate industry system on or from which the software is installed, used, accessed, displayed or run. Except as otherwise permitted by Remote Assistance features described below, a license for the software may not be shared or used concurrently on different industry systems.
- e. Multiple or Pooled Connections. Hardware or software you use to multiplex or pool connections, or reduce the number of devices that access or use the software, does not reduce the number of licenses you need. You may only use such hardware or software if you have a license for each copy of the software you are using.
- f. Device Connections. You may permit a maximum of twenty (20) computers or other electronic devices (each a "Device") to connect via Server Message Bloc (SMB) to the industry system to utilize one or more of the following services of the software: file services, print services, Internet information services, Internet connection sharing and telephony services. The twenty connection maximum includes any indirect connections made through "multiplexing" or other software or hardware which pools or aggregates connections. Unlimited inbound connections are allowed via TCP/IP (Transmission Control Protocol ("TCP") and the Internet Protocol ("IP").
- g. Remote Access. The software contains Remote Desktop and Remote Assistance technologies that enable the software or applications installed on the licensed device to be accessed remotely from other devices.
- Remote Desktop. The single primary user of the licensed device may access a session from any other device using Remote Desktop or similar technologies. A "session" means the experience of interacting with the software, directly or indirectly, through any combination of input, output and display peripherals. Other users, one at a time, may access the licensed software running on this

host device, from any device using Remote Desktop, but only if the remote device is separately licensed to run Windows Embedded 8.1 Industry Pro.

- Remote Assistance. You may use Remote Assistance or similar technologies to share an active session without obtaining any additional licenses for the software. Remote Assistance allows one user to directly connect to another user's device, usually to correct problems.
- h. Device. In this agreement, "device" means a hardware system with an internal storage device capable of running the software. A hardware partition or blade is considered to be a device. The software is licensed to run on up to two processors on the licensed device.
- i. Multiple versions. The software includes multiple versions (such as 32-bit and 64-bit versions), and you or NF Corporation may install only one of those versions at a time. Installing the 32-bit version of Windows Embedded 8.1 Industry Pro on this system requires a change to the BIOS settings to legacy BIOS mode. If you switch to the 64-bit version of Windows Embedded 8.1 Industry Pro from the 32-bit version of Windows Embedded 8.1 Industry Pro, then you should revert back to the original BIOS settings. If you do not revert back to these BIOS settings when switching back to the 64-bit version, the following Windows Embedded 8.1 Industry Pro functionalities will not work as they rely on UEFI mode boot:
 - Secure Boot,
 - Seamless Boot experience,
 - Network unlock for Bitlocker for computer with a Trusted Platform Module (TPM) and
 - eDrive support.

Reverting back to UEFI mode will require a hard drive reformat. All data and personal settings will be lost. It is highly recommended that you back up your data before you revert back to UEFI mode.

2. Binding Arbitration and Class Action Waiver

- a. Application. If you live in the United States, this Section 2 applies to any dispute **EXCEPT IT DOES NOT INCLUDE A DISPUTE RELATING TO THE ENFORCEMENT OR VALIDITY OF YOUR, NF Corporation'S, MICROSOFT'S, OR EITHER OF OUR LICENSORS' INTELLECTUAL PROPERTY RIGHTS**. Dispute means any dispute, action, or other controversy between you and NF Corporation, or you and Microsoft, concerning the software (including its price) or this agreement, whether in contract, warranty, tort, statute, regulation, ordinance, or any other legal or equitable basis. "Dispute" will be given the broadest possible meaning allowable

under law.

- b. Notice of Dispute. In the event of a dispute, you, or NF Corporation must give the other a Notice of Dispute, which is a written statement of the name, address and contact information of the party giving it, the facts giving rise to the dispute, and the relief requested. You must send any Notice of Dispute by U.S. Mail to NF Corporation, ATTN: Legal Department. NF Corporation will send any Notice of Dispute to your U.S. Mail address if available, or otherwise to your e-mail address. You and NF Corporation will attempt to resolve any dispute through informal negotiation within 60 days from the date the Notice of Dispute is sent. After 60 days, you or NF Corporation may commence arbitration.
- c. Small claims court. You may also litigate any dispute in small claims court in your county of residence or the NF Corporation's principal place of business, if the dispute meets all requirements to be heard in the small claims court. You may litigate in small claims court whether or not you negotiated informally first.
- d. Binding arbitration. **If you and NF Corporation, or Microsoft, do not resolve any dispute by informal negotiation or in small claims court, any other effort to resolve the dispute will be conducted exclusively by binding arbitration governed by the Federal Arbitration Act ("FAA"). You are giving up the right to litigate (or participate in as a party or class member) all disputes in court before a judge or jury.** Instead, all disputes will be resolved before a neutral arbitrator, whose decision will be final except for a limited right of appeal under the FAA. Any court with jurisdiction over the parties may enforce the arbitrator's award.
- e. Class action waiver. **Any proceedings to resolve or litigate any dispute in any forum will be conducted solely on an individual basis. Neither you, NF Corporation, nor Microsoft, will seek to have any dispute heard as a class action, private attorney general action, or in any other proceeding in which any party acts or proposes to act in a representative capacity. No arbitration or proceeding will be combined with another without the prior written consent of all parties to all affected arbitrations or proceedings.**
- f. Arbitration procedure. Any arbitration will be conducted by the American Arbitration Association (the "AAA"), under its Commercial Arbitration Rules. If you are an individual and use the software for personal or household use, or if the value of the dispute is \$75,000 or less whether or not you are an individual or how you use the software, the AAA Supplementary Procedures for Consumer-Related Disputes will also apply. To commence arbitration, submit a Commercial Arbitration Rules Demand for Arbitration form to the AAA. You may request a telephonic or in-person hearing by following the AAA rules. In a dispute involving \$10,000 or less, any hearing will be telephonic unless the arbitrator finds good

cause to hold an in-person hearing instead. For more information, see adr.org or call 1-800-778-7879. You agree to commence arbitration only in your county of residence or in the NF Corporation's principal place of business. NF Corporation agrees to commence arbitration only in your county of residence. The arbitrator may award the same damages to you individually as a court could. The arbitrator may award declaratory or injunctive relief only to you individually, and only to the extent required to satisfy your individual claim.

g. Arbitration fees and incentives

- i. Disputes involving \$75,000 or less. NF Corporation will promptly reimburse your filing fees and pay the AAA's and arbitrator's fees and expenses. If you reject the NF Corporation's last written settlement offer made before the arbitrator was appointed ("last written offer"), your dispute goes all the way to an arbitrator's decision (called an "award"), and the arbitrator awards you more than the last written offer, NF Corporation will give you three incentives: (1) pay the greater of the award or \$1,000; (2) pay twice your reasonable attorney's fees, if any; and (3) reimburse any expenses (including expert witness fees and costs) that your attorney reasonably accrues for investigating, preparing, and pursuing your claim in arbitration. The arbitrator will determine the amounts.
 - ii. Disputes involving more than \$75,000. The AAA rules will govern payment of filing fees and the AAA's and arbitrator's fees and expenses.
 - iii. Disputes involving any amount. In any arbitration you commence, NF Corporation will seek its AAA or arbitrator's fees and expenses, or your filing fees it reimbursed, only if the arbitrator finds the arbitration frivolous or brought for an improper purpose. In any arbitration NF Corporation commences, it will pay all filing, AAA, and arbitrator's fees and expenses. It will not seek its attorney's fees or expenses from you in any arbitration. Fees and expenses are not counted in determining how much a dispute involves.
- h. Claims or disputes must be filed within one year. To the extent permitted by law, any claim or dispute under this agreement to which Section 2 applies must be filed within one year in small claims court (Section 2.c) or in arbitration (Section 2.d). The one-year period begins when the claim or dispute first could be filed. If such a claim or dispute is not filed within one year, it is permanently barred.
- i. Severability. If the class action waiver in Section 2.e is found to be illegal or unenforceable as to all or some parts of a dispute, then Section 2 will not apply to those parts. Instead, those parts will be severed and proceed in a court of law, with the remaining parts proceeding in arbitration. If any other provision of Section 2 is found to be illegal or unenforceable, that provision will be severed

with the remainder of Section 2 remaining in full force and effect.

- j. Third-Party Beneficiary. Microsoft Corporation is not a party to this agreement but is a third-party beneficiary of your and the NF Corporation's agreement to resolve disputes through informal negotiation and arbitration. If your dispute is with Microsoft, Microsoft agrees to do everything NF Corporation agrees to do in Section 2, and you agree to do everything regarding Microsoft that Section 2 requires you to do regarding NF Corporation. Mail a Notice of Dispute with Microsoft to Microsoft Corporation, ATTN: LCA ARBITRATION, One Microsoft Way, Redmond, WA 98052-6399. You may commence an arbitration or small claims court case against Microsoft in your county of residence or King County, Washington.

3. Choice of Law

The laws of the state or country where you live govern all claims and disputes concerning the software or this agreement, including breach of contract claims and claims under state consumer protection laws, unfair competition laws, implied warranty laws, for unjust enrichment, and in tort, except that the FAA governs all provisions relating to arbitration. If you acquired the software in any other country, the laws of that country apply. This agreement describes certain legal rights. You may have other rights, including consumer rights, under the laws of your state or country. You may also have rights with respect to the party from whom you acquired the software. This agreement does not change those other rights if the laws of your state or country do not permit it to do so.

4. Activation

- a. More on how activation works. The software will notify you or NF Corporation, if NF Corporation activates the software, whether the installed copy of the software is properly licensed. During activation, the software will send information about the software and your device to Microsoft. This information includes the version, language, and product key of the software, the Internet protocol address of the device, and information derived from the hardware configuration of the device. For more information about activation, see go.microsoft.com/fwlink/?linkid=280262. If the licensed device is connected to the Internet, the software will automatically connect to Microsoft for activation. You can also activate the software manually by Internet or telephone. In either case, Internet and telephone service charges may apply.
- b. Re-activation. Some changes to your device components or the software may require re-activation of the software.
- c. Activation failure. During online activation, if the licensing or activation functions of the software are found to be counterfeit, improperly licensed, or include

unauthorized changes, activation will fail and the software will attempt to repair itself by replacing any tampered Microsoft software with genuine Microsoft software. The software will notify you or NF Corporation if the installed copy of the software is improperly licensed or includes unauthorized changes. In addition, you or NF Corporation may receive reminders to obtain a properly licensed copy of the software. You may not be able to obtain certain updates or upgrades from Microsoft if your copy of the software is found to be improperly licensed.

5. Internet-Based Features; Privacy

Some software features use Internet protocols, which send to Microsoft (or its suppliers or service providers) device information, such as your Internet protocol address, the type of operating system, browser and name and version of the software you are using, the language code of the device where you installed the software, and other information described below, in the Windows Privacy Statement at go.microsoft.com/fwlink/?linkid=280262, or in the Windows Embedded user interface. Microsoft uses this information to make the Internet-based features available to you, in accordance with the Windows Privacy Statement at go.microsoft.com/fwlink/?linkid=301572 and information that may be presented to you in the Windows Embedded user interface. Some Internet-based features may be delivered and updated at a later date if, for example, you acquire an application that relies on one of those services, or to help make the software safer or more reliable. Internet features include, but are not limited to the features described below, in the Windows 8.1 Privacy Statement at go.microsoft.com/fwlink/?linkid=301572 and the Windows Embedded user interface. NF Corporation may have elected to turn on one or more of the following features in the licensed device.

- a. Accelerators. When you click on or move your mouse over an Accelerator in Internet Explorer, any of the following may be sent to the applicable service provider (which may not be Microsoft): the title and full web address or URL of the current webpage, standard device information, and any content you have selected. For more information, see go.microsoft.com/fwlink/?linkid=280122.
- b. Cookies. If you choose to use online features in the software, such as online Help and Support, cookies may be set. To learn how to block, control and delete cookies, please read the cookies section of the Privacy Statement at go.microsoft.com/fwlink/?linkid=74170.
- c. Digital Certificates. The software uses digital certificates to confirm the identity of Internet users sending X.509 standard encrypted information, to digitally sign files and macros, and to verify the integrity and origin of the file contents. The software may retrieve and update certificates and certificate revocation lists, and the list of trusted certification authorities, over the Internet.
- d. Feedback Features. The Customer Experience Improvement Program automatically

sends to Microsoft anonymous information about your hardware and how you use this software. The Help Experience Improvement Program (HEIP) automatically sends to Microsoft information about the version of Windows that your PC device is running and about how you use Windows Help and Support, including queries you enter when you search Windows Help and Support and any ratings or feedback on the Help topics presented to you. Windows Error Reporting automatically sends reports to Microsoft that describes which software components had errors. These reports may include memory dumps. From time-to-time, Microsoft will also download a small file to your device that permits them to collect information about specific errors you have while using the software. The data collected by these features helps Microsoft improve their software.

- e. IPv6 Network Address Translation (NAT) Traversal service (Teredo). Each time you start your licensed device, Teredo will attempt to locate a public Internet Protocol version 6 (IPv6) service on the Internet. This occurs automatically when your licensed device is connected to a public or private network, but does not occur on managed networks such as enterprise domains. If you use a program that requires Teredo to use IPv6 connectivity, or if you configure your firewall to always enable IPv6 connectivity, then Teredo will periodically contact the Microsoft Teredo service over the Internet. The only information sent to Microsoft is standard computer information and the name of the service requested (for example teredo.ipv6.microsoft.com). The information sent from your device by Teredo is used to determine if your device is connected to the Internet and if it can locate a public IPv6 service. Once the service is located, information is sent to maintain a connection with the IPv6 service.
- f. Malicious Software Removal. The software may periodically scan for and remove malware from your device, using the malicious software removal tool most recently downloaded to your device. After the scan completes and at regular intervals, a report will be sent to Microsoft with specific information about malware detected, errors, and other information about your device. This information is used to help protect your device from malicious software, as well as to improve the software and other Microsoft products. You may disable the software's reporting functionality by following the instructions found at go.microsoft.com/fwlink/?linkid=241725.
- g. Network Awareness. This feature determines whether a system is connected to a network by either passive monitoring of network traffic or active DNS or HTTP queries. The query only transfers standard TCP/IP or DNS information for routing purposes. You can switch off the active query feature through a registry setting.
- h. Plug and Play and Plug and Play Extensions. Your device may not have the drivers

needed to communicate with hardware that you connect to your device. If so, the update feature of the software can obtain and install the correct driver on your device. An administrator can disable this update feature.

- i. Search Provider Update. The software will download an update to the data on your device about search providers. This update upgrades your providers with the latest features, such as new icons or search suggestions. This is a one-time update, but the software will try to perform the update several times if it does not successfully download the update. For more information, see go.microsoft.com/fwlink/?linkid=280122.
- j. SmartScreen Filter. If enabled, the SmartScreen Filter will check the addresses of webpages and downloads you attempt to view against a frequently updated list of webpages and downloads that have been reported to Microsoft as unsafe or suspicious. SmartScreen will also check downloaded programs that you attempt to run against a list of commonly downloaded or run programs to help you make more informed trust decisions. More information can be found by visiting the Internet Explorer Privacy Statement at go.microsoft.com/fwlink/?linkid=280122. By enabling SmartScreen in either Windows or Internet Explorer, you consent to this feature, and you agree to use the SmartScreen Filter only in conjunction with Windows or Internet Explorer. You may not, either manually or by enabling or authorizing any software or service, copy, display, distribute, collect or store any data provided by the SmartScreen Filter.
- k. Windows Defender. If turned on, Windows Defender will search your device for many types of malicious software ("malware"), including viruses, worms, bots, rootkits, "spyware", "adware," and other potentially unwanted software. If you choose the "recommended" security settings when you first start using the software, such malware and other potentially unwanted software rated "high" or "severe" will automatically be removed. This removal may result in other software on your device ceasing to work or your breaching a license to use that software. It is possible that software that is not unwanted may be removed or disabled. If you use Windows Defender and Windows Update, Windows Defender is regularly updated through Windows Update.
- l. Windows digital rights management technology. Some content owners use Windows digital rights management technology (DRM) to protect their copyrights and other intellectual property, including by disabling the software's ability to play protected content if Windows DRM fails. You agree that Microsoft may include a revocation list with the licenses.
- m. Windows Media Player. When you use Windows Media Player it checks with Microsoft for compatible online music services in your region and new versions of the player. You may only use Windows Media Player as described at

go.microsoft.com/fwlink/?linkid=104605.

- n. Windows Update. If you use the Windows Update service in the software, updates or downloads to the Windows Update service will be required for proper functioning of the service, from time to time, and will be downloaded and installed without further notice to you.
- o. Windows Store for Windows Embedded 8.1 Industry Pro Retail. NF Corporation has disabled links to the Windows Store and you must not enable such links.
- p. Windows Store for Windows Embedded 8.1 Industry Pro, Windows Embedded 8.1 Industry Pro Tablet, Windows Embedded 8.1 Industry Pro Small Tablet. In addition to the terms of this agreement for Internet-based features, you may only use the Windows Store under the terms available at go.microsoft.com/fwlink/?linkid=246694. Those terms also contain information about Windows Notification Service. Windows apps or any preinstalled apps on your device may use Windows Notification Service. You agree that notifications may be sent to you as described in the Windows 8.1 Privacy Statement and Windows Store terms of service.

6. Proof of License

If you acquired the software on the device, or on a disc or other physical media, your proof of license is the genuine Microsoft certificate of authenticity label with the accompanying genuine product key, and proof of purchase from a supplier of genuine Microsoft software. A valid license may also include a Windows activation file installed on the device by NF Corporation. If there is a COA or other Windows label, it must be affixed to the device or appear on the NF Corporation's software packaging or peripherals when purchased. If you receive an authenticity label separate from your device, it does not establish proof of license.

If you acquired and downloaded the software online, your proof of license is the genuine Microsoft product key for the software that you received with your purchase, and your proof of purchase from an authorized electronic supplier of genuine Microsoft software. Proof of purchase may be subject to verification by your merchant's records.

7. Updates and Upgrades

You may only obtain updates or upgrades for the software from Microsoft or authorized sources. Certain upgrades, support, and other services may be offered only to users of genuine Microsoft software. For more information about Genuine Windows, see go.microsoft.com/fwlink/?linkid=104612. To identify genuine Microsoft software, see howtotell.com.

8. Fonts, Icons, Images, and Sounds

- a. Font components. While the software is running, you may use its fonts to display and print content. You may temporarily download the fonts to a printer or other output device to print content, and you may embed fonts in content only as permitted by the embedding restrictions in the fonts.
- b. Icons, images, and sounds. While the software is running, you may access and use its icons, images, sounds, and media only from the licensed device. You may not share the sample images, sounds and media provided with the software or use them for any other purpose.

9. .NET Framework

The software includes one or more components of the .NET Framework, which you may use only as described at go.microsoft.com/fwlink/?linkid=66406, if you use the .NET Framework components to conduct internal benchmark testing.

10. H.264/AVC and MPEG-4 Visual Standards and VC-1 Video Standards

THIS PRODUCT IS LICENSED UNDER THE AVC, THE VC-1, AND THE MPEG-4 PART 2 VISUAL PATENT PORTFOLIO LICENSES FOR THE PERSONAL AND NON-COMMERCIAL USE OF A CONSUMER TO (i) ENCODE VIDEO IN COMPLIANCE WITH THE ABOVE STANDARDS ("VIDEO STANDARDS") AND/OR (ii) DECODE AVC, VC-1, AND MPEG-4 PART 2 VIDEO THAT WAS ENCODED BY A CONSUMER ENGAGED IN A PERSONAL AND NON-COMMERCIAL ACTIVITY AND/OR WAS OBTAINED FROM A VIDEO PROVIDER LICENSED TO PROVIDE SUCH VIDEO. NO LICENSE IS GRANTED OR SHALL BE IMPLIED FOR ANY OTHER USE. ADDITIONAL INFORMATION MAY BE OBTAINED FROM MPEG LA, L.L.C SEE WWW.MPEGLA.COM.

11. Adobe Flash Player

The software may include a version of Adobe Flash Player. You agree that your use of the Adobe Flash Player is governed by the license terms for Adobe Systems Incorporated at go.microsoft.com/fwlink/?linkid=248532. Adobe and Flash are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.

12. Third Party Programs

This software contains certain third-party programs. You agree that your use of them is governed by the license terms provided with those programs.

13. Not Fault Tolerant

The software is not fault tolerant. NF Corporation installed the software on the device and is responsible for how it operates on the device.

14. Support Services

Contact NF Corporation for support options. Refer to the support number provided with the device.

15. Disclaimer of Warranty

The software is licensed "as-is." You bear the risk of using it. Microsoft gives no express warranties, guarantees or conditions. You may have additional consumer rights under your local laws which this agreement cannot change. To the extent permitted under your local laws, NF Corporation and Microsoft excludes the implied warranties of merchantability, fitness for a particular purpose and non-infringement. For Australia only: You may have statutory guarantees under the Australian Consumer Law and nothing in these terms is intended to affect those rights.

16. Limitation on and Exclusion of Remedies and Damages

You can recover from Microsoft and its suppliers only direct damages up to the amount you paid for the software. You cannot recover any other damages, including consequential, lost profits, special, indirect or incidental damages.

This limitation applies to

- anything related to the software, services, content (including code) on third party Internet sites, or third party programs; and
- claims for breach of contract, breach of warranty, guarantee or condition, strict liability, negligence, or other tort to the extent permitted by applicable law.

It also applies even if

- repair, replacement or a refund for the software does not fully compensate you for any losses; or
- Microsoft knew or should have known about the possibility of the damages.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. They also may not apply to you because your country may not allow the exclusion or limitation of incidental, consequential or other damages.

17. Export Restrictions

You must comply with all domestic and international export laws and regulations that apply to the software, which include restrictions on destinations, end users, and end use. For further information on geographic and export restrictions, visit go.microsoft.com/fwlink/?linkid=141397 and microsoft.com/exporting.

18. Entire Agreement

This agreement (together with terms accompanying any software supplements, updates, and services that are provided by NF Corporation, or Microsoft and that you use), and the terms contained in web links listed in this agreement are the entire agreement for the software and any such supplements, updates, and services (unless Microsoft provides other terms with such supplements, updates, or services). You can review the terms at any of the links in this agreement after your software is running by typing the URLs into your browser address bar, and you agree to do so. You agree, that for each service or included app, if any, that is governed by this agreement and also specific terms linked in this agreement, you will read the terms for that service before using the service. You understand that by using the service, you ratify this agreement and the linked terms. There are also informational links in this agreement. The links containing terms that bind you and us are:

- go.microsoft.com/fwlink/?LinkID=301572 (Windows Embedded Industry 8.1 Privacy Statement)
- go.microsoft.com/fwlink/?linkid=280262 (Windows 8.1 Privacy Statement)
- go.microsoft.com/fwlink/?linkid=281874 (Arbitration Procedure)
- go.microsoft.com/fwlink/?linkid=104605 (Windows Media Player)
- go.microsoft.com/fwlink/?linkid=246694 (Windows Store Terms of Use)
- go.microsoft.com/fwlink/?linkid=246338 (Microsoft Services Agreement)
- xbox.com/legal/livetou (Xbox LIVE Terms of Use)
- go.microsoft.com/fwlink/?linkid=66406 (.NET Framework Terms)
- go.microsoft.com/fwlink/?linkid=248532 (Adobe Flash Player License Terms)

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WARRANTY

NF Corporation certifies that this product was thoroughly tested and inspected and found to meet its published specifications when it was shipped from our factory. In the unlikely event that you experience an issue during use, please contact our company or agency of our company from which you purchased the product.

All NF products are warranted against defects in materials and workmanship for a period of one year from the date of shipment. During the warranty period, NF will repair the defective product without any charge for the parts and labor.

For repair service under warranty, the product must be returned to either NF or an agent designated by NF. The Purchaser shall prepay all shipping cost, duties and taxes for the product to NF from another country, and NF shall pay shipping charges to return the product to the purchaser.

This warranty shall not apply when corresponding to following particulars.

- A) Failure caused by improper handling or use of the product in a manner that does not conform with the provisions of the Instruction Manual.
- B) Failure or damage caused by transport, dropping, or other handling of the product after purchase.
- C) Failure caused by repair, adjustment, or modification of the product by a company, organization, or individual not approved by NF.
- D) Failure caused by abnormal voltage or the influence of equipment connected to this product.
- E) Failure caused by the influence of supply parts from the customer.
- F) Failure caused by such as corrosion that originate in the use of causticity gas, organic solvent, and chemical.
- G) Failure caused by the insect or small animal that invaded from the outside.
- H) Failure or damage caused by fire, earthquakes, flood damage, lightning, war, or other uncontrollable accident.
- I) Failure caused by the reason that was not able to be foreseen by the science and technology level when shipped from our company.
- J) Replacement and replenishment of consumables such as batteries.

NF Corporation

Request for Repair

When a failure occurred and the product was found to be defective or you have any uncertainty, please get in touch with NF Corporation or its authorized agent.

In such a case, let us know the model name (or product name), serial number (SERIAL No. given on the nomenclature plate), and symptom and operating conditions as detail as possible.

Though we will make efforts to reduce the repair period, when five or more years have passed since you purchased the product, it may take time due to, for instance, the out of stock of repair parts.

Also, if the production of repair parts is discontinued, the product is extremely damaged, or the product is modified, we may decline the repair.

WABUN: (DA00068819-004)

If there are any misplaced or missing pages, we will replace the manual.
Contact the sales representative.

NOTES

- Reproduction of the contents of this manual is forbidden by applicable laws.
- The contents of this manual may be revised without notice.
- Information provided in this manual is intended to be accurate and reliable. However, we assume no responsibility for any damage regarding the contents of this manual.
- We assume no responsibility for influences resulting from the operations in this manual.

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ZA57630 INSTRUCTION MANUAL (BASICS)

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